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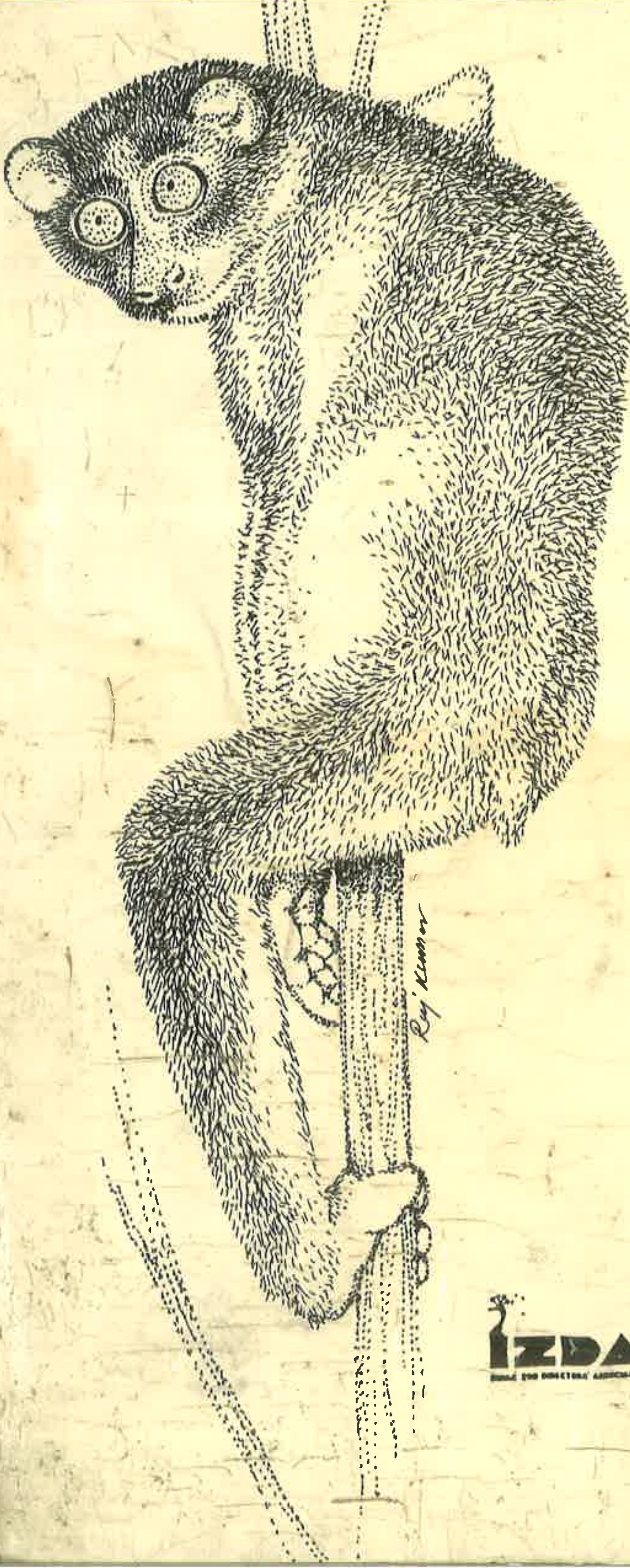

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INDIAN ZOO DIRECTOR

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CENTRAL ZOO A

For Internal Circulation

A COMPENDIUM OF PUBLICATIONS FROM INDIAN ZOOS

VOL - I

(Health & Disease Management)

Compilers

S.K. PATNAIK
L.N. ACHARJYO

INDIAN ZOO DIRECTORS' ASSOCIATION
&
CENTRAL ZOO AUTHORITY

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Compilers :

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PREFACE

Zoo movement in India is more than a century old. Different Zoos have done pioneering works in the field of up-keep and management of indigenous and exotic animals in captivity. It was not only confined to these works, but they have also published their works in different books, journals, magazines, reports etc. The earliest such known work is that of Ram Brahma Sayal of Alipore Zoological Garden, Calcutta in 1892. This is recognised all-over the world as one of the earliest reference books on zoo animal management. This has recently been reprinted by the Central Zoo Authority in 1995. Similarly, many other papers on wildlife diseases, biology, nutrition, management, education and awareness etc. have been published by the Indian authors from time to time in national and international publications. But they were not available for ready reference to the zoo workers for their day to day work and for further research. A necessity of putting all these articles together was felt by the Indian Zoo Directors' Association. The Central Zoo Authority also agreed to support such a venture for the benefit of the Indian zoo community. We are thankful to different authors, institutions, publishers etc., who have readily responded for copying of articles for publication in this compendium. The first volume is being entirely devoted to health and disease management. Subsequent volumes are planned on different subjects like animal biology, further papers on diseases, conservation etc. which will depend on the response of the contributors and publishers. We are thankful to the Central Zoo Authority and its Members Secretary, Sri S.C. Sharma for actively supporting this venture. We are also thankful to all authors and editors of journals for including their papers in the compendium for the benefit of the Indian Zoo Community. It is our earnest hope that this publication will be useful for zoo personnels for their day to day management.

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HISTOPATHOLOGICAL CHANGES IN THE LIVER OF A SPOTTED DEER (*AXIS AXIS*) INFECTED WITH *FASCIOLA GIGANTICA*

BY

A. T. RAO[1] and L. N. ACHARYA[2]

From a five year old spotted deer which died at Nandan Kanan (Zoological Park), pieces of liver fixed in 10% formal saline were collected, later processed by routine histopathological techniques and stained by H. & E., Masson's trichrome, phosphotungstic acid haematoxylin (PTAH), Z. N. carbol fuchsin and prussian blue staining technique for iron and Stein test for bile pigments (Lillie, 1954).

Histopathology

Macroscopically, throughout the surface and substance of liver there were white scars of varying sizes. The walls of the bile ducts were enormously thickened and at some places they assumed nodular appearance and were hard to cut. In some of the bile ducts, large number of adult *Fasciola gigantica* were seen.

Microscopically, the bile ducts revealed extensive hyperplastic changes in their lining epithelial cells and in certain locations they assumed a glandular appearance. Their walls were infiltrated with large number of lymphocytes, macrophages, plasma cells and giant cells. There was diffuse proliferation of connective tissue in the periportal areas resulting in replacement of large portion of parenchyma.

In some of the bile ducts, large number of eggs of *Fasciola* cut in various planes were seen deeply embedded in a pool of dead and degenerating erythrocytes, macrophages, giant cells and cellular debris. Many of the ova were surrounded and invaded by a number of epitheliod cells and giant cells and some of the latter had even pierced through their walls with an attempt to ingest the embryonic mass. A good number of ova revealed shrinkage and degenerative changes whereas few others were also calcified. Some eggs in tissue sections manifested densely stained eosinophilic club shaped radiating structures on their external surface. These structures were stained deep blue by PTAH technique.

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Bile ducts showing such lesions enormously distended and in certain areas, the mucosa was completely denuded. The macrophages and giant cells revealed intense phagocytic activity and were loaded with an iron free acid fast granular pigment which was positive for bile pigments.

The walls of the bile ducts revealed the presence of multiple focal/diffuse areas of necrosis of connective tissue. There was also varying amounts of calcification in the centre of these lesions. A notable feature observed was, the presence of multiple focal egg granulomas near about the vicinity of larger bile ducts. The adjacent liver parenchyma revealed varying degrees of degenerative changes like granular degeneration, vacuolar degeneration and necrosis.

Ova were also encountered in the lumina of venules which had resulted in phlebitis and intimal proliferation and their nuclear degeneration and desquamation. The lumina of hepatic arterioles were much narrowed due to hypertrophy of median coat and proliferation of subintimal tissue.

Discussion

The essential tissue changes in liver of spotted deer infested with Fasciola are similar to those described in bovines and ovines by earlier workers. An interesting feature observed is the presence of a number of giant cells and macrophages invading the eggs in the bile ducts. Some of the phagocytic cells are loaded with yellow granular pigment in H.& E. stained sections. These granules on differential staining are found to be iron free acid fast pigment but appear green in Stein test.

Yet another interesting feature observed in tissue sections is the presence of densely stained eosinophilic club shaped radiating structures on the external surface of eggs. Such structures were reported earlier around the ovum of *Schistosomes* (Datta 1933, Rao, 1934). Regarding the pathogenesis of those structures, it was opined by Lichtenberg *et al* (1966) that these structures appeared around ova due to mechanism of antigen-sequestration invoked by heavily infected host during acute stage of Bilharziasis, when antibody production against certain antigenic fractions of mature Schistosome eggs increased sufficiently to attain a critical concentration and ratio, thus resulting in antigen-antibody precipitation around Schistosome eggs. Surprisingly, such structures have not been reported previously around *Fasciola* eggs in any species of animals and further studies are necessay to explain the exact pathogenesis of these structures in spotted deer and their absence in other species of animals.

Eggs are mostly encountered within the larger bile ducts. However, a few eggs are also noticed in the periductal tissue which has resulted in the formation of egg granulomas. Such eggs might have reached these areas due to the abrasions produced by adult parasites as suggested by Urquhart (1956).

Acknowledgment

The author is grateful to Dr. M. M. Patnaik, State Veterinary Parasitologist for identifying the parasites and to Dr. S. K. Mishra, Dean of the College for providing facilities.

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Reprint from THE INDIAN VETERINARY JOURNAL

Vol. 46, No. 8, August 1969.

Correspondence

Sir,

Sub : *Tuberculosis in a lesser Whistling teal (Dendrocygna Javonica).*

The present communication deals with the occurrence of tuberculosis in a lesser whistling teal for the first time in this country.

Out of the twelve whistling teals received on 1-11-65 from Calcutta Zoo, at Nandan Kanan (Biological Park), Cuttack district, one was found dead on 20-12-67. No remarkable symptoms could be observed as it was remaining with other birds. On postmortem examination, the spleen was enlarged, mottled in appearance due to presence of multiple yellow caseonecrotic lesions protruding from the surface surrounded by clear connective tissue capsule. Lungs revealed similar solitary large nodule in the parenchyma. The liver was enlarged and hard to cut. The capsule was very much thickened, the parenchyma was pale in colour and at places revealed grey circumscribed lesions. Impression smear of lungs, spleen and liver revealed acid fast organisms.

Representive portions of organs were collected and processed by routine histological procedures and stained by H. & E. Mecalum Good Pasture Method and Z.N. Carbol Fuchsin techniques.

Microscopically, H. & E. stained sections of spleen revealed extensive areas of caseation necrosis along with Karyorrhectic nuclei replacing major portion of parenchyma. There was a dense zone of infiltrating macrophages, lymphocytes, giant cells and fibrous connective tissue around the necrotic area. A large number of daughter tubercles of varying sizes were noticed adjacent to the larger tubercles. The macrophages and giant cells revealed vacuolation of the cytoplasm. An interesting feature observed was the presence of mere aggregates of large number of giant cells at certain locations.

Sections of lungs also showed similar lesions. Sections of liver revealed areas of degeneration and atrophy of the hepatic cells with reticulin network intact. The reticulin fibres revealed fibrinoid degeneration. Acid fast organisms were detected in tissue sections of spleen, lung and liver. The acid fast organisms are morphologic cally indistinguishable from *Mycobacterium tuberculosis*. Unfortunately the materials could not be sent to Bacteriology Department for isolation of organisms. However, the authors would like to mention here that there was a case of pulmonary tuberculosis in a stump tailed macaque which died on 6-8-67. The enclosure of that monkey was adjacent to that of whistling teals. It is quite possible that the infection might have spread from monkey to the teal.

Grateful acknowledgements are due to Dean, Dr. S. K. Misra of Orissa Veterinary College, for providing facilities, to the Chief Conservator of Forests and Wild life Conservation Officer, Orissa for permitting to send the materials for histopathological examination and to the staff of the Pathology section for their cooperation.

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Reprint from THE INDIAN VETERINARY JOURNAL

Vol. 46, No. 10, October 1969.

Correspondence

Sir,

Sub : *Pathological lesions in livers of two Indian Sambars (Cervus unicolor niger) infected with paramphistomum explanatum Creplin, 1847); Nasmark, 1937 Gigantocotyle explanatum.*

From the perusal of available literature, the occurrence of *paramphistomum explanatum* has not been reported in sambars (Mukherji and Chauhan, 1965) The authors, while studying the necropsy lesions of different wild animals that succumbed at Nandan Kanan - State Biological Park, Orissa observed that the livers of two sambars were heavily infected with *paramphistomum explanatum.*

On gross examination, the liver was hard to cut and white cirrhotic patches were seen both on the surface and in the substance. The common bile- duct was distended with pinkish coloured conical flukes with a slight dorsal curvature. Representative portions of livers were processed by routine histological techniques and stained by H&E.

Prominent histopathological changes were encountered in the common bile duct. The mucosa was thrown into several folds due to extensive hyperplastic changes and a flask shaped projection of mucosa was drawn into the concavity of posterior sucker as reported in case of buffaloes. The epithelial cells of mucosa had undergone degeneration and desquamation and at many locations there were ulcerations together with heavy infiltration of plasma-cells, mononuclear cells and eosinophils. The lumen was distended with exudates admixed with flukes. The wall of the bile duct was much thickened due to proliferation of fibrous connective tissue associated with heavy infiltration of imflammatory cells as a result of which only islands of degenerating hepatic cells were left. The cirrhosis was typical of monolobular type. The smaller bile ducts in these areas were much dilated, distorted and contained inflammatory exudates.

The central veins, the sinusoids and the portal vein were highly congested. There was mild phlebitis of the portal vein associated with the formation of several minute thrombi around the intimal layer and presence of immature flukes in the lumen. The hepatic cords revealed varying degrees of retrogressive changes like cloudy swelling, vacuolar degeneration and necrosis of the cells together with focal haemorrhages.

The salient histological features were essentially similar to those described in buffaloes by Kulasiri and Seneviratne (1956) and Pande *et al* (1968). Kulasiri and Seneviratne (*loc. cit*) mentioned that only two cases studied by them revealed the presence of immature parasites in the portal vein; one was surrounded by granulation tissue and the other was calcified indicating that they did not commonly travel in the vein or survive in them for a long time. They believed that the infection of the bile duct was by transperitoneal route since the gall bladder was not invaded. Contrary to such a concept, Pande *et al* (*loc. cit*) observed that the normal route of entrance appeared to be through the opening of the bile duct. On reaching the submucosa, some immature specimens could, prior to their nodulation, be transported to other organs through portal system. The present report is in agreement with the latter view since apparently normal immature flukes could be detected in the portal vein. The sambars were, however, devoid of gall bladder. The presence of several ulcers in the bile duct mucosa might be due to constant irritation as a result of their mechanical presence.

Acknowledgment

The authors are thankful to Dr. S. K. Misra, Dean of the college for providing facilities, Sri S. R. Choudhury, Wild Life Conservation Officer, Orissa for permitting to send the materials for histopathological examination, Dr. M. M. Patnaik, Helminthologist, Orissa for indentification of parasites and the staff of Pathology section for their co-operation.

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Dated 21-3-69.

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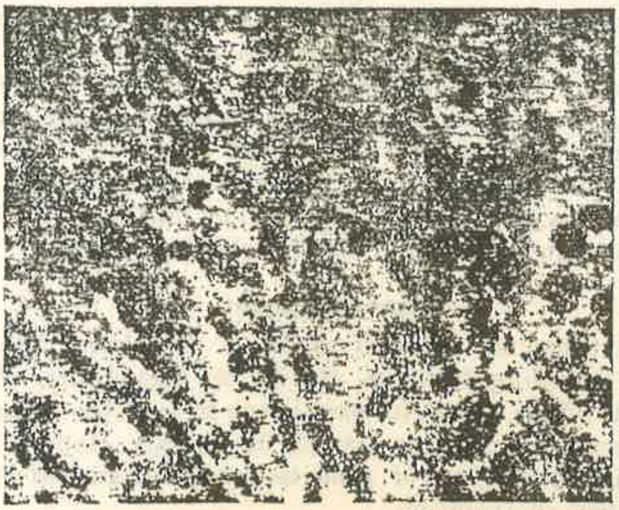
A case of fibrosarcoma in a baby elephant

By

A. T. Rao and L. N. Acharjyo



Section of a fibrosarcoma in skin-Plemorphic fibroblasts in scant amount of collagen.

H. & E. x 250

[To face page 593]

Reprint from THE INDIAN VETERINARY JOURNAL
Vol. 47, No. 7, July 1970.

Correspondence

Sir,

Sub : *A case of fibrosarcoma in a baby elephant* :

The extensive list of neoplasms of wild animals reported in the world literature cited by Sivadas *et al* (1968) does not include fibrosarcoma in elephants. The present communication deals with a case of fibrosarcoma encountered in a male baby elephant aged two years and two months at Nandan Kanan Zoo.

Biopsy material was taken from a growth seen a little above the right eye. The growth was a circumscribed nodular mass having the size of a table tennis ball. It was soft and the cut surface haemorrhagic.

The neoplastic cells were spindle shaped and highly anaplastic. Numerous mitotic figures could be seen. The neoplastic tissue was highly vascular and was seen invading the cutaneous muscles resulting in their hyalinisation. The animal was under observation for nine months and no recurrence was noticed.

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NOTES ON THE HELMINTH PARASITES OF VERTEBRATES IN BARANGA ZOO (ORISSA)

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Postmortem examination of 153 vertebrates of 36 kinds and medication of 15 mammals of 8 kinds, in the course of disease investigation work at the Baranga Zoo, revealed 127 of them being infected with 16 trematodes, 17 cestodes, 34 nematodes and 3 acanthocephalid species. Perusal of pertitnent literature (Southwell, 1930; Baylis, 1936; Mudaliar and Alwar, 1947; Skrajabin, 1952; Ramanujachari and Alwar, 1954; Alwar and Lalitha, 1961; Yamaguti, 1958, 1969, 1961; 1963; Humphery and Segal, 1966; Segal, *et al* 1968.) and study of the collection indicated that most of the parasites had been recorded or described from the Indian subcontinent except for seven and eight of them were the new host records. For information of the veterinarians, the parasites are host-wise listed here, with an asterisk mark against the new records.

Host	Number of animals examined	Number found infected	Parasites found
Reptiles :			
1 Indian python (*Python molurus*)	7	7	*Bothridium pythonis* Blainville, 1824
		7	*Ophidascaris filaria* Dujardin, 1845 (= *O. ajgariasis* Khera, 1954)
2 Russel's viper (*Vipera russelli*)	2	2	*Polydelphis attenuata* (Molin, 1858) (= *Hexametra attenuata*)
		2	*Kalicephalus willeyi* (Linstow, 1904)
3 Monitor lizard (*Varanus monitor*)	2	1	*Duthiersia fimbriata* (Dies, 1850)
Birds :—Ciconiformes			
4 Spoon bill (*Platalea leucorodia*)	2	2	*Microsomacanthus filirostris* Weld, 1885
5 White ibis (*Threskiornis melanocephala*)	2	2	*Patagifer chandrapuri* Srivastav, 1952
6 Black ibis (*Pseudibis papillosa*)	8	8	*Patagifer wesleyi* Verma, 1936
7 Darter (*Anhinga rufa*)	1	1	*Contracecum tricuspis* (Gedoelst, 1916)
8 Openbilled stork (*Anastomus oscitans*)	18	18	*Chaunocephalus ferox* (Rudolphi, 1795)
		7	*Synhimantus laticeps* (Rudolphi, 1819)
Gruiformes			
9 Sarus crane (*Grus antigone*)	1	1	*Petasiger antigonus* Nigam, 1944

Host	Number of animals examined	Number found infected	Parasites found
Falconiformes			
10 White eyed buzzard (*Butastur teesa*)	1	1	*Contracecum milvi* Yamaguti, 1935
		1	*Idiogenes butasteri* Chaterjee, 1954
11 Indian vulture (*Gyps bengalensis*)	1	1	*Porrocecum depressum* Zeder, 1800
12 Barred jungle owlet (*Glaucidium radiatum*)	1	1	*Centrorhunchus globocaudatum* (Zeder, 1800)*
Galliformes			
13 Pea fowl (*Pavo cristatus*)	12	11	*Ascaridia lineata* (Schneider, 1866)
		2	*Dyspharunx pavonis* Sanwal, 1951
		3	*Heterakis beramporia* Lane, 1914
		4	*Raillietina tetragona* (Molin, 1858)
		2	*Cotugnia longicirrosa* Johri, 1939
14 Painted spurfowl (*Galloperdix lunulata*)	3	1	*Cotugnia dignopora* (Pasquale, 1890)
15 Redspur fowl (*Galloperdix spadicea*)	2	2	*Ascardia compar* Schrank, 1790
16 Grey jungle fowl (*Gallus sonneratii*)	3	2	*Cotugnia intermedia* Johri, 1934
		1	*Heterakis gallinae* (Gemlin, 1790)
Columbiformes			
17 Pigeons (*Columba livia*)	11	2	*Raillietina columba* (Molin, 1719)

Host	Number of animals examined	Number found infected	Parasites found
		1	*Cotugnia Cuneata* Meggit, 1924
		5	*Ascaridia columbae* (Gamel, 1790)
		2	*Echinostoma revolutum* Frolich, 1802
Others			
18 Jungle myna (*Acridotheres fuscus*)	3	1	*Choanotaenia sonoti* Mukherjee, 1964
		3	*Diplotrianea tricuspis* Fedtsch, 1874 (=*D. acridotheri* Karve, 1934)
19 Brahminy myna (*Sturnus pagodarum*)	3	1	*Choanotaenia senoti* Mukherjee, 1964
20 Pied myna (*Sturnus contra*)	5	2	*Raillietina penetrans* Johri, 1934
21 Red-billed Blue magpie (*Urocissa erythrorhyncha*)	3	3	*Passerilepis stylosa* (Rud, 1810)*
Mammals :—Rodents			
22 Giant flying squirrel (*Petaurista petaurista*)	9	2	*Longistriata longispicularis* Singh, 1962
		1	*Suphacia sciuri* Mirza and Singh, 1934
23 Albino rat (*Rattus* sp.)	3	3	*Hymenolepis diminuata* (Rud, 1819)
		1	*Hymenolepis nana* Siebold, 1852
Artiodactyla			
24 Wild boar (*Sus cristatus*)	3	3	*Globocephalus connorfilli* Lane, 1922
		2	*Oesophagostomum dentatum* Rud, 1833

Host	Number of animals examined	Number found infected	Parasites found
		1	*Artufechinostomum sufrartifex* Lane, 1915
		1	*Opisthorchis novorca* Braun, 1902
		1	*Fasciolapsis buski* Lankester, 1887
25 Spotted deer (*Axis axis*)	12	3	*Fasciola gigantica* Cobbold, 1855
		10	*Cotylophorum cotylophoron* Fischoeder, 1901
26 Sambar (*Cervus unicolor*)	4	4	*Fischoederius elongatus* Poirier, 1883
		1	*Homologaster poloniae* Poirier, 1883
		1	*Trichuris discolor* Linstow, 1906
		4	*Paramphistomum explanatum* Creplin, 1847
27 Barking deer (*Muntiacus muntjak*)	12	1	*Homologaster poloniae* Poirier, 1883
		1	*Fischoederius elongatus* Poirier, 1883
28 Nilgai (*Boselaphus tragocamelus*)	2	2	*Paramphistomum gracile* Fischoeder, 1901
		2	*Fischoederius cobboldi* Poirier, 1883
		2	*Ashworthius martinagliae* Ortlepp, 1938
Proboscidea			
29 Elephant (Drugged) (*Elephas maximus*)	2	1	*Quilonia travancra* Lane, 1914
		2	*Murshidia falcifera* (Cobbold, 1882) Lane, 1915

Host	Number of animals examined	Number found infected	Parasites found
Carnivora			
30 Indian fox (*Vulpes bengalensis*)	3	2	*Mesocestoides lineatus* Goeze, 1782
		3	*Dipylidium canninum* Linnaeus, 1758
		2	*Uncinaria stenocephala* Railliet, 1884
31 Jungle cat (*Felis chaus*)	1	1	*Toxocara cati* (Zeder, 1800)
		1	*Spirometra erinaceae* (Rud, 1819)*
		1	*Euparyphium malayanum* Leiner, 1911
		1	*Onicola* sp.*
32 Leopard cat (*Felis bengalensis*)	3	1	*Ancylostoma brasiliense* Gomez, 1901
33 Fishing cat (Drugged) (*Felis viverrina*)	1	1	*Spirometra erinaceae* (Rud, 1819)
		1	*Toxocara leonia* Linstow, 1902
34 Golden cat (Drugged) (*Felis temmincki*)	2	1	*Toxocara cati* (Zeder, 1800) (= *Toxocara mustax* Zeder, 1800)
35 Clouded leopard (Drugged) (*Neofelis nebulosa*)	2	1	*Spirometra-eriaceae* (Rud, 1819)
		1	*Taenia taeniaeformis* (Batsch, 1786)
36 Tiger (Drugged) (*Panthera tigris*)	6	2	*Toxocara cati* Zeder, 1800
		3	*Taenia pisiformis* (Bloch, 1780)
		1	*Spiromotra erinaceae* (Rud, 1819)

Host	Number of animals examined	Number found infected	Parasites found
37 Leopard cub (Drugged)	1	1	*Mesocestoides lineatus* (Goeze, 1782)*
(*Panthera pardus*)	2	2	*Galonchus perniciosus* (Linstow, 1885)
38 Indian lion (Drugged)	1	1	*Ascaris felis* Jehan and Sood, 1968
(*Panthera leopersica*)	1	1	*Galonchus perniciosus* (Linstow, 1885) Railliet, 1918
39 African lion (Drugged) (*Panthera leo*)	1	1	*Spirometra erinaceae* (Rud, 1819)
Primates			
40 Golden langur (*Presbytis geei*)	1	1	*Trichuris trichura* (Linnaeus, 1771)
		1	*Oesophagostomum* (*Conoweberia*) *aculeatum* (Linstow, 1879)*
41 Capped langur (*Presbytis pileatus*)	1	1	*Bertiella studeri* (Balanchard, 1891)
42 Slow loris (*Nycticebus coucang*)	3	1	*Prosthenorchis lemuri* Machado et Fain, 1950*

The parasites recorded from the new hosts include *Prosthenorchis lemuri* from slow loris, *Spirometra erinaceae* and *Onicola* sp. from jungle cat, *Homologaster poloniae* from sambar and barking deer, *Synhimantus laticeps* from open billed stork, *Choanotaenia senoti* from brahminy myna, *Cotugnia intermedia* from grey jungle fowl and *Passerilepis stylosa* from the red-billed blue magpie.

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The authors are grateful to the Director of Animal Husbandry and Veterinary Services, Orissa and the Wild-Life Conservation Officer, Orissa, Cuttack for the facilities given.

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Vol. 48, No. 1, January 1971.

PRIMARY PULMONARY NEOPLASMS IN TWO ZOO BIRDS

BY

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There is paucity of information concerning the incidence of primary pulmonary neoplasms in domestic chicken as well as other birds in captivity. Fox (1923) listed 44 neoplasms found in captive wild birds and 11 varieties of tumours were identified. Eber and Malke (1932) could not observe a single neoplasm out of the 52 peacocks examined postmortem but encountered a case of adenoma of lungs out of the 204 pheasants during the period of 1899-1931 at the University of Leipzig. Primary carcinomas of lungs in domestic fowl were reported by Apperly, 1935 ; Ajinkya and Sardeshpande, 1963 ; Synder and Ratcliffe, 1966 and Bhagwat, 1969. In the present communication, the authors wish to place on record a case of bronchogenic carcinoma in a pea hen and a carcinoid tumour in a pin tail as the literature on the incidence of these tumours is lacking.

Materials and Methods

The materials for this study consisting of lungs, proventriculus and trachea of a pea hen and lungs and a growth around the thyroid of a pin tail were collected during routine necropsy of 95 captive birds at the State Biological Park, Orissa, during 1967-69. Representative portions from these organs were fixed in 10% formol saline and processed for routine histopathological procedures and the paraffin sections were stained by haematoxylin and eosin method, P.A.S. and Z.N. carbol fuchsin technics.

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Observations

Pulmonary neoplasm in a pea hen : Case I :

Macroscopically, diffuse greyish white encephaloid growth was seen extending throughout the length of mediolateral and ventro-medial surface of lung-parenchyma, the former surface of which had a nodular elevation. Two nodular growths were encountered on the wall of the proventriculus projecting into the lumen.

Microscopically, the neoplastic tissue consisted of columnar and/or cuboidal cells arranged in the form of acini and tubules (Fig. I). The cells had a paler and finely granular cytoplasm and round or oval vesicular nuclei which were situated at the bases of the cells. Mitotic figures were, however, few. There were massive intrabronchial growths (Fig. I) which showed finger-like processes extending into the neighbouring lung parenchyma. These had a loose connective tissue stroma. The papillary growths had well vascularised connective tissue stalks lined by single or multilayered epithelium. Rich PAS positive material was encountered in the tips of these cells and the lumina of the formed acini. Neoplastic cells were also seen in the form of broad sheets and in some areas there was necrosis surrounded by a number of giant cells. Acid fast organisms were not noticed on Z. N. carbol fuchsin staining.

There was varying degree of fibrinous pneumonia and venous congestion along with proliferation of reticulo-endothelial cells which were loaded with haemosiderin. Fibrous connective tissue elements were found to be predominant in some areas of the parenchyma.

The secondary growths in the proventricular mucosa and sub-mucosa had histological appearance similar to that of the primary in the lungs. The proventricular glands were also infiltrated by the neoplastic cells. There was abundant fibrous tissue stroma infiltrated with chronic inflammatory cells.

The trachea revealed extensive catarrhal inflammation characterised by degenerative changes and desquamation of mucosa associated with capillary congestion and heterophilic infiltration. The tracheal cartilage had undergone metaplastic transformation into osseous and osteoid tissue with the formation of bone marrow and blood elements.

The neoplasm was classified as *bronchogenic carcinoma.*

Pulmonary neoplasm in a pin tail : Case II :—

Macroscopically, the neoplastic growth was confined to the thoracic cavity and adhered firmly to the chest wall. The growth

Primary pulmonary neoplasms in two zoo birds

By A. T. Rao, L. N. Acharjyo and Ganti A. Sastry

Fig. 1

Section of lungs of a pea hen showing intrabronchial growth. See the arrangement of the columnar cells in the form of acini.

(H. & E. x 125)

Fig. 2

The lungs of a pintail showing carcinoid tumour. Note the alveolar pattern of the cells.

(H. & E. x 125)

Fig. 3

Note the adenomatous and papillary structure of the carcinoid.

(H. & E. x 525)

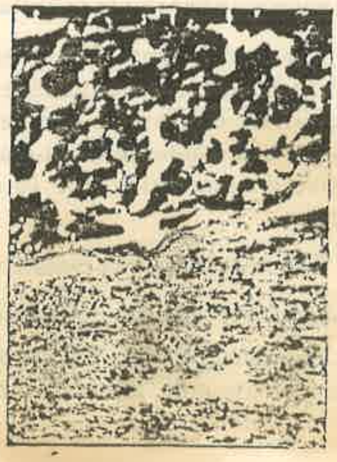

Fig. 4

Note the thyroid gland on one side and carcinoid on the other.

(H. & E. x 125)

had a greyish white appearance like the brain tissue and was cylindrical with rounded ends measuring 8x3x3 cm. and weighed about 30 gm. A major portion of the lung parenchyma was replaced by the neoplastic growth.

Microscopically, the neoplastic tissue consisted of cuboidal and/or columnar cells arranged either in the form of compact masses of cells, in an alveolar pattern (Fig. 2) or in the form of papillary projections supported by scant amount of fibrous connective tissue carrying blood vessels (Fig. 3). The neoplastic cells originated from the bronchial epithelium and were highly anaplastic (undifferentiated). The infiltrative property was indicated by the tendency of the cells to burrow into the loose connective tissue stroma. Tumour emboli were also noticed in the veins. Degenerative changes were noticed in the centre of the compact masses of cells. The tumour growth had increased by expansion and no metastatic lesions were found in other tissues. The infiltrating capacity was limited since the thyroid gland proper was not invaded although the tumour tissue has surrounded the gland (Fig. 4). The tumour was classified as *carcinoid with an adenopapillary pattern.*

Discussion

Although there are frequent reports of primary pulmonary neoplasms in domestic animals in recent years, the incidence of avian pulmonary neoplasms, particularly of zoo birds, are considered to be extremely rare which is evident from the lack of reported information in the literature. On the other hand, it is rather surprising to encounter two cases of primary pulmonary neoplasms out of 95 necropsies of birds conducted at the local zoo during 1967-69 which may well suggest that the incidence may be still higher if further studies are undertaken for a longer period over varieties of birds in captivity.

The histogenesis of lung tumours cannot be always traced out exactly because of the frequent pleomorphism in different tumours and even in different regions of the same tumour. According to Moulton (1961) all the pulmonary neoplasms in animals can be best classified as bronchogenic since they usually arise from the epithelium lining bronchi and bronchioles. In the present investigation, the neoplasm in pea hen is classified as bronchogenic tumour since the growth was oriented around the primary bronchioles and extending out from the epithelium of the wall giving a clear indication of their origin from the bronchial epithelium. In addition, the histological differentiation, the mucin production by the cells and metastatic and infiltrative properties gave further evidence to conclude it as carcinoma. The tumour in the pin tail is classified as a carcinoid tumour with an remained in groups in air spaces. Sections of larvae were encountered in the interalveolar capillaries. The bronchioles were distended with inflammatory exudates together with mononuclear cells.

Kidneys :

The essential lesions were embolic glomerulonephritis characterised by the presence of larvae in the glomerular tuft (Fig. 3) and / or enlargement of the tuft together with vacuolation of endothelial cells and accumulation of an albuminous exudate in the Bowman's space. Innumerable number of larvae were also encountered in the intertubular capillaries, some of which had escaped outside and degenerated resulting in formation of granulomas around them in the parenchyma. The cortical as well as medullary tubules revealed extensive degenerative changes and their lumina were distended with albuminous casts.

Liver :

The lesions in liver were passive congestion and associated degenerative changes in the hepatic cells.

Heart :

The lesions in the heart were severe retrogressive changes leading to frank necrosis of some of the myocardial fibres. The changes in the intermycium were vascular congestion and focal infiltration of mononuclear cells.

Discussion

Unless otherwise heavily infected, the hosts usually do not exhibit clinical symptoms when infected with heart worms. The principal lesions are, however, produced by the mechanical presence of adult worms in the right side of heart resulting in circulatory disturbances. Pulmonary arterial lesions were described in dogs by Hennigar and Ferguson (1957), Adcock (1961) and Otto and Jackson (1969). While Hennigar and Ferguson (*loc. cit*) suggested a hypersensitivity type of inflammatory reaction, Hirth and Nielsen (*loc. cit*) demonstrated exudative villus endarteritis due to extensive infiltration of eosinophils and plasma cells in the pulmonary artery in two red foxes. They opined that such an allergic response may be seen when unusual species are infected with this nematode. In the present report, there was severe endarteritis with necrotic debris and mononuclear cell infiltration and no allergic response was noticed.

The presence of multiple pulmonary infarcts in the present report is due to a thrombus in one of the branches of pulmonary artery as was described in dogs (Jubb and Kennedy, 1963) Adams (1956) found various inflammatory reactions in lungs of a dog which he attributed to the numerous microfilaria diffusely distributed in the

Histopathological changes in some of the organs in heart worm infection in an Indian fox (*Vulpes bengalensis*)

By A. T. RAO and L. N. ACHARJYO

Fig. 1
Dilated right ventricle of the heart of a fox packed with *Dirofilaria immitis*.

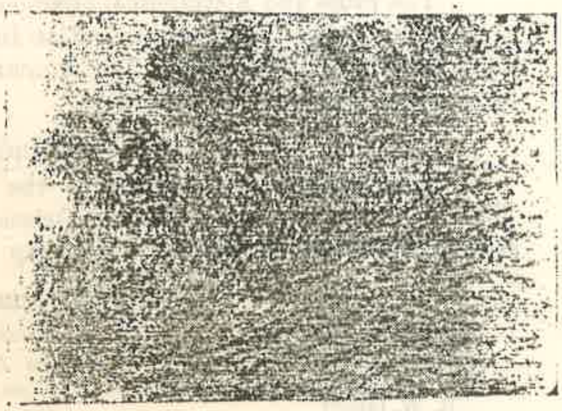

Fig. 2
Section of pulmonary artery showing severe endarteritis and formation of villous projections.
(H. & E. x 85)

Fig. 3
Section of kidney showing embolic glomerulonephritis due to presence of larvae in the glomerular tuft.
(H. & E. x 250)

parenchyma. Mello *et al* (1960) described the presence of microfilaria in the centre of necrotic inflammatory areas in lungs and spleen of a Collie dog. According to them, the larvae played an important role in pathogonesis. In the present report, there was no inflammatory reaction around the larvae in the capillaries of organs studied as described by Smith and Jones (1961) in dogs but in kidneys there was embolic glomerulonephritis and granulomas around the degenerated larvae.

Passive congestion in liver was described as in the present report by several workers notably Pullock (1948), Winter (1959), Litchenberg *et al* (1962) and Otto and Jackson (*loc. cit*). Winter (*loc. cit*) attributed the pulmonary haemosiderosis and inflammation to be due to the waste products of the adult's digestion but in the present observations, haemosiderosis was not a predominent feature.

Summary

The gross and histological changes of pulmonary artery, lungs, kidney, liver and heart of an Indian fox heavily infected with heart worms have been described. The known lesions of canine infection have been compared and discussed.

Acknowledgment

The authors are thankful to the Dean of the College and the Wild Life Conservation Officer, Orissa, for providing facilities and staff of Pathology section for their help.

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Reprint from THE INDIAN VETERINARY JOURNAL

Vol. 48, No. 7, July 1971.

OVARIAN ADENOCARCINOMA IN TURKEY HENS-

A report of two cases

BY

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Fox (1923) reported a single case of papillary cystadeno-carcinoma of ovary in a wild turkey while examining 44 tumours of wild birds. Kronberger (1962) reported 39 tumours in zoo birds out of 630 tumours collected from different types of birds during 1917—1961 at Leipzig Veterinary Pathological Institute. In the above studies, the ovary was found to be the most frequently affected organ. Although ovarian tumours have been reported from time to time in domestic fowls in this country, there is paucity of information concerning their occurrence in zoo birds. The present communication reports two cases of adenocarcinomas in turkey hens for the first time in India.

Materials and Methods

The materials utilised for the present study consisted of neoplastic growths from ovary and spleen of a turkey hen aged 7 years and 10 months and ovarian growths, transplantation growths in the mesentery, pancreas and serosa of proventriculus and gizzard of another turkey hen aged about 9 years that died at Nandan Kanan Zoo on 27-6-70 and 16-10-70 respectively. The tissues received at the laboratory were examined grossly and representative portions of the primary and secondary growths from different areas were fixed in 10% buffered formol saline. The paraffin sections were prepared by routine technics and stained with haematoxylin and eosin for histopathological examination.

Observations

Case No. 1 :—Turkey hen aged 7 years and 10 months (died on 27-6-70).

Necropsy findings

On opening the abdominal cavity, about 250 ml. of straw coloured fluid was seen. An ovarian growth measuring 9x5.5x6 cm and weighing about 260 gm was seen occupying the abdominal cavity (Fig. I) as a result of which some of the visceral organs like liver, kidneys and heart were atrophied. The neoplastic growth consisted of innumerable number of nodules of varying sizes. The

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nodules were mostly firm to cut and solid in appearance but at some places, they had cystic character. Occasional presence of immature follicles were detected on the surface of the growth. The spleen had a mottled appearance due to numerous greyish white nodular metastatic growths.

Histopathology

Microscopically, the tumour consisted of cuboidal to columnar cells arranged either in the form of acini or in solid masses. The cells had an intensely stained acidophilic granular cytoplasm and round compact nuclei which were mostly situated at the bases of the cells. Mitotic figures were not common. The lumen of the formed acini contained pale acidophilic granular albuminoid material which represented the secretion of the tumour cells. A group of acini were supported by moderate amount of stromal tissue. At some places, the fibrous connective tissue had undergone metaplastic transformation into osseous tissue. The metastatic growth in the spleen had similar microscopic appearance but the stromal reaction was minimal. The arterioles of the ovarian growth and spleen revealed marked sclerotic changes and in some there was obliteration of their lumina.

Case No. 2

Turkey hen aged about 9 years (died on 16-10-70)

Necropsy findings

On opening the carcase, about 350 ml and 100 ml of straw colored fluid was seen in the abdominal and thoracic cavities, respectively. An ovarian growth measuring 8x6x5 cm weighing about 130 gm was seen occupying the abdominal cavity as a result of which, the liver and spleen were atrophied. The morphological appearance of the growth was similar to that of the previous case (Fig. 2) but without any cyst formation. Due to presence of innumerable transplantation growths in the mesentery and pancreas (Fig. 3) there were adhesions of the intestinal loops. In addition, the serosa of the gizzard and proventriculus also revealed transplantation growths.

Histopathology

The microscopical appearance was more or less similar to the description given in the previous case but the nuclei had a vesicular appearance. The cells were mostly arranged in the form of acini or solid blocks in some areas. The arrangement of cells was in the form of papillomatous projections. Cyst formation was, however, not a feature, as such, the tumour has been classified as papillary adenocarcinoma of ovary. The secondary growths in the mesentery, pancreas

Ovarian adenocarcinoma in turkey hens - A report of two cases

By A. T. Rao, L. N. Acharjyo and B. C. Nayak

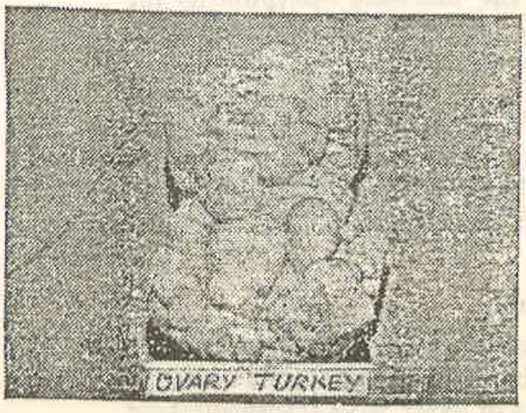

Fig. 1
Neoplastic growth of the ovary from a turkey hen showing innumerable number of nodules of varying sizes. (Case No. 1)

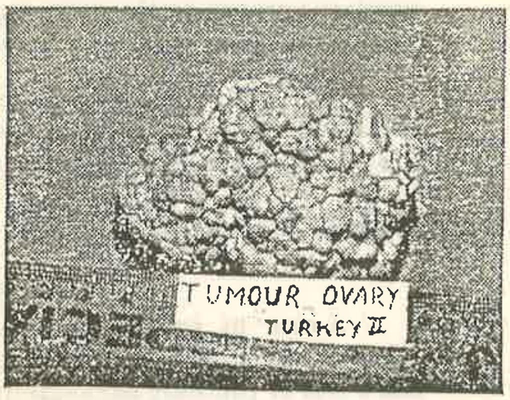

Fig. 2
Ovarian growth from turkey hen. (Case No. 2)

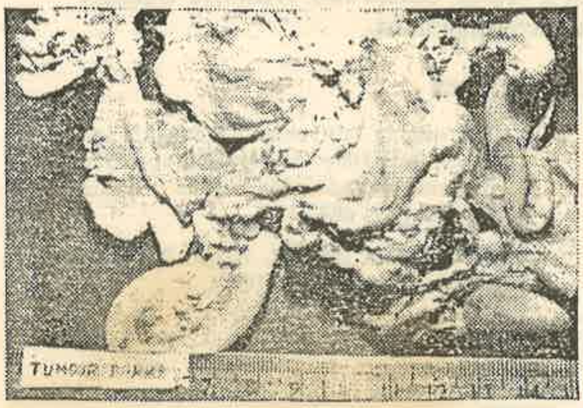

Fig. 3

Transplantation growths in the mesentery and pancreas of Case No. 2.

[*To face page 690*]

and serosa of the proventriculus and gizzard had a similar histological appearance as that of the primary growth.

Discussion

The frequent involvement of ovarian tissue in neoplastic transformation is emphasised by earlier workers notably Kronberger (*loc. cit*). Similar views have been expressed by the present investigators which went to explain that the increased susceptibility for neoplastic growth in the ovary may be ascribed to the constant stress imposed on the organ due to frequent ovulation.

The gross and microscopic findings reported in the present studies are similar to those described by earlier workers in domestic fowls. Since the histological features of the secondary growths are similar to those of the primary growths, it is concluded that the ovary is the site of the neoplasm.

Summary

A case of ovarian cystadenocarcinoma along with metastatic growths in the spleen of a turkey hen aged 7 years and 10 months and a case of papillary adenocarcinoma of ovary with transplantation growths in the mesentery, pancreas and serosa of proventriculus and gizzard of a turkey hen aged about 9 years have been reported.

Acknowledgment

Due acknowledgements are given to Dr. S. K. Misra for providing facilities, to the staff of the Pathology section for their assistance and to the Chief Conservator of Forests, Orissa and Wild life Conservation Officer, Orissa for their encouragement.

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Reprint from The Indian Veterinary Journal
Vol. 48, No. 8, August 1971.

Correspondence

Sir,

Sub : *Further observations on pulmonary neoplasms at Nandan Kanan Zoo.*

Rao *et al.* (1971) have reported a case of carcinoid tumour in lungs of a pin-tail and a bronchogenic carcinoma in a pea hen. During the routine necropsy and histopathological examination of lung tissues of birds died at Nandan Kanan Zoo (Orissa), another pea hen aged 5 years that died on 4-11-1970 and a peacock aged about 1½ years that died on 6-3-1971 had manifested pathological changes in lungs similar to the description given earlier for bronchogenic carcinoma but metastatic growths were not observed in any organs.

It was considered useful in reporting these cases since similar type of bronchogenic carcinomas were encountered within a short period although only 18 pea fowls were necropsied so far at the zoo.

Stewart (1966) while discussing the tumours of captive wild animals and birds commented the relative high incidence of lung tumours. Snyder and Ratcliffe (1966) speculated that the frequency of avian neoplasms was probably due to the increased atmospheric carcinogens. They further stated that pulmonary tumours were frequent in the family Anatidae and the species susceptibility played a part in the tumour incidence. Beer (1968) stated that the incidence of respiratory cancer in water birds has considerably increased in the last 20 years in most of the larger zoos throughout the world and it has been suggested that it may be due to increased contamination of water. It is quite likely that the frequent incidence of pulmonary tumours at Nandan Kanan Zoo might be due to its situation which is just adjacent to an industrial establishment of Barang Glass Factory which might be responsible for atmospheric pollution of carcinogenic agents.

Acknowledgment

Due acknowledgments are given to Dean, Dr. S.K. Mirsa for providing facilities, staff of Pathology department for their help and Sri R. Misra, I.F.S. Wild Life Conservation Officer, Orissa for his encouragement.

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A case of hepatoma in a Sarus crane (*Grus antigone*)

By
A. T. Rao and L. N. Acharjyo

Neoplatic tissue of liver arranged in the form of solid blocks of cells adjacent to the vascular spaces.

(H & E. x 450)

[*To face page* 992]

Reprint from THE INDIAN VTERINARY JOURNAL
Vol. 48. No. 10, October 1971.

A CASE OF HEPATOMA IN A SARUS CRANE (*GRUS ANTIGONE*)

BY
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Although primary liver tumours have been frequently reported in domestic fowls and ducks, a perusal of available literature indicates scanty information pertaining to their occurrence in captive birds. Eber and Malke (1932) reported two neoplasms of iiver out of 459 turkeys and one hepatoma out of 204 pheasants examined. The present communication reports a case of hepatoma in a Sarus crane.

Observations

The materials consisting of pieces of liver utilised for the study were collected from a Sarus crane that died at Nandan Kanan Zoo.

Gross lesions: Greyish white, soft, multiple, circumscribed encapsulated nodular growths ranging from 2 millimeters to 5 centimeters were seen on the surface as well as in the substance of liver. They were sharply defined from the adjacent liver tissue.

Histopathology: The neoplastic cells were indistinguishable from normal hepatic cells. They were arranged in the form of cords or with a distinct alveolar arrangement or in the form of solid masses of cells adjacent to vascular spaces (Fig.). The neoplastic cells had vesicular, variable sized nuclei with single and rarely double nucleoli. The cytoplasm was granular and less acidophilic than the adjacent hepatic cells. The neoplastic growth was separated from the normal liver tissue by a band of fibrous connective tissue capsule. Due to pressure of the tumour, the lobules were distorted, the sinusoids were congested and the hepatic triads were compressed. Multiple growths in the hepatic tissue were due to multicentric origin of the tumour.

Summary

A case of hepatoma was encountered in a Sarus crane (*Grus antigone*) during routine postmortem examination of captive birds at Nandan Kanan Zoo. The gross and histopathology of the tumour have been described.

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Acknowledgement

Grateful acknowiedgements are due to Dean, Dr. S. K. Misra for providing facilities, the staff of Pathology section for their help, the Wild life Conservation Officer, Orissa for encouragement and to Dr. Ganti A. Sastry, Professor of Pathology, Andhra Veterinary College for going through the manuscript.

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Notes on the nodular disease of the intestine of lion (*Panthera leo*) caused by ***Galonchus perniciosus*** (Ancylostomatidae : Nematoda)

BY

M. M. PATNAIK, A. T. RAO and L. N. ACHARJYO

Fig. Photomicrograph of a section passing through a medium sized nodule. See the parasites in tunnels having walls of fibrous tissue.

[*To face page 1072*]

Reprint from THE INDIAN VTERINARY JOURNAL
Vol. 48. No. 10, October 1971.

Correspondence

Sir,

Sub : *Notes on the nodular disease of the intestine of lion (Panthera leo) caused by Galonchus perniciosus (Ancylostomatidae : Nematoda)*

In India, Baylis and Daubney (1922) recovered *Galonchus perniciosus* (Linstow, 1885) Railliet, 1918 from a leopard (*Felis pardus*) while Mudaliar and Alwar (1947) and Patnaik and Acharjyo (1970) reported on the occurrence of this nematode in a cheetah and a lion (*Panthera leo*) respectively. The present report is on the pathological changes in the intestine of a lion cub brought about by *G. perniciosus*.

During necropsy of a lion cub, 27 nodular lesions of 2 cm in diameter were discernable from the serosal side of the intestinal wall. Each nodule had a dark perforation communicating from the intestinal lumen to the inner cystic space. Squeezing of those nodules yielded cellular debris and the parasites. Study of the adult parasites revealed them to be *G. perniciosus*. The formalin fixed lesions were sectioned and stained with haematoxylin and eosin.

The lesions were mostly confined to the sub-mucosal tissues. The smaller lesions contained one or two adult nematodes in the tunnel-like space with a wall of fibrous tissue (Fig). The older lesions contained degenerating fragmented parasites and calcified debris in some parts. The mucosal layer and the villi on the nodule were eroded. There were empty tunnels in the sub-mucosal tissue, apparently due to the parasites migrating into the lumen. The inner walls of such tunnels showed eosinophilic granulomatous reactions. The inner circular and outer longitudinal muscles adjacent to the nodules have undergone retrogressive changes and there was hyperplasia of mesothelial cells of serosa. The reactionary changes in the blood vessels included sclerosis, perivascular cuffing with plasma cells, mononeuclear cells and eosinophils.

From the nature of tissue reactions, it was apparent that the nematodes feed on the mucosal exudates and haemorrhagic fluid while in the nodules. The plasma cell response and calcification of the dead parasites suggested definite immunological response of the host.

Acknowledgment

The authors are grateful to the Director of Animal Husbandry and Veterinary Services, Orissa and to the Wild-life Conservation Officer, Orissa, for the facilities given for the study.

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Reprint from THE INDIAN VETERINARY JOURNAL
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FURTHER OBSERVATIONS ON FASCIOLIASIS AMONG WILD UNGULATES AT NANDAN KANAN ZOO

BY

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Interest was aroused to further investigate into the occurrence of fascioliasis among wild ungulates at Nandan Kanan Zoo ever since the authors observed the histopathological peculiarities in Fasciola infected liver of a spotted deer. The materials utilised for this study consisted of livers heavily infected with *Fasciola gigantica* in 12 out of 24 spotted deer and 3 out of 5 black bucks necropsied during 1967–71. In addition, 10 barking deer, 6 sambars, 3 four-horned antelopes and a nilgai necropsied during the period were found to be free from Fasciola infection. Representative portions of the Fasciola infected liver tissues were processed by routine histopathological techniques and stained by haematoxylin and eosin techniques for examination.

Observations

The gross and histopathological changes in livers of spotted deer and black bucks were found to be almost similar and hence described together. Macroscopically, the organs presented pale parenchyma, extensive haemorrhagic areas and/or multiple greyish white scars. Haemorrhagic and pale areas were soft whereas the scar tissues were tough to cut. The surface of the organs were rough due to nodular elevations and depressions giving a typical appearance of cirrhosis. The capsule was markedly thickened due to presence of fibrin flakes. The common bile duct, particularily of the spotted deer was enormously thickened, prominent and had a tortuous appearance. On incision, adult *F. gigantica* were recovered in large numbers.

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Microscopically, the walls of the bile ducts manifested marked thickening due to proliferation of fibrous connective tissue, infiltration of mononuclear cells and presence of eggs. Some of the microphages had ingested haemosiderin pigments which were particularly noticed in the livers of black bucks. The bile duct mucosa showed either extensive hyperplastic changes in some specimens or denudation of mucosa due to presence of mature flukes which were mostly seen in black bucks. The lumen of the ducts contained catarrhal exudate along with ova. The periductular and perivascular fibrosis was more pronounced in spotted deer than in black bucks. The hepatic arterioles were markedly thickened due to medial hyperatrophy. There was marked cirrhosis with pseudolobulations and infiltration of mononuclear cells. Immature flukes causing traumatic destruction of hepatic tissue leaving a trail of haemorrhagic tracts were encountered in the parenchyma of livers of two spotted deer (Fig.) and two black bucks. Such areas revealed extensive haemosiderosis.

Discussion

In the present study, an incidence of about 50% and 60% of the spotted deer and black bucks respectively necropsied during the period of last four years showed fascioliasis but the other wild ungulates like sambars, barking deer, four horned antelopes and a nilgai were not affected although they were housed within the same fencing adjacent to a canal and the source of grass supply remaining the same which is apparently the source of infection.

Regarding lesions, there appeared to exist broad similarities between the wild ungulates studied and other susceptible animals. The presence of numerous haemorrhagic tracts suggested a transperitoneal route of migration of the parasite. Cirrhotic livers and fibrinous flakes on the capsule indicated the replacement of the fluke tracts by fibrous connective tissue. According to Sinclair (1967) alterations in the larger bile ducts were not considered as a feature of early stage of Fasciola infection in ruminants. Immature flukes along with pools of haemorrhagic exudate with minimum alterations in the common bile duct were encountered in the liver of two black bucks and comparatively lesser fibroblastic activity in all three specimens suggested that it was an early stage of infection. In spotted deer, however, extensive hyperplasia of the bile ducts along with marked periportal fibrosis were the common features in all the specimens indicating advanced stages of infection. Although extensive calcification of the common bile duct was noticed earlier in the spotted deer by Rao and Acharjyo (1969), it was not observed in any of the specimens in the present study. Club-shaped structures on the external surface of Fasciola eggs reported earlier were also not noticed present investigation which emphasised the rarity of their occurrence.

Further observations on fascioliasis among wild ungulates at Nandan Kanan Zoo

By A. T. Rao and L. N. Acharjyo

Immature fluke along with haemorrhagic exudates in the liver parenchyma.

[H & E x 85]

Summary

Gross and histopathology of Fasciola infected livers of 12 spotted deer and 3 black bucks out of 24 spotted deer and 5 black bucks necropsied during 1967-71 are described and the comparative pathology discussed.

Acknowledgments

Due acknowledgements are given to Dr. S. K. Misra, Dean and Dr. S. N. Panda, Head of Department of Pathology and Hygiene for providing facilities and to Sri R. Misra, Wild Life Conservation Officer, Orissa, Cuttack for his encouragement.

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Reprint from THE INDIAN VETERINARY JOURNAL

Vol 49, No. 7, July 1972.

PINIONING OF WILD BIRDS IN CAPTIVITY-A CLINICAL STUDY

BY

L. N. ACHARJYO[1] and S. C. OJHA[2]

A modern trend in most zoological parks is to present the large number of wild birds in captivity in outdoor enclosures and paddocks invariably provided with ponds under natural surroundings. This is practised for presenting a better display and to avoid their loss from flying away. Birds when kept in out-door enclosures need to be curtailed of their flying ability which is usually done by pinioning or exarticulation of one of the wings, shortening it permanently. The other methods to prevent flight are clipping of flight feathers, radial neurectomy or brailing of one wing only, which are not much in vogue due to their limitations.

Knowledge of pinioning is thought to be very much limited even among many veterinary surgeons (Hurlimann, 1939). Pinioning is performed in one of the wings only to make it asymmetrical so that whenever the bird mak-s any attempt to fly, it cannot keep up in air but topple down at once (Moore, 1937). When both the wings are pinioned, they are usually capable of certain amount of flight (Moore, *loc. cit*). This practice is generally restricted to large and medium sized birds such as geese, ducks, gulls, storks, cranes, flamingoes, pelicans etc. Smaller birds in cages and aviaries are usually left alone.

Moore (*loc. cit*) has described pinioning as amputation of one of the wings at the level of matacarpals as close as possible below the carpal joint, which is left intact (Fig 1) Berge and Westhues (1966) have described exarticulation at the level of the carpal joint of one of the wings only (Fig 2) for preventing the flight in swans, geese, wild ducks etc.

Pinioning was carried out in wild birds of various species maintained at Nandan Kanan Zoo (Orissa) for letting them out in open paddocks and this paper is presented as there is paucity of reports in India on pinioning and its zoological significance.

Surgical technique

Site for pinioning selected in 80 birds was the carpal joint and in 26 birds only at the level of the matacarpals, just below the carpal

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joint. The bird was secured well by the attendant and the desired site was selected by spreading the wing and feeling the carpal joint. A strong ligature was placed with a bandage cloth a little above the carpal joint. The feathers were plucked out from either of the sites selected for amputation and painted with tincture of iodine.

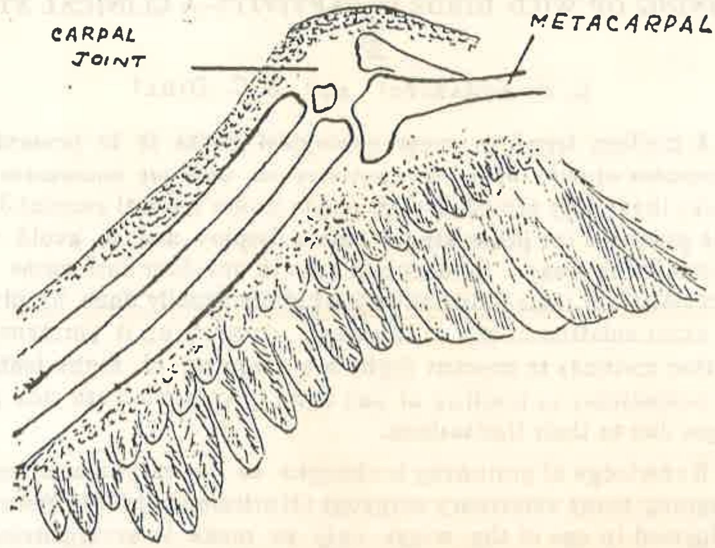

Fig. 1.

Note the site of pinioning through the metacarpals.

The wing was then spread out and a circular incision made at the level of the carpal joint. The incision was extended to sever all the attachments and the wing was completely disarticulated. Very little haemorrhage was encountered which was controlled easily. The wound was then covered with tincture benzoin pack and bandaged. While pinioning at the level of matacarpals, the wing was used to be spread out on a clean wooden block. Then a bone chisel of appropiate size was placed at right angle to the wing at the site of amputation and a hard blow with a mallet given on the chisel. This completely severed the muscles and the skin along with the matacarpal bones. The wound was sealed with a tincture benzoin pack and bandaged.

Results

Pinioing was carried out in 106 birds of 20 kinds from July 1967 to March 1971 and the detailed statement is given in the Table. Recovery was quite uneventful. In most cases no post operative complications like severe pain, depression or loss of appetite could be

Pinioning of wild birds in captivity - A clinical study

By L. N. Acharjyo and S. C. Ojha

Fig. 2

Left wing pinioned at the carpal joint in a sarus crane recorded. The birds moved about freely soon after the operation and accepted the feed when offered. Only the Rosy pelicans remained off-feed for two consecutive days. Ligature was removed a day after the operation and the bandage was removed on the 7th or 8th day leaving the benzoin seal intact, until complete healing of the wound was obtained. Some birds operated at the carpal joint reinjured the wound with mild disturbance and so rebandaging was necessary. No anaesthesia or post operative application of antibiotics was necessary.

TABLE

Sl. No.	Species of the bird	No. of operations performed	Site of operations
1.	Grey Heron	11	Carpal joint.
2.	Sarus Crane	11	-do-
	-do-	9	Metacarpal
3.	Lilford Crane	1	Carpal Joint
4.	Denoselle Crane	2	-do-
5	Rosy Pelican	4	Metacarpal
6.	White Necked stork	8	Carpal joint
	-do-	1	Metacarpal
7.	Adjutant Stork	7	Carpal joint
8.	Lesser Whistling Teal	12	-do-
9.	White Ibis	9	-do-
10.	Painted Stork	4	-do-
	-do-	2	Metacarpal
11.	Black Ibis	7	Carpal joint
12.	Black Necked Stork	9	Metacarpal
	-do-	2	Carpal joint
13.	Spoon Bill	2	-do-
14.	Brahminy Duck	8	-do-
15.	Pintail	1	-do-
16.	Gadwall	1	-do-
17.	Bar Headed Goose	2	-do-
18.	Grey Lag Goose	1	-do-
19.	White Stork	1	-do-
20.	Black Stork	1	Metacarpal

Discussion

For curtailing the ability to fly in wild birds, different methods, like pinioning at the metacarpals, exarticulation of the carpal joints clipping off flight feathers, radial neurectomy and brailing of the wings have been suggested. The clipping of flight feathers has its own limitation as it needs periodic check up and involves the usual disturbances with risk of injury to the bird, each time. Besides, some birds may be able to fly even much earlier without being noticed, as the flight feathers grow very fast. Success acheived by radial neurectomy (Bodrossy and Dozsa, 1939) as recommended by Grazimk (1943) was reported to be of slightest value because of the failure of this method, tried in various birds at Basle zoological gardens (Hediger, 1954). Brailing - a temporary fixation of the wing in the flexed position by means of a strap suggested by Startup (1967) is mostly for growing pheasant chicks and is thought to be of limited value as the brail is used only for short periods and if left in the same position for more than three weeks, may prevent satisfactory growth of the wing.

Though pinioning is mostly performed in zoological gardens to keep the birds within bounds, pinioning performed at either site gives a single permanent cure. The pinioned wing cannot easily be spotted out until it is fully stretched out by the bird. Considering the site of metacarpal bone and the carpal joint for pinioning, no untoward complications could be seen excepting that the birds easily reinjured the operative site on slightest traumatism when operated at the carpal joint. Hediger (*loc-cit*) also did not observe any failure in a large number of operations performed at metacarpals in various birds.

Startup (*loc-cit.*) reported that local anaesthesia such as procaine may be infiltrated around the carpo-metacarpal joint or general-anaesthesia like halothane may be given while pinioning older birds and no anaesthesia is required for 4 to 10 days old chicks. Hediger (*loc.cit.*) observed that no anaesthesia was necessary for pinioning through the metacarpals as the pain felt of the operation is apparently negligible. As such in the present series of operations conducted, no anaesthesia was employed.

When Lesser Whistling teals were operated at the carpal joint and left out in paddocks, they easily escaped into the nearby lake by swift walk and slight flight. This is thought to be due to the fact that some birds like smaller ducks, teals and mandarians soon after the operation do not seem to realise of their wings having been put out of action and so they try to fly with slightest alarm (Hediger, (*loc.cit*).

Lorenz (1940) observed a peculiar behaviour in a grey goose consequent to pinioning-severe pain, depression, complete loss of appetite and no breeding activity. On the contrary, Hediger (*loc cit.*) reported that pinioned grey geese bred repeatedly. Startup (*loc cit.*) reported that shock and haemorrhage are the two risks involved in pinioning but shock is most likely to develop in wild birds e.g. cranes. In this zoo, out of twenty kinds of birds pinioned, only the Rosy pelicans remained off-feed for two consecutive days, probably due to shock. These birds here have never bred either previously or even after pinioning. It is considered therefore to avoid this operation in birds which may get seriously affected by pinioning or feather clipping. The biological characteristics and attachment of birds need to be considered while deciding for pinioning.

It was noted that fish eating birds like storks, herons and pelicans regurgitated out when they were subjected for pinioning soon after feeding but no such behaviour was seen when done before feeding.

Summary

Pinioning of 106 wild birds of 20 kinds at the carpal joint and metacarpal bone was carried out successfully without any untoward complication at the Nandan Kanan Zoo (Orissa). The different aspects of pinioning and surgical technique are discussed.

Acknowledgment

The authors gratefully acknowledge the facilities provided in undertaking the above study to the Wildlife Conservation Officer, Orissa, Cuttack and the Dean, Faculty of Veterinary Science and Animal Husbandry, Orissa University of Agriculture & Technology, Bhubaneswar.

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Reprint from THE INDIAN VETERINARY JOURNAL
Vol. 49, No. 8, August 1972.

Correspondence

Pulmonary hydatidosis in captive animals at Nandan Kanan Zoo

The present communication dealing with the incidence of hydatids in the lungs of captive animals is based on the routine necropsy examination of animals that were dead at Nandan Kanan Zoo during 1967-1972.

1. Giant flying squirrel (*Petaurista petaurista*).

Giant flying squirrels are commomly found in Simulipal National Park, Mayurbhanj District, Orissa. Some of these animals are kept in captivity at Nandan Kanan Zoo. Out of 10 animals necropsied during the period under study, a male one revealed the presence of 4 hydatids each measuring about 2·5 cm. in length and 2 cm. in breadth in both right and left lungs and the cysts were fertile. No other gross lesions were detected. According to Crandall (1965), giant flying squirrels are very delicate animals and they rarely live for a long time in captivity. Since the animals in question was kept in captivity for about 6 months, it must have had a natural death but not due to the presence of hydatid cysts in lungs. Reddy and Ali Khan (1970) reported pulmonary hydatidosis in a great Indian squirrel. They, however, attributed the cause of death to shock resulting from rupture of a hydatid cyst.

2. Spotted deer (*Axis axis*).

Out of the 27 spotted deers necropsied during the period, in an adult male a solitary lemon sized cyst was found in the medial aspect of left diaphragmatic lobe. The cyst measured 4 cm. in length and 2 cm. in breadth and was found fertile. Brunette and Rosen (1970) detected cysts in lungs of 26 California deers out of 2049 necropsied during a 25 year period from January, 1945 to December, 1969. He briefly reviewed the incidence of hydatid disease in varieties of deer of U.S.A. and Canada.

3. Indian Pangolin (*Manis crassicaudata*).

A solitary sterile cyst was detected at the hilar region in the left lung of a male, out of 12 animals necropsied during the period. The cyst measured 2 cm. in length and 1·5 cm. in breadth.

In India, in captive animals, hydatids were recorded in elephants, Southwell (1930); liver of a lion, lungs of a giraffe Ramanujachari and Alwar, (1954, 1955) and spleen and lungs of a monkey (Alwar and Lalitha, 1961) and lungs of a great Indian squirrel (Reddy and Ali Khan, 1970).

Acknowledgments

Due acknowledgments are given to Dr. S. K. Misra, Dean, Faculty of Veterinary Science for providing facilities; to Sri R. Misra, Wild Life Conservation Officer, Orissa for his encouragement and to Dr. D.N. Das, Ex-Reader in Parasitology for his valuable suggestions.

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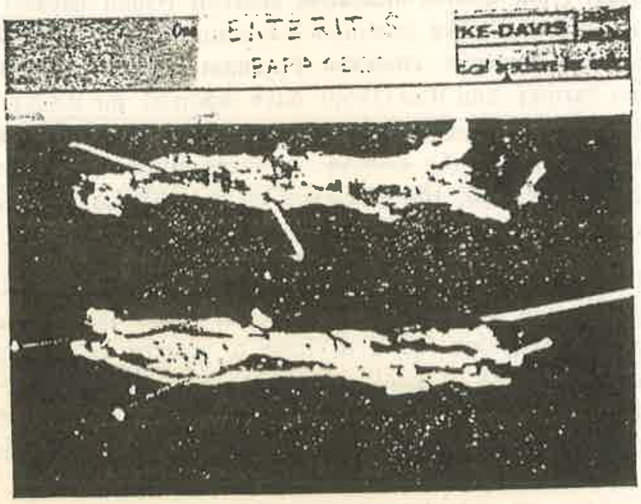
Ulcerative enteritis resembling Quail disease in a large Indian Parakeet (*Psittacula eupatria*)

By A. T. RAO, L. N. ACHARJYO and B. C. NAYAK



Note the characteristic discrete ulcers
in the small intestines of a parakeet.

[*To face page 880*]

Reprint from THE INDIAN VETERINARY JOURNAL
Vol. 49, No. 9, September 1972

ULCERATIVE ENTERITIS RESEMBLING QUAIL DISEASE IN A LARGE INDIAN PARAKEET (*PSITTACULA EUPATRIA*)

BY

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Apart from Quails, ulcerative enteritis (Quail disease) has been reported in other birds like common Bob-white, Grause, Partridge, Turkey, Pheasant and domestic chickens (Peckham, 1965). Shukla and Rajya (1968) and Parihar and Rao (1969) have reported the disease in domestic fowls from India. The authors are not aware of any. published reports on the occurrence of the disease in large Indian Parakeet and hence in this communication, the existence of the disease at Nandan Kanan Zoo has been indicated.

During the routine necropsy examination of birds that had succumbed at the Zoo during 1967–71, a large Indian Parakeet (dead on March 6, 1971) was found to have a number of discrete ulcers in the lower two thirds of small intestines including both the caeca. The ulcers had different sizes ranging from 0·2 to 0·5 cm with characteristic irregular pale raised borders and depressed centres appearing in the form of craters (Fig.). Some of these ulcers had fused to form larger ones but perforation of ulcers through the serous coat was not a feature.

Histopathological alterations of the transverse sections of the intestines passing through the ulcers consisted of massive areas of necrosis of villi admixed with serofibrinous exudate. The smaller ulcers had involved the submucosa whereas larger ones had involved the deeper layers of the intestines including the muscular coat. The mucosa revealed desquamation of the epithelial cells, haemorrhages and infiltration of lymphocytes and plasma cells. A number of Gram positive coccobacillary organisms in clumps were detected in the cellular detritus. The submucous layer was markedly widened due to engorgement of capillaries and infiltration of infilammatory exudate. The muscular coat and serosa were thickened due to accumulation of oedematous fluid and inflammatory cells. The non–ulcerated areas of intestines revealed acute catarrhal enteritis and their lumina contained desquamated epithelial cells and erythrocytes. No lesions of pathological significance were detected in liver except for a marked congestion of the sinusoids associated with the presence of bacteria with morphology similar to that seen in intestines.

* Veterinary Assistant Surgeon, Nandan Kanan, Barang, Cuttack.

Acknowledgment

Thanks are due to Dr. S.K. Misra, Dean, Faculty of Veterinary Science and Animal Husbandry for providing facilities and to Sri R. Misra, Wild-Life Conservation Officer, Orissa for his encouragement.

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Reprint from THE INDIAN VETERINARY JOURNAL

Vol. 50, No. 2, February 1973.

Correspondence

Sir,

Sub : *Histopathology of intestinal lesions due to echinococcus granulosus in an Indian wolf (Canis lupus)*

Echinococcus granulosus, a common tape worm of canidae, is a problem of public health importance for its larval stage is found in a wide variety of animals including man. Sometimes, the infection passes from wild herbivores to wild carnivores and then to domestic dogs, (Soulsby, 1965). It is well known that the adult parasite produces little or no ill effects in the host's tissue, unless they are present in large numbers. In this communication, an account on the pathological changes observed in the intestines of wolf, which was heavily infested with *Echinococcus granulosus* is reported.

An extremely anaemic wolf, belonging to Nandan Kanan zoo which was necropsied revealed marked catarrhal enteritis associated with large number of minute tape worms in both small and large intestines. The parasites which were collected in 10 per cent formol saline were later identified as *Echinococcus granulosus*. Formalin fixed pieces of intestines were processed by routine histological techniques and stained by haematoxylin and eosin.

Histologically, the intestines revealed extensive acute catarrhal enteritis characterised by proliferation of goblet cells, desquamation of lining epithelial cells of mucosa and ulceration associated with mononuclear leucocytic infiltration. These pathological changes were attributed to heavy parasitic invasion, for the cestodes were seen penetrating into the crypts through the powerful rostella armed with hooks. The suckers also manifested tissue detritus further indicating the pathogenic behaviour of the parasites. Since no other conspicuous lesion was encountered, the cause of death was ascribed to anaemia and enteritis resulting from severe parasitism.

The larval stage of the parasite has been earlier reported (Rao, *et al*, 1972). in some of the intermediate hosts like giant flying squirrel, spotted deer and Indian pangolin in the Nandan Kanan Zoo. The infection in those animals must have been acquired by ingestion of eggs shed in faeces of infected carnivores. The carnivores in turn must have acquired the infection by ingestion of untreated offals from the slaughter house. The existence of infection in a wide variety of intermediate and definitive hosts indicates that the cycle of the disease is complete.

Sincere thanks are due to Dr.S.K. Misra, Dean and Sri R. Misra, Wild Life Conservation Officer for their encouragement and to the Head, Division of Parasitology, Indian Veterinary Research Institute, Izatnagar, U. P. for identifying the parasites.

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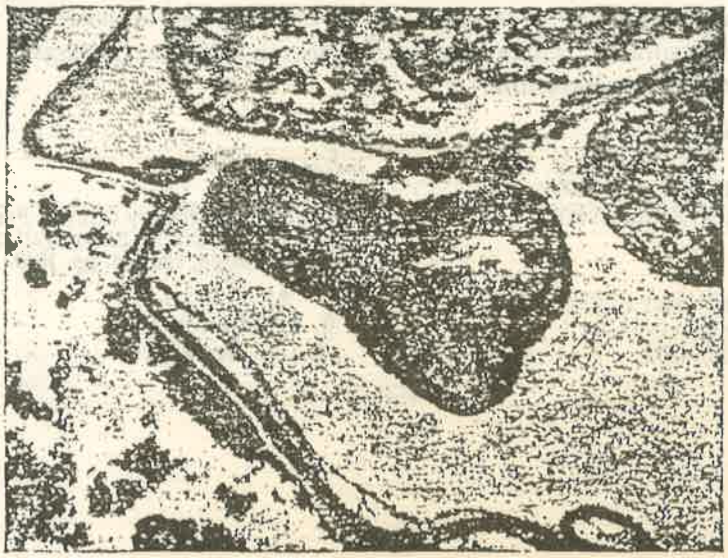
L. N. ACHARJYO

Pathology of liver in *Stephanurus dentatus* infection in Indian wild pigs (*sus scrofa cristatus*)

By A. T. RAO, L. N. ACHARJYO and S. C. MISRA



Section of *S. dentatus* in a pool of haemorrhagic exudate in liver parenchyma.

[H & E x80]

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Vol. 50, No. 6, June, 1973.

Correspondence

Sri,

Sub : *Pathology of liver in stephanurus dentatus infection in Indian wild pigs (sus scrofa cristatus).*

Pieces of liver were received from 13 wild pigs that had a natural death at Nandan Kanan Zoo, Orissa, during 1967–72. Of these, the livers of 4 pigs had lesions suggestive of parasitic infection. On incision, a number of adult male nematodes were recovered from the organ which were indentified as *Stephanurus dentatus.*

Grossly, the affected livers were moderately enlarged, pale in color and firm to cut. The surface presented firm, greyish coloured nodular lesions of different sizes ranging from 3 mm. to 3 cm. in diameter. The hepatic lobulations were prominent. In two specimens, there were tortuous haemorrhagic tracts whereas the other two manifested multiple, unilocular cystic structures of different diameters ranging from 2 mm. to 1 cm. containing clear watery fluid.

Microscopically, the nodular lesions observed at necropsy comprised of extensive areas of eosinophilic granulomas predominantly composed of central eosinophils in a state of disintegration. The peripheral cells consisted of intact eosinophils which were surrounded by varying amounts of granulation tissue. The adult male nematodes were embedded in a pool of haemorrhagic exudate in the liver parenchyma (Fig.). In some sections, blood elements and ingested detritus were noticed in the cup shaped buccal capsule and throughout the gut indicating that the parasite feeds on the host's tissue. Majority of the hepatic lobules, particularly underneath the capsule were obliterated due to extensive haemorrhage. In other areas, the hepatic cells manifested extreme degree of vacuolar degeneration. Periportal fibrosis associated with infiltration of eosinophils, plasma cells and lymphocytes and biliary hyperplasia were also not infrequent.

These findings indicate that the presence of adult parasites in the liver caused considerable damage to the organ due to mechanical and possibly toxic effects. The gross and histopathology of liver lesions were in close agreement with those described in domestic pigs. (Jubb and Kennedy, 1963; Soulsby, 1965; Lap, 1966; Paneyra and Nani, 1967; Chauhan and Rao, 1972).

Due acknowledgments are given to Dr. S. K. Misra, Dean, Faculty of Veterinary Science and Animal Husbandry, Bhubaneswar and to Sri R.Misra, Wild Life Conservation Officer, Orissa for their encouragement.

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Indian vet. J. 51, July—August 1974

LEECH INFESTATION OF WILD ANIMALS

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Little information is available on leech infestations of wild animals of India. In the nostrils of a 5 month old sloth bear cub (*Melursus ursinus*) and a two year old female elephant (*Elephas maximus*) infestations with *Limnatis granulosa* were encountered. The following observations are placod on record.

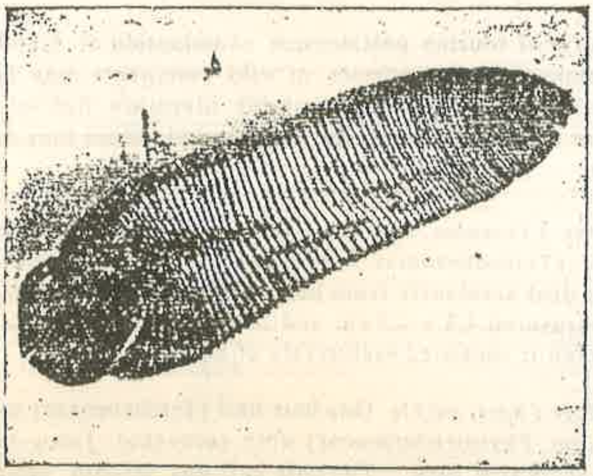
The sloth bear cub was brought to Nandankanan from Simulipal (Mayurbhanj) on 21-5-72. At the time of receipt, a leech protruding out of the right nostril was marked. No other untoward symptom was noticed except occassional shaking of the head. The leech crawled deep into the nostrils when efforte were made to secure the animal and remove the leech. The efforts of the animal to dislodge the leech by vigourous shaking of the head were in vain. The leech could be pulled out with a long forceps on 15-6-72.

The elephant, which was received from Annandpur (Keonjhar) on 2-2-73 was passing oozed blood from the trunk. There were no other systemic disturbances. Leech infestation in the nostrils was suspected. Mechanical removal was not possible. On filling the nostrils (trunk) with saturated saline and allowing the animal to sneeze out the leeches the removal of 2 leeches (one from each nostril) was possible.

The contracted leeches measurad 4·5 and 5.5 cm long, 1·0 and 1.5 cm wide, and ventral suckers 1 and 1·25 cm in diameter. They were about 8-10 cm long when living (Fig.).

Acknowledgment

Authors thank Sri G. S. Naik, Divisional Forest Officer for taking the photograph.



Leech infestation of wild animals—L. N. ACHARYA, B. N. ACHARYA and M. M. PATNAIK.

Leech recovered from an elephant.

Inidaa vet. J. 56, February, 1979 : 153

INCIDENCE OF TRICHOBEZOARS AND PHYTOTRICHOBEZOARS IN TWO SPECIES OF WILD RUMINANTS

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During the course of routine postmortem examination at Nandankanan Biological Park, Orissa, the rumen of two species of wild ruminants was found to contain hair and hair *cum* food balls. Perusal of the available literature did not reveal any information on the occurrence of such balls in wild animals and hence they are recorded here for general information.

(1) Mouse Deer (*Tragulus meminna*)-One smooth surfaced tennis ball-size mass classified as hair ball (Trichobezoars) was recovered from the rumen of a 10 year old male mouse deer that died accidently from heart failure while being caught for transportation. The dry ball measured 4.8 x 4.5 cm and the dry weight of the ball was 20 grams, (Fig.). On cut section it consisted exclusively of hairs.

(2) Spotted Deer (*Axis axis*): One hair ball (Trichobezoar) and one hair *cum* food ball (Trichobezoar *cum* Phytotrichobezoar) were recovered from the rumen of a male spotted deer aged 10 years that died. The hair ball was smooth surfaced, almost round, measured 6.6 x 5.0 cm and weighed (dry weight) 50 grams.

The hair *cum* food ball was oval in shape, had irregular surface, measured 7.9 x 6.4 cm. and weighed 49 grams. On incision, the hair ball consisted ~~purely of~~ hairs, while the hair *cum* food ball revealed alternate layers of food particles and hairs.

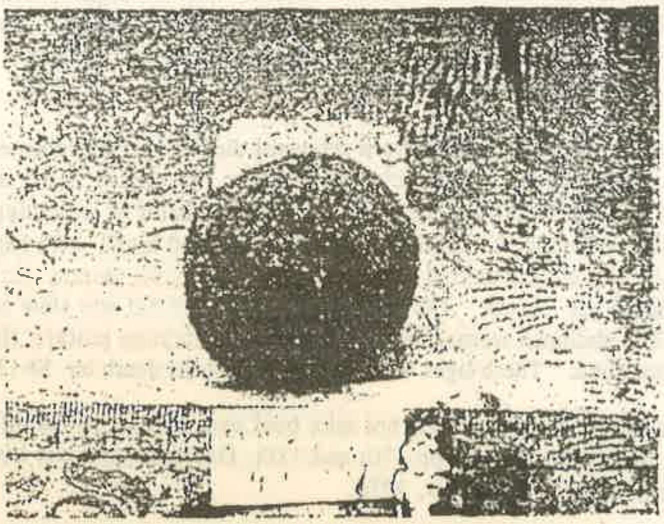
The habit of licking themselves and among themselves might have been responsible for the formation of such hair and hair *cum* food balls in the rumen of these two species of deer.

Acknowledgment : Due acknowledgments are given to the Dean, Faculty of Veterinary Science and Animal Husbandry, Bhubaneswar and to the Chief Wild Life Warden, Orissa and Wild Life Conservation Officer, Orissa for their encouragement.

* Veterinary Assistant Surgeon, Nandankanan Zoo, Barang, Cuttack.

Incidence of Trichobezoars and Phytotrichobezoars in two species of wild ruminants

L. N. Acharjyo and B. C. Nayak



Trichobezoar recovered from the rumen of a mouse deer

Indian vet. J. 57. March, 1980 : 252-253

HAEMORRHAGIC CYSTITIS IN A CAPTIVE BLACK PANTHER (*PANTHERA PARDUS*)

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This communication presents a clinical case of haemorrhagic cystitis observed in an 8½ year-old male Black Panther at Nandankanan Biological Park, Orissa. The animal was in the park since 18-10-72. He was receiving a diet of about 3 kg beef per day. Vitamin supplements were given intermittently by oral route.

On 11-12-76, the Black Panther refused its usual diet of beef and showed sluggish movements. On closer observation, the animal was found to be voiding scanty dry faeces 6 to 8 times daily. Polyuria and oliguria were present. Its usual habit of scratching the ground just before urination was not noticed. During urination, the hind limbs were kept apart and the penis was protruded out and the animal remained in sitting down posture for sometime even after the flow of urine has ceased. The movement of the animal was slow and sluggish even after excitement. The abdomen seemed to be full while in urination posture, though the animal was not taking usual food. These signs were exhibited till his death on 30-12-1976

During this period, the animal did not take beef even though it was offered daily. The panther took goat meat (about ½ kg) on 17th and 18th December and one live fowl or pigeon on 22nd, 25th, 26th and 27th December, 1976.

The case was at first suspected to be of lower intestinal obstruction which might be due to pieces of bone. Stool samples were negative for helminthic ova, protozoon cysts, RBC and pus cells. Urine samples were collected from the clean cement floor of the panther house and examined 3 times during the period of illness. The urine was brownish yellow in colour, slightly turbid and alkaline. Traces of albumin and bile pigment, rare pus cells and RBC, traces of sugar and desquamated epithelial cells were also detected in urine each time. Bacteriological examination of urine could not be taken up as there was no wav to collect aseptically. Basing on this, it was tentatively diagnosed to be a case of urinary infection.

To relieve constipation, magnesium sulphate, Vaculax tablets and Biagar oil were given in drinking water at the beginning. The panther consumed little quantity of medicated water and as such the treatment was not effective.

Furadentin syrup was given (one teaspoonful) two times daily in small quantity of drinking water from 14-12-76 to 22-12-76. Here again, the animal was not consuming the medicated water in full. Aureomycin soluble powder (10 g) and vitamin C tablets (1000 mg) were given in drinking water from 23-12-76 to 26-12-76. None of the treatments showed any improvement. The condition of the panther deteriorated day by day and finally it died on 30-12-78.

* Nandankanan Biological Park, P.O. Baranga Dist : Cuttack.

On postmortem, the urinary bladder was found to be ruptured and the peritoneal cavity contained about 6 litres of strong urine smelling blood tinged fluid. The bladder was very much thickened and dark red in colour (Fig.). The mucosal surface of the bladder was rough and haemorrhagic. A few heart worms (*Dirofilaria immitis*) were found in the right ventricle and pulmonary artery.

Haemotoxyline-eosin stained sections revealed haemorrhagic exudates in all the layers of the bladder associated with marked haemosiderosis. The proliferated macrophages were hypertrophied due to ingestion of haemosiderin pigment. The serosa was thickened due to oedema and infiltration of macrophages.

Acknowledgments : The authors are thankful to the Dean, Orissa Veterinary College, Bhubaneswar, the Chief Wild life Warden, Orissa and the Wild life Consversation Officer, Orissa for the facilities provided.

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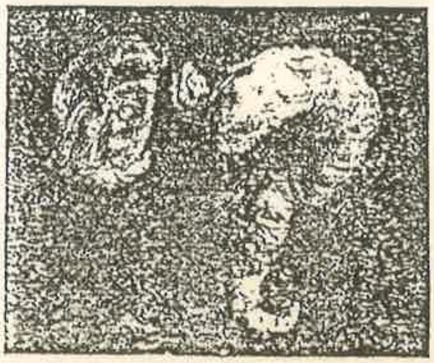
Haemorrhagic cystitis in a captive black panther
(*Panthera pardus*)

S.B. Tripathy, L.N. Acharjyo, A.T. Rao and B.C. Nayak



Photograph showing thickened dark red bladder and impacted large intestine

Indian vet. J. 57. April, 1980 : 347-349 Clinical

PROLAPSE OF THE GENITALS INCLUDING PROLAPSE OF CLOACA IN MALE GHARIAL (*Gavialis gangeticus*) : A CLINICAL CASE REPORT

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Orissa Veterinary College, Bhubaneswar

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Nandankanan Biological Park, P.O. Baranga, Cuttack, Orissa

The gharial (*Gavialis gangeticus*) is one of the three living species of Indian crocodiles. Since it is one of the critically endangered species, attempts are now being made to save the species from extinction and to rehabilitate it in nature. So far, this species is not known to breed in captivity. With an aim to breed this species in captivity, a large gharial breeding pool with a capacity of 2.70 million litres and a depth of 9.15 metres has been constructed by Orissa Forest Department at Nandankanan Biological Park, Orissa. At present there are three (one male and two female) almost adult gharials in this pool. These gharials have been reared from small babies to the adult size in this park.

Case History

In January 1977, the male gharial of the park, measuring 2.70 metres in length (with an estimated age of 15 years) was observed to have protruded out the penis along with a small bulbous mass for several minutes. This was thought to be an indication that the animal attained puberty and was exhibiting libido.

After about one year of the above incidence, it was seen to repeat the protrusion of the penis along with a small bulbous mass (Fig. 1).

Clinical Observations :

The animal refused to take its diet of fresh water fish when offered and was inactive. The illness continued and got further aggravated as time passed on. The prolapsed bulbous mass was seen gradually increasing in size and the signs of pain were noticed when the animal came out of the pool for basking. It was feeling difficulty while crawling on the ground and was moving with arched back. It preferred to remain out of water for most of the time. The reddish brown colour of the prolapsed mass gradually turned greyish in colour.

Diagnosis

The case was diagnosed as a case of prolapse of the genitals including a portion of cloaca and surgical manipulation was felt necessary.

Control and Treatment

Since the gharial was in 9.15 metre deep water, control of the animal could be possible after three days of the observation of protusion and other clinical signs. A cotton rope noose was passed slowly over the snout and behind the forelimbs when the male gharial was lying partially out of water very near the pool. Three persons at a time lifted the tail out of the ground and dragged it away from the pool with simultaneous pulling of the rope by several persons. As soon as it was a bit away from the pool, complete control could be achieved with the help of six wooden poles (2 metres long and forked at one end) and cotton ropes as described by Mohapatra *et al.* (1976). Care was taken to see that the prolapsed mass was not damaged during handling of the animal. Then the crocodile was placed upside down for manipulation of the prolapsed mass.

The prolapsed bulbous mass was about 25 cm in diameter and formed the base of the penis. The anteriorly pointing partially relaxed penis measured 24 cm in length including 4 cm long double pronged glans (Fig. 2).

Siquil (Squibb) 1 ml (20 mg) was given intramuscularly to lessen straining. The protruded mass was cleaned thoroughly with soap and water and later by potassium permanganate solution. Xylocaine 5% ointment (Suhrid Geigy) was applied over it. Aureomycin 2% powder (Cyanamid) was applied liberally over the prolapsed mass. Sufficient quantity of liquid paraffin was put all round the prolapsed mass ; the latter was reduced by manipulation gradually into the cloaca (Fig. 3).

A purse string suture was applied using chromic catgut No. 1 around the cloacal opening to prevent the prolapsed mass to recur (Fig. 4).

Post-operative treatment and Observation :

After the operation, 1000 mg of Achromycin (Cyanamid) was given intramuscularly and the animal was released back into the pool. The animal moved freely as usual inside the pool.

Further injections of Achromycin were tried without success on first and second day following surgical reduction of the protrusion as the animal could not be secured. Instead, Terramycin (Pfizer) in 20 ml daily dose was sprayed into the oral cavity from a distance with the help of a syringe when the reptile was basking keeping its mouth open.

Slight bulging around cloaca was marked on 4th day following surgical intervention. So two Hostacycline capsules (Hoechst) of 500 mg each were concealed inside the fish and fed. This method of treatment was continued for six consecutive days.

The crocodile was not accepting its food even after operation. It took one fish (60 gm) on the third day of operation, about 300 gm of fish on the fourth day and subsequently started taking its usual diet of about 900 gm of fish per day.

The animal was declared completely cured 11 days after the surgical intervention as there were no clinical signs of illness and it behaved normally. No recurrence has been noted till now.

Prolapse of the genitals including prolapse of cloaca in a male gharial (*Gavialis gangeticus*): A clinical case report

J. Mohanty, S.B. Tripathy, L.N. Acharjyo, P.C. Pradhan and B. Mishra

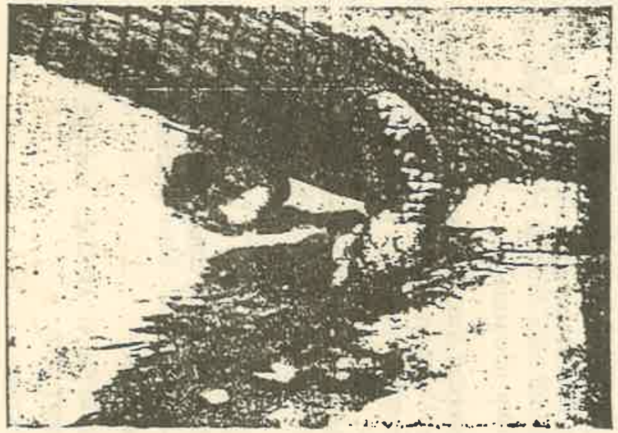

Fig. 1. Male gharial in crawling posture showing prolapse of the genitals and cloaca. Gangrenous lesion is seen at the base of the mass

Fig. 2. The prolapsed genitals and cloaca of the gharial being cleaned and attempts being made to reduce after controlling the animal in upside down position

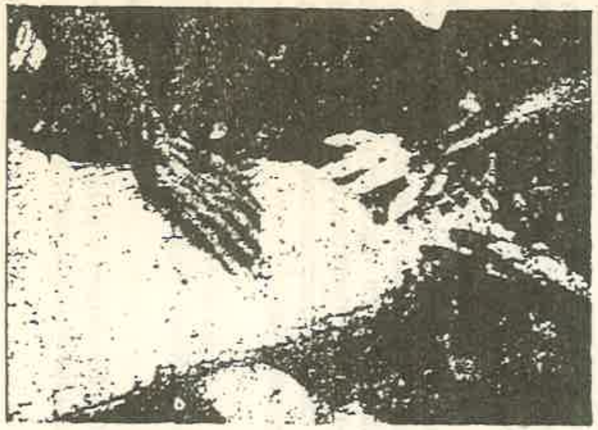

Fig. 3. The prolapsed mass has been reduced by manipulation

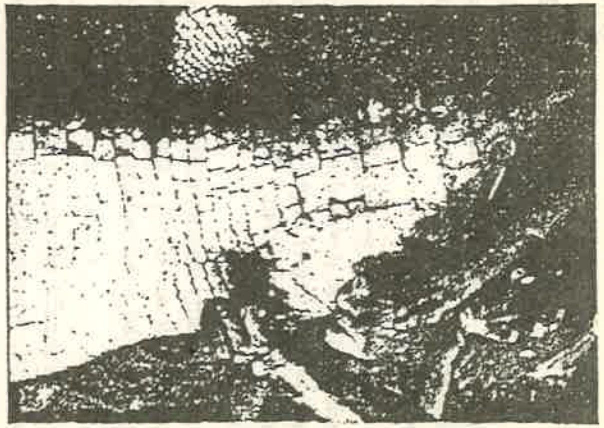

Fig 4. Purse string suture is being given after reducing the prolapsed genitals and cloaca of the male gharial

[To face page 347]

Discussion

It is difficult to diagnose and handle a patient like an adult gharial, specially in a deep water tank. Since this gharial specimen was almost semi-tamed and is kept on hand feeding, it was possible to control the animal (with sufficient risk for the handlers) and to give oral medicines.

Initially, after restraining the crocodile upside down, the animal was struggling very much. As such, it was decided to give some tranquilizer. As there is no reference of the exact dose, 20 mg of Siquil was given with caution. The crocodile somewhat calmed down though not fully relaxed. Repositioning and suturing could be done while the animal was ying quietly.

Breeding season in the gharial species is said to commence from the last part of January (Acharjyo *et al.*, 1975). Since the protrusion was observed during this period of 1977, it was thought to be a fair indication of maturity of the animal and manifestation for the desire to mate.

A similar protrusion this year might have resulted in a mating-either successful or unsuccessful. A normal retraction of the penis into the cloaca failed to occur resulting in continuous increase in the size of the protruding mass. Thus, a sizable part of the cloacal wall which formed the base of the penis remained prolapsed along with the penis exhibiting a pathological condition. One may anticipate some injury at the time of mating as the cause for failure of the normal retraction of the penis into its normal physiological position.

When the animal used to move on the ground for basking, the prolapsed mass sustained bruise and trauma resulting in inflammation and further enlargement of the mass. Accompanied pain was responsible for the impediment in the movement. Arching of the back was intended probably to prevent friction of the prolapsed mass with the ground. It was remaining most of the time outside the water to get relief from irritation.

The two-pronged glans appeared highly congested with ulceration on its surface. The penis was a rigid structure with a soft base. Replacement was done by slow and gradual pushing of the base followed by the penis. Purse string suture was given using chromic catgut with an intention that after some days when there will be no more irritation on the surface of penis and its base stucture consequent upon the healing of the ulcerated surface, there will be no cause for recurrence and by that time suture would have dissolved, thus avoiding a post-operative removal.

Summary

A case of prolapse of the genitals including a portion of cloaca in a male gharial has been reported. Etiopathogenesis and surgical management have been described and discussed.

Acknowledgment

The authors wish to express their gratitude to Sri. G. M. Dash and Sri. S. Mohapatra, Orissa Forest Department, Bhubaneswar for necessary help.

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Indina vet. J. 57. November, 1980 : 885-890

NEOPLASMS IN THE FAMILY ANATIDAE AND GRUIDAE AT NANDANKANAN ZOO

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A systematic necropsy examination of varieties of captive birds dead at Nanadankanan Zoo (India) and histopathological examination of vital organs hitherto collected from such birds are being carried out since 1967 to gain information on the incidence and prevalence of avian neoplasms at the zoo. So far, about 1100 birds were necropsied and the nature of spontaneous neoplasms affecting various species of Indian wild birds recorded earlier and in the present study are being reported.

Review of literature

A brief review of neoplasms in the Family Anatidae and Gruidae reported in the literature is given in the Table 1.

Materials and Methods

The specimens for this report were obtained from the local zoo. All the tissues suspected for neoplasms, after detailed necropsy examination, including the entire carcases were submitted to the Department of Pathology for histopathological diagnosis. Tissue samples fixed in 10 per cent formol-saline were processed by standard histological techniques. Tissue sections of 6 microns thickness were stained with routine haematoxylin and eosin method.

Results

Case 1 :

A female pin tail aged about 7 years died on 10-12-75.

At necropsy, the anterior border of right lung revealed an encephaloid mass resulting in compression of oesophagus, trachea and pulmonary tissues. Similar lesions were also seen around the lower half of cervical region. The left lung revealed a small nodule on the postero-lateral border.

Microscopically, the neoplastic tissue consisted of uniformly sized cuboidal and/or columnar cells arranged in the form of compact masses of cells, acinar or papillary pattern. Necrotic changes were noticed in the centre of compact growths. The tumour was classified as bronchogenic carcinoma (carcinoid with an adenopapillary pattern).

Case 2 :

Female wild duck (crested pochard) aged about 7 years died on 27-2-76.

At necropsy, multiple, pedunculated and branched cystic structures containing watery/jelly like material were encountered in the thoracic cavity and lower half of the neck region. The posterolateral border of the left lung revealed encephaloid growths.

*Veterinary Assistant Surgeon, Nandanakanan, Baranga, Cuttack

Table 1—*List of neoplasms in the family Anatidae and Gruidae reported in the literature*

Sl. No.	Kind of bird		Type of tumour	Organ(s) involved	No. of cases	No. examined	Name of zoo and year of study	Reference
1.	Duks	—	Sarcoma —do—	Skin, Pleura, Lungs,	1 3 —	— —	— —	Semmer (1889)
2.	Red headed duck Black duck Lesser Snow goose	— — —	Papillary adenoma Hypernephroma Fibroma	Kidney Adrenal Clavicle	1 1 1	— — —	— — —	Fox (1923)
3.	Goose	—	Teratoma	Ovary	1	40	—	Babic (1931)
4.	Ducks	—	Adenocarcinoma	Liver	1	692	1899-1931 (Leipzig Zoo)	Eberland Malke (1932)
	Goose	—	Chondro sarcoma myxomatodes	Cartilage	1	720	—do—	—do—
5.	Birds	—	Malignant hepatoma	Liver	2	8,000 birds	1901-1946 Philadelphia zoo	
6.	Anatidae	—	Hepatoma	Liver	6	420	1945-60 Philadelphia zoo	
7.	Anseriformes	—	Malignant tumours	—	5	601	1901-1934 Philadelphia Zoo	
8.	Anseriformes	—	Pulmonary carcinoma Fibrosarcoma Squamous cell cinoma Carcinoma —do— Adenocarcinoma Biliary adenoma Carcinoma —do— —do—	Lungs Wing Scalp Skin Oesophagus Intestines Gal Bladder Liver Liver Ovary Testes	1 1 1 1 1 1 1 1 4 1 1	—	1935-55	Lombard and Whitte (1959)
9.	Ducks	—	Pulmonary tumour	Lungs	5	—	Philadelphia zoo	Stewart (1966)
10.	Widgeon Pochard	— —	Fibrosarcoma Adenocarcinoma	Lungs Lungs	1 1	—	—	Snyder and Ratcliffe (1966)
11.	Mute swan	—	Fibroma	—		1	—	Chang *et al* (1969)

Neoplasms in the family Anatidae and Gruidae at Nandankanan zoo

A. T. Rao and L.N. Acharjyo

Fig. 1. Cystadenocarcinoma—
Lung of crested pochard (case 2). Note multiple cystic structures lined by cuboidal cells. Note the eosinophilic material in the lumina. H. & E.

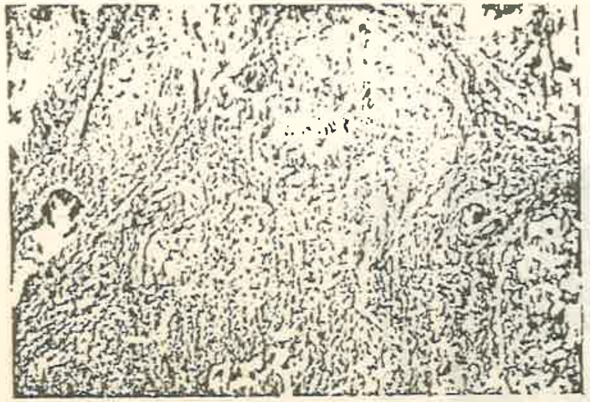

Fig 2. Bronchogenic carcinoma in Moscovy duck (case 3)
Note intrabronchial growths.
The acinar structures are lined by columnar cells
H. & E.

Fig. 3. Bile duct carcinoma-Moscovy duck (case 4)
Note the massive proliferation of new bile ducts.
H. & E.

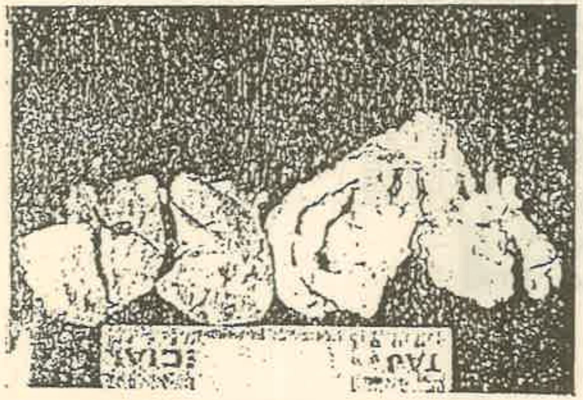

Fig. 4. Mesothelioma—Lilford crane (Case 5)
Note the numerous nodular structures over peritoneum, intestinal serosa and liver.

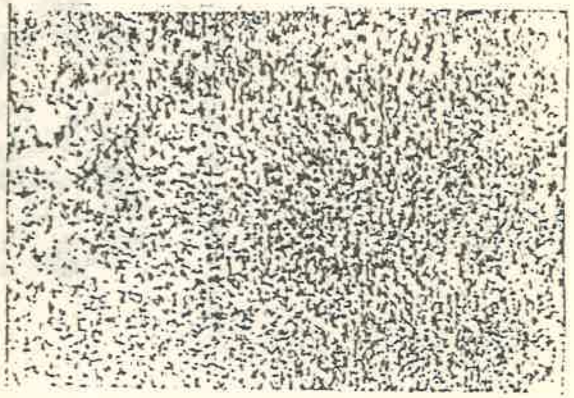

Fig. 5. Mesothelioma—Lilford crane (Case 5)
Note the mesodermal cells arranged in an irregular fashion. H. & E.

Microscopically, the extra pulmonary growths consisted of irregular variable sized cystic structures (Fig. 1) lined by single occasionally multilayered cuboidal cells. Some of the acini revealed papillary growths of epithelial cells. The intrapulmonary growths were made up of tall columnar cells arranged in an acinar pattern or in broad sheets. Necrotic changes were encountered in these growths. The tumour was classified as bronchogenic carcinoma (Cystadeno carcinoma type).

Case 3 :

Male Moscovy duck aged about 5 years died on 11-2-77.

At necropsy, the posterior border of the left lung revealed a hard greyish-white nodule having the size of 2.5 × 10 cm.

Microscopically, the neoplastic tissue consisted of cuboidal and/or columnar cells arranged in an acinar pattern or in broad sheets replacing large areas of lung tissue (Fig. 2). Stromal tissue revealed lymphofollicular reaction and presence of plasma cells. The tumour was classified as bronchogenic carcinoma (adenocarcinoma type).

Case 4 :

Female Moscovy duck aged about 5 years died on 26-5-1977.

At necropsy, the liver was abnormally enlarged and mottled. The visceral surface of the left lobe had a globoid elevation measuring 4.0 x 4.0 cm in size. Both the lungs revealed small nodular growths.

Microscopically, the hepatic tissue was diffusely invaded by proliferating bile ducts which were seen either in the form of elongated branched tubules or acini (Fig. 3) lined by single layer of cuboidal cells on basement membrane. The invasion of newly formed bile ducts had caused atrophy of the hepatic cells. The stromal tissue of the neoplasm revealed marked hyperaemia and infiltration with lymphocytes and plasma cells. Liver was markedly cirrhotic. Metastatic nodular tumour growths were encountered in lungs. The tumour was classified as bile duct carcinoma.

Case 5 :

Female Lilford crane aged about 10 years died on 27-12-78.

The bird was suffering from leg weakness for about seven months prior to death. At necropsy, numerous varying sized hard greyish-white nodules were present on mesentery, peritoneum (Fig. 4) and intestinal serosa. Liver was abnormally enlarged, mottled and studded with hard nodules. Ovary was non-functional and oviduct was rudimentary.

Microscopically, the tumour tissue on mesentery and intestinal loops was composed of spindle shaped, fusiform, round or flat mesodermal cells arranged in an irregular fashion

(Fig. 5). The scanty oedematous stromal tissue was infiltrated by a number of lymphocytes, plasma cells and heterophils. The tumour presented a sarcomatous appearance.

Sections of liver revealed metastatic mesothelioma growths replacing large areas of hepatic tissue. The tumour tissue was made up of acini composed of single/occasional multi-layered cuboidal cells lined on a basement membrane giving an adenocarcinomatous appearance. The tumour was classified as mesothelioma.

Table 2—*Prevalance of different kinds of neoplasms in some zoo birds at Nandankanan since 1967*

Sl.No.	Kind of birds	No. of birds died	No. of tumour bearing birds	Description of tumour
Cranes				
1.	Sarus crane	18	3	1. Hepatoma (Rao and Acharjyo, 1971b) 2. Adenocarcinoma of intestine (Rao and Acharjyo, 1973) 3. Concomitant neoplasia (Rao *et al.*, 1974)
2.	Lilford crane	1	1	1. Mesothelioma
3.	Desmoisele crane	1	—	
Ducks				
1.	Moscovy ducks	15	2	1. Adenocarcinoma of lung 2. Bile duct carcinoma
2.	Brahamini duck	20	1	1. Aortic body (Shah *et al.*, 1974) tumour
3.	Pin tail	60	2	Carcinoid of lung—2 cases (Rao *et al.*, 1971b)
4.	Crested Pochard	6	1	Cystadenocarcinoma of lung
5.	Other ducks including geese	109	1	Myxosarcoma in liver
Fowls				
1.	Pea fowls	35		1. Bronchogenic carcinoma—3 nos. (Rao and Acharjyo, 1971a) 2. Lymphoid leucosis (Shah *et al.*, 1973)
2.	Turkey fowls	8	2	Adenocarcinoma of ovary—2 cases (Rao *et al.*, 1971a)
3.	Jungle fowl	7	1	Lymphoid leucosis (Rao *et al.*, 1975)
	Total —	280	18	

Case 6 :

Female goose aged about 6 years died on 21-9-75.

At necropsy, the left lobe of liver was abnormally enlarged and tough to cut. The right lobe was enlarged and studded with a number of nodules. Ovary was non-functional.

Microscopically, large areas of hepatic tissue were replaced by extensive myxomatous growths characterised by round or spindle shaped cells having numerous interlacing cytoplasmic prolongations. Binucleated cells, mitotic figures and multinucleated giant cells were common. The hepatic tissue which was not involved by neoplastic process revealed extensive cirrhosis. The tumour was classified as myxosarcoma.

Prevalence of different kinds of neoplasms in some Zoo birds at Nandan Kanan since 1967 including those recorded in the present study are shown in Table 2.

Discussion

It is seen from Table 2 that 10 per cent of the birds belonging to ducks, geese, fowls and cranes which died during the last 12 years at the Zoo had spontaneous neoplastic conditions of which pulmonary tumours predominated over others. Stewart (1966) while discussing the tumours in captive wild animals and birds also commented on the relatively high incidence of lung tumours. Snyder and Ratcliffe (1966) speculated that the frequency of avian neoplasms was probably due to the increased atmospheric carcinogens. They further stated that the pulmonary tumours were frequent in the family Anatidae and the species susceptibility played a part in the tumour incidence. Beer (1968) stated that the incidence of respiratory cancer in water birds had considerably increased in the last 20 years in most of the larger zoos throughout the world and it has been suggested that it may be due to increased contamination of water. It is quite likely that the high incidence of neoplasms at Nandankanan zoo might be due to its situation which is adjacent to an industrial establishment of a glass factory resulting in possible pollution of water and atmosphere.

The histogenesis of lung tumours cannot be always traced out exactly because of frequent pleomorphism in different tumours and even in different regions of the some tumour. According to Moulton (1961) all the pulmonary tumours can be best classified as bronchogenic for they arise from the epithelial lining of the bronchi and bronchioles. In the present investigation, three distinctly separate types of pathological manifestations of a single neoplastic entity have been encountered in three different species belonging to the family Anatidae, one of carcinoid type, second a cystadenocarcinoma and third an adenocarcinoma. The difference in histological behaviour among these tumours might be due to varying susceptibility of the species and tissue response and probably some other unidentified factors involved in the disease process.

The morphology of the bile duct carcinoma in Moscovy duck and myxosarcoma in goose corresponds to the description given by Moulton (*loc. cit.*). The microscopic pathology of mesothelioma encountered in Lilford crane was, however, little different from mesothelioma encountered in Sarus crane by Rao *et al.*, (1974) for the primary growth in the former had sarcomatous appearance while the latter had an adenocarcinomatous appearance. Metastatic lesions were encountered in liver in the former and in lungs in the latter case. Similar explanation as has been hypothesised for pulmonary tumours in the family Anatidae can be offered in the present case as well.

Summary

All the species of birds that succumbed at Nandankanan zoo since 1967 were routinely screened for spontaneously occurring neoplasms during detailed necropsy examination. Thirteen tumours involving different organs of varieties of captive Indian birds have been earlier reported. This paper reports additional 3 types of pulmonary tumours of diverse histological features in 3 different species belonging to the family Anatidae, bile duct carcinoma with metastatic growths in lungs in a Moscovy duck, mesothelioma with metastatic growths in liver of a Lilford crane and myxosarcoma in the liver of a goose.

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Indian vet J. 58. July, 1981 : 585

PATHOLOGY OF ASCARIASIS IN A PEA FOWL *(PAVO CRISTATUS)* CAUSED BY *ASCARIDIA PERSPICILLUM* RUDOLF 1803

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A male pea fowl chick aged about 6 months died after showing signs of diarrhoea. At necropsy, the liver was found friable and pale in colour with multiple greyish-white necrotic foci on the surface and in the substance. Two adult ascarids identified as *Ascaridia perspicillum* were found partially embedded deeply into the parenchyma. There was a rough nodular elevation on the mucosal surface of proventriculus. Intestines revealed acute catarrhal enteritis associated with a number of ascarids.

Histologically, the hepatic lesions consisted of bile duct invasion of adult nematodes resulting in purulent cholangitis (Fig.). The bile duct walls were often thickened due to infiltration with reactionary cells consisting predominantly of lymphocytes and plasma cells and a few heterophils. In addition, multiple suppurative foci weje encountered throughout the parenchyma. Proventriculus exhibited severe catarrhal inflammation and hyperplastic changes of the mucosal epithelial cells. The tissue reactions in the intestines included destruction of the superficial mucosal lining and crypts and infiltration with inflammatory cells consisting of lymphocytes, monocytes and plasma cells. The lamina was oedematous while submucosal blood vessels were markedly congested.

Remarks : The pathology of ascariasis in pea fowl caused by *Ascaridia perspicillum* is akin to that of chicken caused by *Ascaridia galli*. The purulent reaction in liver is possibly due to enteric bacteria accompanying the parasite.

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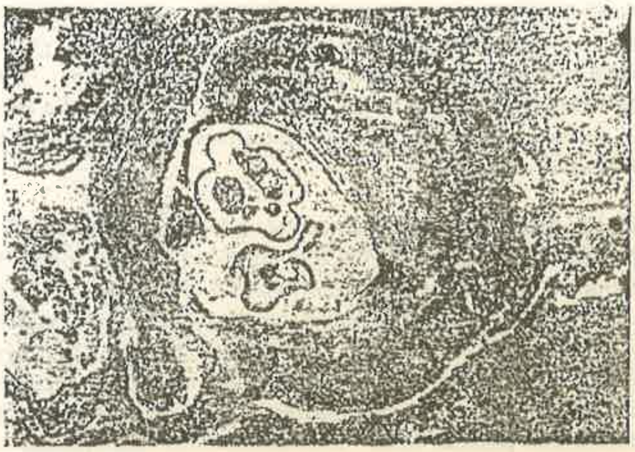
** Directorate of Animal Husbandry and Veterinary Services, Orissa, Cuttack.

Pathology of Ascariasis in a pea fowl (*Pavocristatus*) caused by *Ascaridia perspicillum* Rudolf 1803

A. T. Rao, L. N. Acharjyo and M. M. Patnaik



Liver showing cross section of parasite and purulent cholangitis H & E

Indian vet. J. 59. March, 1982 : 177-180

SPONTANEOUS NEOPLASMS IN MOSCOVY DUCKS AT NANDAN KANAN ZOO

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In an earlier report, the incidence of different spontaneous neoplasms in the family Anatidae and Gruidae at Nandan Kanan Zoo has been recorded (Rao and Acharjyo, 1980). A total of 18 neoplasms were earlier recorded since 1967 in zoo birds. The present communication records the data of different types of neoplasms involving serous surface, lungs and liver in moscovy ducks.

History

Two moscovy ducks were purchased from a local bird dealer and were exhibited for the first time in the zoo on January 1, 1970. Six more were procured on January 25, 1973. From this parent stock, fertile eggs were incubated artificially and 31 ducklings were successfully reared in the zoo. All these birds were kept in an enclosure having chain link fence wall. A spacious water tank had been provided for the birds to swim about freely. They were fed with commercial poultry feed (Agro Industries) with addition of extra pulses, grains, soaked paddy and greens.

Results and Discussion

The results of the studies are given in Tables 1, 2, and 3.

Table 1—*Details of necropsies performed and tumour bearing birds at Nandan Kanan Zoo during the period from July 12, 1961 to March 31, 1979*

Sl. No.	Kind of bird	No. of necropsies performed	No. of tumour bearing birds	Per cent
1.	Moscovy Ducks	25	10	40 00
2.	Ducks in general	221	15	7.00
3.	Birds in general	1150	28	2.04

Table 2—*Proportionate cause specific mortality for tumours in moscovy ducks*

Total population	Total No. died	Percentage mortality	No. of deaths due to tumours	Proportionate cause specific mortality rate for tumours
39	25	63.6	10	40

2

Table 3—*Epidemiological data of neoplasms in Moscovy ducks at Nandan Kanan Zoo*

Sl. No. (1)	Sp. No. (2)	Age in years (3)	Sex (4)	Date of death (5)	Organs involved (6)	Lesions: Gross (7)	Lesions: Microscopic (8)	Diagnosis (9)	Remarks (10)
1.	225	5	M	1-2-77	Left lung	Greyish white nodule	Cuboidal/columnar cells in acinar/solid pattern. Lymphoid cell infiltration in the form of follicles.	Bronchogenic carcinoma	—
2.	231	5	F	5-5-77	Liver and lungs	Markedly enlarged liver and greyish-white nodules in lungs	Proliferating bile ducts in form of tubules/acini with papillary projections	Cholangiocellular carcinoma	Cirrhosis
3.	277	7	M	16-5-78	Peritoneal cavity and lungs	Fleshy growths in the peritoneum with nodular growths in lungs.	Mesothelial cells in acinar pattern. Metastasis in lungs.	Mesothelioma	Cirrhosis
4.	264	5	F	2-7-78	Thoracic cavity and lungs	Massive fleshy growths in peritoneum with extension into lungs.	Same as 277	Mesothelioma	Ascites, cirrhosis & biliary hyperplasia.
5.	272	7	F	4-6-78	Right lobe of liver	Markedly enlarged liver, irregular in shape with nodules.	Dilated vascular spaces lined by endothelial cells	Haemangioma	Ascites

Table 3—Contd.

6.	269	5-6	F	21-8-78	Thoracic cavity and lungs	Large areas of thoracic cavity were occupied by neoplastic growths. 80 % of lung parenchyma was replaced by tumour.	Neoplastic cells in solid acinar or papillary pattern oriented around bronchioles	Broncho-genic carci-noma	Fatty liver with cirrhosis, ovary non-functional, heart atro-phied
7.	271	7	M	9-9-78	Thoracic cavity, lungs and liver	Entire thoracic cavity was filled with nodular fleshy growths which were seen extending anteriorly. The pleura was studded with nodular growths of different sizes. Both lungs consolidated. Left lobe of liver markedly enlarged and bile tinged.	Mesothelial cells in acinar papillary/solid pattern. The tumour was highly vascular with dilated capillaries	Mesothe-lioma	Ascites and cirrhosis
8.	273	7-8	M	27-9-78	Lungs	Nodular growths in both lungs	Same as 269	Broncho-genic carci-noma	Cirrhosis and non functio-nal ovary.
9.	270	8	M	20-1-79	Thoracic cavity, perito-neal cavity, liver and breast muscles	Muscular growths in peritoneal and thoracic cavities	Cuboidal cells in form of acini or solid pattern supported by stroma	Mesothe-lioma	Ascites and cirrhosis
10.	304	6	M	10-7-79	Lungs	Nodular growths in lungs.	Same as 269	Broncho-genic carci-noma	—

During the past 13 years, 2.04 per cent of the total birds necropsied were found to be tumour bearing, of which the ducks in general and moscovy ducks in particular, were more frequently affected than others. Though the average life span of moscovy ducks, particularly in captivity under Indian conditions is not available, the so-called "cancer age" for this species appears to be 5-8 years. Males and females appear to be more or less equally susceptible for tumours.

As is seen from these observations, zoo birds, particularly moscovy ducks, provide an excellent experimental model for study of tumour incidence if they are allowed to live their whole life span unlike domestic birds.

Among the neoplasms recorded, mesothelioma and bronchogenic carcinoma were common. It was opined that chronic irritation (as suggested by Boyd, 1970 for mesothelioma among asbestos insulation workers) coupled with possible atmospheric (Snyder and Ratcliffe, 1966) and water pollution (Beer, 1958) might be acting as contributory factors for high incidence of tumours as the zoo is located near a glass factory. It is quite likely that moscovy ducks might be more susceptible to irritants and contaminants emanating from the factory. Association of cirrhosis in majority of cases possibly supports this hypothesis.

Acknowledgments

Due acknowledgements are given to the Dean, Orissa Veterinary College, Bhubaneswar ; Head of the Department of Pathology, Orissa Veterinary College, Bhubaneswar and the Wild Life Conservation Officer, Orissa, for providing facilities.

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Indian vet. J. 60, March, 1983 : 237-239

OCCURRENCE OF FOOT-AND-MOUTH DISEASE AMONG SOME WILD UNGULATES IN CAPTIVITY*

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Foot-and-mouth disease is a contagious viral infection of cloven-footed domestic and wild mammals (Fletch, 1970). A recent review of this disease in African wild game states that at least 29 different species are susceptible (Anon, 1963). Sinha (1975) while reviewing its occurrence among wild animals of India reports that its occurrence in India is country-wide and has been reported from Andhra Pradesh, Karnataka, Madhya Pradesh, Hazaribagh and Palamu in Bihar, Indo-Nepal border, Kashmir, Himalayan Ranges and in Taroba National Park in Maharastra. Its occurrence among Saiga antelopes has been reported by Boiko *et al.* (1974) and the virus isolated was subtype A22. Mukhopadhyay *et al.* (1975) isolated F.M D virus (Type A) from Nilgai ; Neugebauer (1976) in Zebu cattle and Tibetan black-bear and Prasad *et al.* (1978) from Yak (Type-O). However, the occurrence of the disease in captive ungulates from this country has been rarely reported.

This communication reports the occurrence of foot-and-mouth disease in wild ungulates in captivity at Nandankanan Biological Park, Orissa.

An outbreak of foot-and-mouth disease was recorded in the month of December, 1978 in Nandankanan Biological Park, Orissa. The disease first appeared in Blackbucks on 7-12-1978 and then was detected in Spotted Deer and Sambars. Though Barking Deer, Hog-Deer and Indian Wild Boars remained adjacent to the enclosure of Blackbucks, they did not show any symptoms of foot-and-mouth disease. The species of wild ungulates maintained in the Park were Sambar, Blackbuck, Spotted Deer, Hog-Deer, Barking Deer, Indian Wild Boar, Four-horned Antelope, Gaur or Indian Bison and Mouse-Deer. The species of ungulates affected were Sambar, Blackbuck and Spotted Deer and they showed the lesions of foot- and-mouth disease in tongue, muzzle and hooves. The number of cases recorded were 25 over population at risk 113, the morbidity rate being 22.1%. The number of deaths recorded were 5, two in Blackbucks, two in Spotted Deer and one in Sambar. The outbreak was of moderate type and the animals affected had no history of vaccination before the onset of the outbreak. The materials collected in duplicate samples from the affected animals were tongue epithelium and heart muscles and sent to the Regional Typing Centre, Calcutta and Central Laboratory, I.V.R.I., Mukteswar for typing of the virus.

This outbreak continued upto 14-12-1978. The minimum incubation period was one day and the maximum was 7 days. The total number of cases recorded were 25, nineteen

* This work was carried out under the All India Co-ordinated Research Project for Epidemiological Studies on F.M.D., Orissa Veterinary College, Bhubaneswar-3.

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Number of animals of risk and number affected in the Park

Sl. No. 1	Species 2	No. at risk 3	No. affected 4	Morbidity rate 5	No of deaths 6	Remarks 7
1.	Sambar (*Cervus unicolor*)	34	6	17.6%	1	The animals were not vaccinated before the onset of outbreak.
2.	Spotted Deer (*Axis axis*)	16	4	25%	2	
3.	Hog-Deer (*Axis porcinus*)	5	—	—	—	
4.	Barking Deer (*Muntiacus muntjak*)	13	—	—	—	
5.	Mouse-Deer (*Tragulus meminna*)	1	—	—	—	
6	Blackbuck (*Antelope cervicapra*)	28	15	53.5%	2	
7.	Fourhorned Antelope (*Tetracerus quadricornis*)	4	—	—	—	
8.	Gaur or Indian Bison (*Bos gaurus*)	1	—	—	—	
9.	Indian Wild Boar (*Sus scrofa cristatus*)	11	—	—	—	
	Total	113	25	22.1%	5	

primary and six secondary cases. The virus type isolated was "0" type of F.M.D. virus. Based on the epidemiological data, the following conclusions were arrived at :

$$\text{Incidence rate} = \frac{25}{113} \times 100 = 22.1\%$$

$$\text{Secondary attack rate} = \frac{6}{113-19} \times 100 = 6.4\%$$

$$\text{Case fatality rate} = \frac{5}{25} \times 100 = 20\%.$$

The source of infection was an outbreak of F.M.D. in other cattle nearer to the Park, where the same type of virus was isolated and the infection was possibly transmitted to the ungulates through the human attendants. It appeared that both cattle and wild ungulates were equally susceptible to virus of this type.

Acknowledgement : The authors are thankful to Indian Council of Agriculture Research for providing funds and facilities to carry out this work. They are also thankful to Sri Ch. G Mishra, Wildlife Conservation Officer, Orissa, for the facilities provided during the course of investigation.

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CAUSES OF MORTALITY IN PEA-FOWLS (*PAVO CRISTATUS*) AT NANDANKANAN ZOO

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The incidence and distribution of diseases in pea-fowls is poorly understood. A few records of diseases concern mainly individual cases and no consolidated information is available. The purpose of this communication is to throw some light on the common causes of mortality in captive pea fowls at Nandankanan.

The materials for this study were based on detailed necropsy examination coupled with histopathological studies attempted on 100 pea-fowls belonging to different age groups of either sex, the data of which were collected during last 2 decades. Particulars of age and sex-wise incidence of mortality due to various causes have been given in the Table.

It is seen from the Table that mortality rate is maximum in young chicks upto 6 months of age and in aged birds above 5 years. Pneumonia is an important cause of death in all groups while chronic diseases like neoplasms and gout are of importance in older birds.

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Causes of mortality in different age groups of pea-fowls of either sex

Cause of mortality	0-3 months		3-5 months		6 months-1yr		1-2 yrs		3-4 yrs		5-8 yrs		Remarks
	M	F	M	F	M	F	M	F	M	F	M	F	
1. Pneumonia	3	12	—	—	—	1	—	2	—	1	2	11	
2. Ascariasis	—	1	—	—	1*	—	2	—	—	—	—	—	* Adult ascaris found in liver
3. Coccidiosis	—	—	3	3	—	—	—	—	—	—	—	—	
4. Non-parasitic enteritis	1	3	—	—	—	—	1	—	—	—	1	—	
5. Unabsorbed egg yolk	1	—	—	—	—	—	—	—	—	—	—	—	
6. Intussusception proventriculus	—	—	—	—	—	—	1*	—	—	—	—	—	* Associated with suppuration
7. Crop distention	—	—	—	—	—	—	1	—	—	—	—	—	
8. Traumatic pericarditis	—	—	—	—	—	—	1*	—	—	—	—	—	* Caused by penetration of a nail
9. Proventriculitis	1	1	3*	—	—	—	—	—	—	1	—	—	* Associated with Tetrameres in one case
10. Traumatic ventriculitis	—	—	—	—	—	—	—	—	—	—	1	—	Sharp stick injury
11. Visceral gout	—	—	—	—	—	—	—	—	—	—	2	1	Involvementof kidneys and all serous surfaces
12. Bronchogenic carcinoma	—	—	—	—	—	—	—	—	—	—	1	2	
13. Lymphoid leucosis	—	—	—	—	—	—	—	—	—	—	4	1	Involvement of liver, heart, spleen, kidney and proventriculus
14. Cannibalism	1	—	—	—	—	—	1	—	1	—	1	1	
15. Eaten by predator/ death due to traumatic injuries	1	2	—	1	—	—	1	—	—	—	3	3	
16. Stress due to transport	—	—	—	—	—	—	—	—	—	—	1	—	
17. Heat stroke	1	6	—	—	—	—	1	—	—	—	—	3	
18. Undetermined	2	—	—	—	—	—	—	—	—	—	—	—	

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OBSTIPATION IN A LEOPARD (*PANTHERA PARDUS*)

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Intestinal obstruction has been reported to occur in canines mostly due to foreign bodies (Easeley, 1974). Amongst the incriminating materials, involvemet of bone is very frequent for causing impaction of faecal material at colon (Archibald and Horney, 1965). Mohanty *et al.* (1960) reported obstruction in an Alsatian dog caused by fish bones, some of which were penetrating into the intestinal wall. Obstipation at the colonic region has been ascribed to foreign material, neurologic disorder and debility (Burrows, 1980) Report of intestinal obstruction in wild animal is very rare. Zenoble *et al.* (1982) have described a case of gastric impaction in a tiger which died after surgery due to pulmonary oedema. This paper discusses a very unusual case of intestinal obstruction in a leopard.

Case History

The patient was a 10 year old female leopard (*Panthera pardus*) belonging to the Nandan Kanan Zoo, a biological park of Orissa. On 17th September 1983. the leopard was observed to be straining for defaecation. She did not take any food. Next day, the same condition persisted. She took some food on 19th, even though occasional straining was continuing. She was given 3 tabs. of Bisocodyl[1], three analgesic tablets[2] and three tablets of antacids[3]. However the animal did not defecate.

Clinical examination and follow up treatment :

The leopard was brought to the Intensive Care Unit on 2 st Sept. and was kept in a squeeze cage. Soap water enema was given and it was repeated next day without any result. Only some brownish coloured fluid with sand particles came out. Electrolytes in drinking water and B. complex injection were given.

There was rise of temperature (103°F) on 24th Sept. Treatment for next three days consisted of Analgin[4] and Vitamin B. Complex injections and oral electrolytes. On 27th ag in laxative tab[5]. (4tab.) was repeated along with an enzyme[6] preparation. Sepcialists from Veterinary

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1 Dulcolax enteric coated tablet containing Bisocodyl-M/S German Remedies.
2 Ultragin tablet containing analgin, paracetamol and calcium-M/S Geofrey Manners.
3 Diavol containing Aluminium hydroxide, Magnesium carbonate, Magnesium hydroxide and Dimethyl polysiloxane-M/S Carter Wallace.
4 Novalgin-containing analgin-M/S Hoechst Pharmaceuticals.
5 Dulcolax tab.-containing Biscodyl. M/S German Remedies.
6 Bestozyme Syrup-containing Diastase, Papain and B. Complex. M/S Biological Evans.

11

College examined the animal on 29th. Abdomen was found to be tense. Straining persisted with occasional mucoid discharge. It was diagnosed as a case of intestinal obstruction. Following therapy was advised for 5 days.

Ringer's Lactate solution – 250ml s/c daily.

Electral powder in drinking water.

Enzyme preparation in drinking water

Gentamycin[7] - 2ml i/m twice daily for 3 days.

Vitamin B_1, B_{12}, B_6[8] injection i/m for 5 days.

Liver extract[9] i/m on alternate day

Laxative[10] preparation 50ml orally twice a day

Since there was no improvement, surgery was resorted to on 4.10.84.

Surgical Treatment

Triflupromazime hydrocloride 140mg was given intramuscularly followed by local infiltration of lignocaine (2%) at the right flank, with the animal controlled in the squeeze cage. Necessary pre-surgical preparations were done. Skin, the abdominal muscles and peritoneum were incised vertically for a length of 12 cm. Palpation of the abdominal contents revealed a segment of color distended with stool. (Fig. 1) Distended portion of colon was brought out through the abdominal incision. Stool masses took the shape of balls, each with a diameter of 10cm. Seven such balls were removed through an intestinal incision of 12cm. by gentle manipulation (Fig. 2). The site of operation was approached from outside and all the manipulations were performed by introducing the hand through the space between two contiguous bars of the cage. The opening in the intestine was closed by one layer of Cushing using chromic catgut No.1. Peritoneum and abdominal muscles were sutured with chromic catgut. Skin was closed with nylon. Healex spray was given over the skin suture.

Postoperative Treatment

Postoperatively following medication was offered Dicrysticins[11] one small vial twice daily for 5 days followed by one vial daily for 2 days.

Dexamethasone[12] - 1ml i/m at two hour intervals-two injections during early postoperative period.

7 Lisarin–containing Gentamycin. M/S Sarabhai.
8 Neurobion–containing Vit. B_1, B_{12}, B_6. M/S Merk, Sharp and Dhome.
9 Eelamyl-Liver extract preparation. M/S Sarabhai.
10 Cremaffin–containing Liquid paraffin and milk of magnesia. M/S Boots India.
11 Dicrysticins 'HS'–containing penicilin and streptomycin. M/S Sarabhai.
12 Decadron–containing Dexamethasone. M/S Merk, Sharp and Dhome.

Obstipation in a leopard (*Panthera pardus*)—

J. Mohanty, L. N. Acharya and A. K. Mohanty

Fig. 1 Through the right flank abdominal incision the intestinal mass is being palpated.

Fig. 2 Impacted faecal masses have been removed through an incision 12 cm. long over the colon.

Novalgin 3ml i/m.

Ringers lactate solution 200ml s/c.

Neurobion injections were continued from 5th Oct. for a fortnight on altrernate days. Electrolyte[13] powder in drinking water was used to be given on all these days. A plasma expander[14] was given for two days.

The leopard started taking food from 7th October. Normal defaecation was resumed from 11th October. Enzyme with vit C was given daily with cremaffin for a week.

After removal of suture, the leopard was left in her permanent enclosure on 22nd October, 84.

Discussion

The leopard being an old animal had probably a nervous debility which resulted in chronic constipation and formation of hard stool masses. Once the hard mass got obstructed, there was no chance of improvement even though all types of medications including nervine tonics were administered According to Burrows (1980), injestion of bones, foreign material or hair may result in large colonic faecal concretions which the animal cannot eliminate. Defecation becomes progressively more difficut as these masses slowly develop and if unnoticed and untreated, they may eventuate in obstipation.

Since Ketamine was not available it was decided to carry out the operation under deep sedation and local infiltration anaesthesia after restraining the animal in squeeze cage. Except very rare occasional struggling, the patient remained under analgesic influence throughout the period. The stage of sedation though gradually became light, continued for two days. This was because the animal was without food for 15 days and the dose of Trifiupromozine was also heavy.

Postoperatively, nervine tonics, laxatives and digestives were continued to relieve the pressure over the suture line of the intestine. After complete satisfaction about the animal's condition, the leopard was left in her normal enclosure for ensuring a natural surrounding and some exercise which was almost absent in the squeeze cage.

Summary

A female leopard suffered from obstipation due to faecal concretion in the region of colon. There was no response to medicinal treatment. Enterotomy was performed after 15 days of obstruction. Satisfactory recovery occurred in 17 days.

13 Electral–containing electrolytes and glucose-M/S Fairdeal Corporation.
14 Haemacil–containing gelatin for intravenous administration-M/S Hoechst Pharmacuetical.

Acknowledgement

The authors are highly obliged to Shri S.K. Patnaik, I.F.S. Wild Life Conservation Officer, Orissa and his associates for all the facilities and help provided to carry out the treatment.

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Indian vet. J. 63. September, 1986 : 780-781 Short communications

NECROPSY LESIONS IN THREE REPTILES AT NANDANKANAN ZOO

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In India, diseases and causes of mortality in reptiles are poorly understood. Only scattered reports of some snake diseases like impaction (George 1965), *Arizona* infection (Sharma *et al.* 1970), pneumonia (Das and Angelo, 1970), corynebacterial and pseudomonas infection (Rao *et al.* 1980) and salmonellosis (Misra and Verma, 1981) are available. Mohanty *et al.* (1980) successfully reduced a prolapse of genitals in a gharial. Rao and Acharjyo (1981) reported the pathology of *Ophidascaris* infection in a python. This paper records the causes of mortality in 3 different species of reptiles at Nandankanan Zoo.

Case—I

A female salt water crocodile (*Crocodylus porosus*) died on 25.1.82. The animal had been anorectic for 15 days prior to death. At necropsy, the myocardium contained haemorrhages. The stomach was distended and contained numerous stones, sand and lumps of earth. The mucosa revealed numerous dirty white circumscribed or star shaped ulcers (Fig. I). The wall of the stomach revealed multiple haematomas.

Histologically, the sections of stomach revealed numerous necrotic ulcers involving the mucosa and submucosa. The inflammatory cells consisted of mononuclear cells, plasma cells and foreign body giant cells bordering the necrotic area which contained clumps of bacterial colonies. The markedly congested blood vessels in the muscular coat had perivascular infiltration of mononuclear cells. At some places in the muscular coat, there were extensive haemorrhages. Sections of heart revealed focal haemorrhages among the disrupted and degenerated myocardial fibres. Death in this animal was attributed to cardiomyopathy.

Case—2

A female yellow monitor (*Varanus flaviscens*) died on 9.1.82. This animal had an earlier history of gangrenous dermatitis of the hind foot. At necrospsy, the lungs were congested. The surface and substance of liver revealed numerous pin head sized greyish-white foci uniformly distributed throughout the organ (Fig. 2)

Histologically, the sections of liver revealed numerous granulomas with central caseonecrotic tissue surrounded by mononuclear cells and foreign body giant cells. The sections were negative for bacteria and fungi in Gram, Zeihl-Neelsen's carbol fuchsin and periodic acid-schiff stained slides. Death in this animal was attributed to necrotic hepatitis.

Case—3

Female Star tortoise (*Geochelone elegans*) died on 14.1.82. At necropsy, the Harderian gland revealed inspissated pus. Liver was enlarged and congested. The lower third of intestines was cyanosed, distended and impacted with large number of hard seeds, stony material and straw (Fig. 3). Death was attributed to intestinal impaction.

Of all the organ systems, the intestinal canal of reptile is most exposed to the disease (Reichanbach-Klinke and Elkan, 1955). Hunt (1957, has reported that 40 per cent of the deaths in reptiles were due to diseases of the gut. Faulty feeding and lack of exercise were responsible for such diseases in captive reptiles. Hunt (1956) also reported a case of intestinal obstruction in *Pseudemys scripta elegans* due to ingestion of *Curica papaya* seeds. The large intestine was stretched to capacity and on the point of rupturing. Similar observations have been made in the present report in case of crocodile and tortoise which died due to gastro intestinal disorders resulting from pica which perhaps developed due to nutritional errors. According to Reichenbach-Klinke and Elkan (*loc cit.*), white foci in liver of reptile were due to sporozoan/tubercular/fungal infections and malignancy. None of these causes were traced in case of the yellow monitor.

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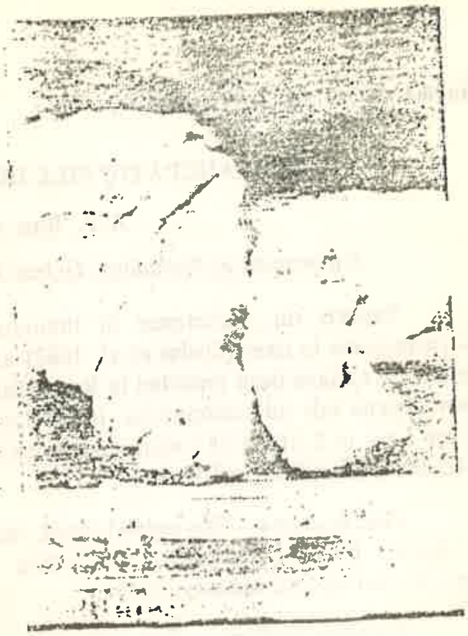

Fig. 1. Stomach of a salt water crocodile showing gastric ulcers

Fig. 2. Liver of a land monitor showing numerous necrotic foci

Fig. 3. Intestine of a star tortoise showing impaction

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INTRAHEPATIC BILE DUCT CARCINOMA IN A TIGRESS

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Reports on occurrence of tumours in tigers are meagre. From India, cavernous haemangioma in liver (Sivdas *et al.* 1963) and sweat gland carcinoma of lower eyelid (Basak *et al.* 1976) have been reported in Royal Bengal tigers. This paper places on record a case of intrahepatic bile duct carcinoma in a tigress "Ganga", a normal coloured tigress which had given birth to 2 litters of 5 white tiger cubs when mated with another normal coloured tiger of Nandankanan Biological Park.

Case history : This animal aged nearly 11 years was found anorectic a fortnight prior to death. She was observed to be losing weight and body hairs. In spite of treatment the animal died on 2nd January, 1986.

Necrospy findings : The peritoneal cavity contained about 2 litres of straw-coloured fluid. The liver was abnormally enlarged and showed numerous dense, multinodular cauliflower-like-greyish white growths measuring 2-8 cm in diameter over the surface and in the substance. Both the lungs revealed similar nodules measuring 1-3 cm in diameter. There were numerous wedge-shaped pale areas visible through the cortex of the kidney. The intestinal wall was studded with numerous fibrous nodules while the heart and subcutaneous tissues contained numerous *Dirofilaria immitis* and *Dirofilaria repens*, respectively.

Histopathology : The tumour tissue in liver consisted of single/multi-layered, cuboidal/columnar cells with round vesicular nuclei and clear/granular cytoplasm resembling bile duct epithelium (Fig.). There was regular formation of acini having lumens.

The tumour cells were arranged as acini having lumens or occasionally as cords and the growth was identified as intrahepatic bile duct carcinoma as described by Ponomarkov and Mackey (1976). The growths in the lung resembled the primary lesion histologically. In addition, the sections of heart showed suppurative myocarditis while the kidney showed multiple infarcts. Sections of intestines showed numerous fibrous nodules containing parasites in cystic spaces which were identified as *Galonchus perniciosus*.

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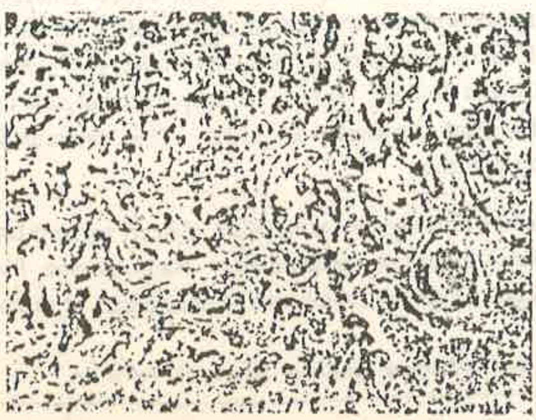
Intrahepatic bile duct carcinoma in a tigress—A.T. Rao and L.N. Acharjyo



Tumour tissue showing formation of acini lined by cuboidal cells—(H&E)

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SARCOCYSTOSIS IN SOME INDIAN WILD RUMINANTS

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Sarcocystis forms cysts in the muscles of intermediate hosts like herbivores, reptiles, birds and smalls rodents, Among wild animals, sarcocystis infection has been reported in the cardiac muscles of Indian lions (Bhatavdekar and Purohit, 1963), wild deer, moufflon and chemois from Czekoslavakia and artiodactyla of various species from East German zoos and game preserves (Ippen *et al.*, 1974), mule deer. virginia deer, sika deer and fallow (Blazek *et al.*, 1976), tongue and skeletal muscles but not oesophagus and cardiac muscles of nine banded armadille (Howells *et al.*, 1975), mule deer (Hudkins-Vivion *et al.*, 1976 and Koller, 1977), oesophagus and myocardium of Indian gaur (Welch and Zimmer, 1981) and in oesphagus but not in heart and skeletal muscles and diaphragm of a goral (Agarwal *et al.*, 1982). This communciation records cases of sarcocystosis in some wild ruminants.

This study was based on histological examination of heart sections from 128 wild ruminants belonging to 10 species of ruminants which died at Nandankanan Biological Park, Orissa during 1967-1984. The details of species examined and occurrence of sarcocysts are given in the table.

Table—*Showing details of sarcocystis infection.*

Sl.No.	Name of the species	No. examined	No. positive for sarcocysts	Associated Pathological condition
1	Sambar	18	1	Pulmonary Tuberculosis
2	Nilgai	8	1	Bluetongue like disease
3	Four-horned antelope	7	1	Arterial Oncoerciasis
4	Mithun	1	1	Pneumonia

In all the 4 species, numerous sarcocysts with clearly demonstrable cell wall containing spherical, ovoid, eliptical to typical banana shaped bradyzoites were seen in myocardial fibres and Purkinje fibres without reactionary cells around them. The bradyzoites measured 10-14 microns in length and 3-4 microns in with. It is opined that these animals might have acquired the infection through ingestion of feed contaminated with the faeces of carnivores as suggested by Welch and Zimmer (1981).

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NODULAR HYPERPLASIA IN THE LIVER OF SOME WILD RUMINANTS AT NANDANKANAN ZOO (ORISSA)

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The prevalence of nodular hyperplasia in the liver of Hog-deer and Nilgai has been briefly reported as there is lack of information in the literature on this condition in wild ruminants.

During the investigation of commonly occurring diseases in nine species of Indian wild ruminants at Nandankanan zoo, Orissa, for the period 1967-1984. 127 animals were subjected to detailed gross histopathological studies. Tumour-like lesions in liver were observed in 9 of the 11 Hog-deer and 2 of the 8 Nilgai examined.

In all the cases, necropsy lesions were prominently seen in liver. The surface and substance of the greenish tinged liver presented numerous greyish white, circumscribed soft nodular elevations measuring 2-5 cm in diameter which were sharply demarcated from the adjacent normal parenchyma. Some of the smaller nodules had coalesced to form bigger ones. Histologically the nodular lesions revealed loss of normal lobular architecture. The radiating hepatic cords and central veins were absent. The hepatic cells which were usually larger than the normal ones (Fig) had variable shapes and sizes with single or multiple hyaline bodies resembling Mallory's bodies. The sinusoids were dilated and contained fibrinoid materials. The periportal tissue including the portal veins and hepatic arteries was formed but the bile ducts were conspicuously absent while the hepatic cells adjacent to the nodules were atrophied.

Nodular hyperplasia is one of the common senile changes of obscure etiology in old dogs (Moulton, 1961; Jubb and Kennedy, 1970 and Ponomarkov and Mackay, 1976). It is, however, rarely reported in other animals. According to Jubb and Kennedy (*loc cit.*) hyperplastic nodules in liver are associated with prolonged but mild fatty changes which may lead to hepatocellular carcinomas. The morphological pattern of lesions described herein are similar to those described for nodular hyperplasia in the liver of dogs. These lesions are difficult to distinguish from hepatic adenomas as has been suggested by Jubb and Kennedy (1970). It is interesting to note that these lesions have not been detected in other types of wild ruminants although they are maintained under identical conditions.

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Nodular hyperplasia in liver of some wild ruminants at Nandankannan zoo – L. N. Acharjyo and A. T. Rao

Note the variable sizes and shapes of hepatic cells in nodular hyperplasia-Hog-deer. H-E

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GOUT IN AVIANS AT NANDANKANAN BIOLOGICAL PARK

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Gout is frequently seen in gallinaceous birds, budgerigars and water fowl, to a lesser extent in parrots and less frequently in pigeons. Sporadic cases or even outbreaks of gout can occur in many species (Arnall and Keymer, 1975) particularly in laying females (Hoff and Davies, 1982). Kronberger and Schuppel (1977) stated gout was an important cause of death in birds of Leipzig zoo during 1957-1976. Damodran *et al.* (1978) reported generalised gout in sarus crane, 2 morning cranes, 2 demoiselle cranes, sulphur crested cockatoo and a pea hen from Madras zoological gardens. This communication reports the incidence and pathology of gout in 10 captive birds (geese-5, pea hens-2, ring necked pheasant, black swan and guinea fowl-one each) out of about 1,600 examined routinely during necropsy at Nandankanan ,Biological park from 1967-1987.

Kidneys were always affected followed by serous surfaces of heart and liver (5 cases), pleura (1 case) and joints (2 cases). In the affected birds which were all adults, the serous surfaces were covered with chalky white crystals of urates whereas the kidneys were swollen, light in colour having distinct tubular markings and marked distention of ureters with urates. Histologically, the lining epithelial cells of the numerous tubules had tendency to confluence and nuclei were pyknotic and fragmented. Frequently there was caseation necrosis with characteristic empty spaces formed as a result of dissolution of urate crystals during processing. The necrotic areas ,were surrounded by lymphocytes, plasma cells, macrophages and gaint cells. There was extensive periglomerular, peritubular and perivascular fibrosis.

According to Hoff and Davies (*loc. cit.*) the incidence of gout in captive wild birds is usually low which has been confirmed at this zoo (about 0.62%) during close scrutiny for the last 20 years in comparison to 6.3% reported by Kronberger and Schuppel (*loc. cit.*) at Leipzig zoo. One of the predisposing factors for the condition may be inactivity of the birds due to captivity as has been suggested by Arnall and Keymer (*loc. cit.*). In the ring necked pheasant, gout has been attributed to vitamin A deficiency because of pustular eruptions observed in oesophagous due to squamous metaplasia of submucous glands. The confusion of visceral gout at necropsy with some diseases like aspergillosis, colibacillosis, mycoplasmosis and egg peritonitis can be eliminated by histopathological examination.

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PARAGONIMIASIS IN SOME WILD CARNIVORES AT NANDANKANAN

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Paragonimus westermanii was reported in Bengal tigers of Hamburg and Amsterdam zoological gardens (Sipley, 1905), leopards and tigers in China (Wu, 1938-1939) and opposum from United States of America (Byrd *et al.*, 1941). From India, these parasites in wild animals were recovered from lungs of tigers (Mudaliar and Alwar, 1947; Schaller, 1967), Himalayan Pine marten (Malaki, 1960) and clouded leopard (Hiregauder and Petkar, 1970). During routine necropsy and histopathological examination conducted on carnivores at Nandankanan Biological park, Orissa during 1967-1987, *P. westermanii* have been recovered from 2 tigers, 4 mongooses and a golden cat and a brief pathology is furished hereunder.

At necropsy, cysts containing one or more reddish brown oval shaped flukes were seen in one or both the lungs. The affected lungs showed patches of atelectasis and emphysema. In the tigers, the interalveolar septae were thickened due to infiltration of mononuclear cells, while the alveolar lining cells were hypertrophied. In the golden cat, in addition, the bronchioles showed squamous metaplasia of mucus secreting glands in the submucosa and peribronchial lymphoid hyperplasia. In the mongooses, there was no inflammatory reaction around the cysts. The lesions described herein were similar to those described by Jones and Hunt (1983).

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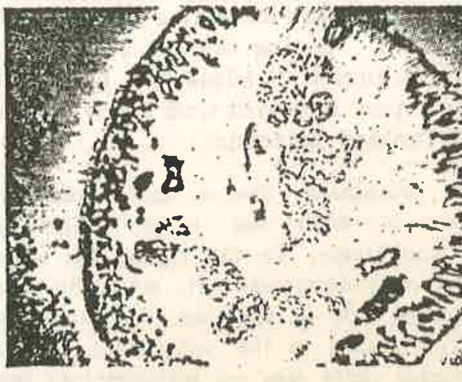

Section of lung of a tiger showing section of *Paragonimus westermani*

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ETIOPATHOLOGY OF MORTALITY IN INDIAN LESSER CATS AT NANDANKANAN BIOLOGICAL PARK

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Out of the 11 species of lesser cats available in India, 5 are generally exhibited in zoological parks; but information on diseases and causes of mortality in these species is extremely meagre (Patnaik and Acharjyo, 1970; Tripathy *et al.*,1971; Rathore and Khera, 1981). This paper reports comprehensive information on causes of mortality of the 5 species of lesser cats at Nandankanan Biological park, Orissa.

Materials and Methods

Data pertaining to date of birth/ arrival /death, age and sex are collected on all lesser cats-clouded leopard *(Neofelis nebulosa)*, golden cat *(Felis temmincki)*, Jungle cat (*Felis chaus*), fishing cat *(Felis viverrina)* and leopard cat (*Felis bengalensis*), maintained at the zoo from January 1961 to November 1989. The animals were broadly divided into 4 different age groups viz. neonatal (o day -1 month), 2 months- 1 year, 2-10 years and over 10 years; the seasons were divided into summer (March-June), rainy (July - October) and winter (November - February). The cause specific mortality was determined on the basis of history, pathoanatomical changes observed at necropsy and histopathological examination wherever found necessary.

Results and Discussion

A total of 109 deaths were recorded and the different causes alongwith age, sex and season specific mortality were tabulated (Tables 1 and 2). It was evident that highest mortality occurred in the first year of life particularly during neonatal period.

The mortality was generally more in male jungle cats than females and reverse was true in leopard cats, but in other species there was no significant difference. Maximum deaths in jungle cats occurred in winter

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followed by summer and rainy seasons whereas in leopard cats maximum deaths occurred during summer (Table 1). No such information is available for comparison from any Indian zoo. The mortality data revealed (Table2) that maximum deaths occurred in jungle cats followed by leopard and golden cats whose breeding performance was quite satisfactory, but majority of the newly born young ones were devoured by the parents particularly males because they were aggressive and they did not help in rearing young ones (Fowler, 1986). It was further stated that maternal neglect and cannibalism were common in felids as was observed in this study. The causes of death in other animals were numerous. Gastritis/ gastroenteritis, pneumonia and traumatic injuries caused significant losses, which was in accordance with the observations made by Rathore and Khera (1981). Though these authors reported tuberculosis, anthrax, pasteurellosis and feline enteritis in felines including lesser cats from different zoos of this country, these diseases were not encountered in the present study; the first disease had been rampant in different species of ruminants, primates, wild boars and occasionally avians and marsupials.

Table 1

Age, sex and season specific mortality in lesser cats

Specificity	Clouded leopard	Golden cat	Jungle cat	Fishing cat	Leop-ard cat
I Age group:					
Neonatal	-	9	30	-	11
2-12 months	1	2	12	1	14
2-10 years	1	2	9	2	5
over 10 years	4	2	2	1	1
II Sex:					
Males	3	7	31	2	13
Females	3	8	22	2	18
III Seasons:					
Summer		8	17	3	19
Rainy	3	5	13	-	8
Winter	3	2	23	1	4
Total	6	15	53	4	31

Table 2

Cause specific mortality

Sl No.	Cause	Clouded leopard	Golden cat	Junglle cat	Leopard cat	Fishing cat	Total
1.	Cannibalism	-	5	30	6	-	41
2.	Maternal rejection	-	4	2	5	-	11
3.	Gastritis/ gastroenteritis	-	1	4	9	2	16
4.	Pneumonia	1	1	4	2	1	9
5.	Traumatic injuries	2	1	-	2	-	5
6.	Septicaemia	-	-	4	1		5
7.	Heat Stress	-	1	1	2	1	5
8.	Nephritis	1@	1	3	-	-	5
9.	Still birth	-	-	2	-	-	2
10.	Pericarditis	-	-	1	2	-	3
11.	Oesophageal choke	-	-	1	-	-	1
12.	Verminous pneumonia	-	-	-	1	-	1
13.	Squamous cell caricinoma of lungs	-	1	-	-	-	1
14.	Diaphragmatic hernia	1	-	-	-	-	1
15.	Peritonitis	1	-	1	-	-	2
16.	Senility	-	-	-	1	-	1
Total		6	15	53	31	4	109

@ Associated with nonsuppurative meningitis

Leopard cat was considered as a new host species for *Filaroides osleri* incriminated for verminous pneumonia (*Rao et al.*, 1971). One of the jungle cats died of asphyxia due to choking of oesophagus by a dry mass of beef and in another there was diffuse peritonitis due to piercing of the intestine by a piece of splintered bone. A golden cat had died of squamous cell carcinoma of lungs with metastatic lesions in extensively fibrosed kidneys in addition to ulceration of buccal mucosa and calcification of gastric musculature perhaps due to uraemia. Concomittantly the right ventricle of heart and intestines were packed, respectively with *Dirofilaria immitis* and *Toxocara cati*. Another golden cat which died of gastroenteritis had also shown squamous metaplasia of the epithelial cells lining the bronchial mucosa due to *Paragoinimus westermanii* associated with peribronchial lymphoid cell hyperplasia. During routine clinical examination *Isospora felina*/(n.sp),*Isospora nandan kanani* (n.sp,)(Patnaik and Acharjyo, 1970), *Ancylostoma brasiliense and Ancylostoma caninum* from leopard cats,*Spirometra erinacea,Toxascaris leonina and Taenia* sp.from fishing cat, *Toxocara cati* from golden cat, *Toxocara cati, Spirometra erinacea, Euparyphium malayanum, Onicola* sp., *Toxocara mistac,* and *Toxascaris leonina* from jungle cat and *Spirometra erinacea and Taenia taeniaeformis* from clouded leopard were also recovered.

Summary

Analysis of data in relation to etiopathology of mortality in 109 Indian lesser cats of 5 species namely clouded leopard, golden cat, Jungle cat, fishing cat and leopard cat carried out during 1961-1989 revealed that highest mortality occurred in first year of life (73.5%) particularly during neonatal period (46%) mostly due to cannibalism and maternal rejection. Other important causes included pneumonia, nephritis, traumatic injuries and heat stress. A number of helminthic and protozoan parasites were recovered from tissues and faeces.

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CAUSES OF MORTALITY IN CARNIVORES OTHER THAN FELIDS AT NANDANKANAN ZOO

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There are 7 families in the Order Carnivora. Since the diseases and causes of death in tigers, lions and lesser cats (Rao and Acharjyo, 1993, 1994a, b) have already been dealt it is felt necessary to report a consolidated information on this aspect in other carnivores as the spectrum of diseases and causes of mortality are not only different but there is woeful paucity of Indian literature with only sporadic case reports of neoplasms (Sivadas *et al.*, 1968; Dutt *et al.*, 1972; Rajan *et al.*, 1973), parasites and parasitic diseases (Singh and Pande, 1966; Sengupta, 1974; Rathore and Khera, 1983) and other miscellaneous diseases (Nair *et al.*, 1964).

Materials and Methods

Data in relation to mortality of 102 carnivores belonging to 14 species of 6 families viz. Ursidae - sloth bear (*Mellurus urcinus*), 34; Canidae - wolf (*Canis lupus*), 5; jackal (*Canis aureus*), 1; wild dog (*Cuon alpinus*), 2; fox (*Vulpes bengalensis*), 4; Hyaenidae - hyaena (*Hyaena hyaena*), 10; Viveridae - large Indian civet (*Viverra zibetha*), 9; mongoose (*Herpestes edwardsi*), 5; binturong (*Arctictis binturong*), 6; Mustalidae - common otter (*Lutra lutra*), 13; hog-badger (*Arctonyx collariş*), 1; Himalayan pied marten (*Martes flavigula*), 2; ratel (*Mellivora capensis*), 5; and Procyanidae- red panda (*Ailurus fulgens*), 5; were collected from January, 1964 upto March, 1992 at Nandankanan Biological Park alongwith other informations like date of arrival/birth, age, sex and date of death. The specific cause of mortality was determined on the basis of history, pathological changes observed at necropsy and histopathological examination, wherever found necessary.

Ecto - and endo parasites were properly collected, wherever appropriate and despatched to Zoological Survey of India, Calcutta, for identification.

Results and Discussion

Bears (15), hyenas (6) and a wolf aged less than 6 months succumbed due to transport / captivity stress as there were no specific gross / histological changes in any vital organs. All the hyenas and five bears died within 2 - 7 days of captivity whereas others within 2-3 weeks. Two of

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the sloth bears exhibited intussusception of intestines of agonal nature without any inflammatory reaction while another had died of asphyxia caused by accidental tying of iron chain around the neck. Two of the hyena pups aged 2-3 weeks showed lesions associated with acute interstitial pneumonia.

Traumatic injuries leading to external/internal haemorrhages were common in most members of carnivores (Ratel-4; Otter-3; wild dog-2 and one each of bear, hyena, civet mongoose and marten) primarily due to infighting among its members. However, in yellow throated marten, the haemorrhages were due to piercing of 4 pieces of iron nails weighing about 18 g at multiple sites through stomach and intestines resulting in traumatic gastritis and peritonitis. One of the bears was sacrificed as it attacked the visitors. In an otter the spleen was enlarged by about 5 times its original size due to haematoma giving a false impression of neoplasm. One of the wild dogs had 4 parasites in coiled position in the right ventricle and were identified as *Dirofilaria immitis*.

Numerous ulcers of varying sizes were seen in the entire gastrointestinal tract surrounded by zone of congestion in 6 bears, 2 civets and one each of binturong and marten. In one of the bears numerous *Ancylostoma caninum* and in 2 civets *Echinoparyphium* sp. were recovered from the intestines. The etiology in others was, however, undetermined.

Intussusception in an otter and ratel was attributed to increased peristalsis resulting from catarrhal gastroenteritis. Death was attributed to intestinal obstruction in a binturong as a result of packing of large intestine with straw, in 2 civets impaction of large intestine with hard dehydrated faecal masses and consequent hind limb paralysis and prolapse of rectum and in a sloth bear to 2 elongated masses of trichobezoars and consequent colicky symptoms. All these animals developed gangrene of the intestines.

Numerous pulmonary abscesses of varying sizes in 2 sloth bears and a civet, interstitial pneumonia in 2 each of hyena pups and civets, exudative pneumonia in a binturong and 3 otters all of undetermined etiology were diagnosed on histopathological examination. Lesions associated with chronic nephritis were seen in a wolf, fox, jackal and a senile hyena and polycystic kidney in a mongoose and otter. In the fox, the lesions were associated with verminous pneumonia along with a large number of unidentified fluke eggs and in jackal with concurrent *D. immitis* and *A. caninum* infestation. Suppurative hepatitis was recorded in 3 binturongs and 5 red pandas. In the latter, the lesions resembled saw dust livers of cattle. In 2 binturongs turbid fluid measuring about 500 ml was seen in the peritoneal cavity due to numerous hepatic abscesses with metastatic lesions on diaphragm and peritoneum.

Death due to senility was recorded in a sloth bear and civet (>15 years), 2 hyenas (>12 years), 2 otters (>16 years) and mongoose (>10 years). Still births in 2 otters and a bear and cannibalism in a newly born bear and an adult bear by its male were reported. A male sloth bear aged 6 years had a solitary fibromatous growth measuring 4x4 cm projecting into the lumen of the pyloric end of stomach. An adult female wolf which died suddenly without exhibiting any clinical signs showed numerous echymoses on lungs, suppuration on thigh muscles and urinary bladder and pin head sized necrotic foci on the surface and substance of congested and enlarged liver. The right ventricle of the heart had 3 heart worms in coiled position. The postmortem lesions suggested septicaemia/toxaemia. The cause of death was not determined due to advanced necropsy changes in one each of sloth bear, wolf, 3 foxes and 2 civets.

Parasites/ova recovered from tissues and faeces were *Limnatis granulosa* (bear), *A.caninum* (bear and jackal), *Echinococcus granulosus* (wolf), *D.immitis* (Wolf, jackal, wild dog, hyena), *D.ripens* (fox), *Paragonimus westermani* (hyena, mongoose), *Mesocestoides lineatus*, *Dypylidium caninum*, *Uncinaria stenocephala*, *Eimeria vulpes*, *E.hissani* and *Isospora vulpes* (Ox), *I. lavinei* (hyena), *Amblyoma javense* (hyena and ratel), *Artyfechinostomum* sp., *Rictularia cahirensis* (civets), *E.pandei*, *E.neualai* and *I.horaei* (mongoose) *Anthrocephalus longispiculum* (badger) and *Boophilus microplus* and *Haemaphysalis indica* (ratel).

From this study it is apparent that both endo-and ecto- parasites are important pathogens in most of the carnivores but specific clinical signs/pathological changes were noticed in leech infestation of sloth bear (clinical signs of frequent shaking of head disappeared after manual removal of leech), dirofilariasis in fox (Rao and Acharjyo, 1971), echinococcosis in wolf (Rao *et al.*, 1973), pancreatic nodules in hog-badger caused by *Anthrocephalus longispiculum* (Rao and Acharjyo, 1972), paragonimiasis in fox and mongoose (Rao and Acharjyo, 1991) and Ancylostomiasis in bear and jackal. Other parasites/ova/oocysts were merely detected in faeces/skin/heart.

It has been observed that unlike felids whose breeding performance was quite satisfactory, at the zoo, the other carnivores did not breed well and as such the spectrum of diseases and causes of mortality are different. It has been concluded that non-infectious and parasitic diseases play an important role in the etiopathology of these carnivorous species.

Summary

The causes for the death of 102 car-

nivores belonging to 14 species of 6 families at Nandankanan Biological Park from 1964 to 1992 was determined on the basis of history, pathoanatomical changes observed at necropsy and histopathological examinations. The important causes of mortality were transport/captivity stress, traumatic injuries, parasitic diseases, pneumonia, senility, intestinal obstruction, suppurative hepatitis, ulcerative gastroenteritis, chronic nephritis and other miscellaneous conditions.

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CAUSES OF MORTALITY IN CAPTIVE BOVIDS AT NANDANKANAN ZOO

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The incidence and causes of mortality in different species of Indian captive wild bovids are poorly understand. However, certain specific diseases such as rinderpest and foot and mouth disease (Singh, 1978), anthrax (Sinha, 1976), tuberculosis (Liston and Soparkar, 1924; Rathore and Khera, 1982; Chakroborty, 1991) which are common in domestic bovids have been frequently reported in a wide variety of wild bovids of Indian Zoos and sanctuaries. This report presents a comprehensive information on diseases and causes of mortality in bovids at Nandankanan zoo.

Data were collected from Nandankanan Biological park from 1968-1992 pertaining to the mortality of 102 black bucks (*Antelope cervicapra*), 20 fourhorned antelopes (*Tetracerus quadricornis*), 16 nilgais (*Bosephalus traqocamelus*), 8 gaurs (*Bos gaurs*) and 2 mithuns (*Bos frontalis*). The specific cause of mortality was determined on the basis of pathoanatomical changes observed at necropsy and histopathological examination wherever found necessary.

Results and Discussion : Recorded causes of death and diseases encountered after pathological examination have been given (Table). It was seen that 69 out of 148 (47 per cent) deaths occurred due to non-infectious causes such as traumatic injuries, debility, still-births, neoplasms, senility drowning etc. Among these, traumatic injuries particularly in black bucks predominated (27 per cent) over others which was a much higher figure in comparison to those reported (20 per cent) by Rathore and Khera (1982). Death due to traumatic injuries was also found to be one of the most common causes in members of Cervidae at this zoo (Rao and Acharjyo, 1992) particularly spotted, barking and sambar deer. Debility and still-births occurred during neonatal period (about 13 per cent) which was much less in comparison to those of Bhattacharya and Chattopadhyaya (1979) in black bucks. The neoplasms recorded in this study

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were mesothelioma and reticulum cell sarcoma in nilgai and epidermoid carcinoma of nasal chamber in black bucks. Rathore and Khera *(loc.cit.)* collected information on the occurrence of horn cancer in a gaur and gnu (*Connochaetes gnu*). Two nilgais and a black buck died of pneumonia due to drowning in the moat. In five black bucks death was attributed to senility (aged 12 - 13 years) as there were no lesions of pathological significance.

Among infectious diseases, pulmonary tuberculosis was a major cause of death particularly in black bucks which was in conformity with those of Rathore and Khera *(loc.cit.)* and Chakbroborty (1991). In this surveillance, generalised tuberculosis in gaur and pulmonary tuberculosis in four horned antelope were also recorded. This disease was considered as one of the most common maladies in most of the India zoos (Rao and Acharjyo, 1992 and 1993). Though rinderpest has been reported in bovids of several zoos and sanctuaries of this country, clinical cases have not been encountered in any of the susceptible population of this zoo despite the fact there were several outbreaks in cattle of neighbouring villages during 1985-86. Diseases of unspecified etiology such as pneumonia and gastroenteritis were also major causes of death in most of the species under study constituting about 22% of the total deaths which was in agreement with those of Rathore and Khera *(loc.cit.)*, Khan *et al.* (1983), Rao and Choudhury (1984). Chakroborty *(loc.cit.)*.

Generally parasites did not pose much problem as far as mortality was concerned except fascioliasis and occasional theileriosis in black bucks where specific lesions were seen but in fourhorned antelopes. mithun and nilgai *Fasciola gioantica* caused much less damage to liver in comparison to those seen in black bucks.

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Indian J. Vet. Path. 1981, 5, 48-49

NEOPLASMS IN NANDANKANAN ZOO ANIMALS

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Though available information on neoplasms in zoo animals is meagre, they are by no means rare as seen from the literature (Fox 1923, Ratcliffee 1933, Lambard and Witte 1957, Kronberger 1962, *Sivadas et al.* 1968, David *et al.* 1970, Rao and Acharjyo 1970). This paper deals with the diagnosis of 4 spontaneously occurring neoplastic conditions in zoo animals encountered during the past 12 Years, since there is paucity of information on this aspect in captive Indian animals.

MATERIALS AND METHODS

Materials for this study were obtained from the local zoo. Formalin fixed tissues were processed by routine histological techniques. Sections were also stained with mucicarmine and Foot's modification of Bielschowsky's method for reticulin, wherever required.

RESULTS

The pathological conditions observed have been tabulated.

DISCUSSION

The tumour myxoma was interesting, for it occurred in a very young animal and was benign. It was encapsulated and did not recur even after a lapse of more then 1.5 Years, though according to Moulton (1961) such tumours are usually malignant, non-capsulated and recurring. The lymphosarcoma recorded in this study in gaur was multicentric in origin affecting lymph nodes, spleen kidney, lungs and liver. The mesothelioma of peritoneum in the female nilgai had metastatic lesions in liver and the gross and microscopic features were similar to those described by Moulton (1961). This neoplasm has not been recorded in Indian wild animals.

In the male nilgai, the reticulum cell sarcoma in the lymph nodes exhibited syncytial giant cells akin to Reed-Sternberg giant cells. Such giant cells observed in Hodgkin's disease in man are rarely encountered in aimals and there are only few case reports in pigs and dogs.

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SUMMARY

Four spontaneously occurring neo-Plasms in Nandankanan zoo animals were myxoma of the left shoulder of a male leopard *(Panthera pardus)* cub, lymphosarcoma affecting lymph nodes, spleen, liver, kidney, lung and liver of a female gaur *(Bos gaurus)*, mesothelioma of peritoneum of a female nilgai *(Boselaphus tracocamalus)* and reticulum cell sarcoma of lymph node of a male nilgai.

ACKNOWLEDGEMENTS

The authors are thankful to the Dean, Orissa Veterinary College, Bhubaneswar; Wild Life Conservation officer, Orissa for encouragement and Dr. N. K. Parhi, Department of Pathology, for help in photography.

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TABLE

CHARACTERISTICS OF DIFFERENT TUMOURS

Species	Organs involved	Histopathological changes	Diagnosis
Male leopard–8 weeks old	Subcutaneous tissue of left shoulder. Tumour mass weighed 270 g Circumscribed, encapsulated, white and slimy in consistency.	Loosely dispersed fusiform or stellate cells with elongated protoplasmic projections (Fig. 1) with abundant mucinous matrix. Nuclei round, elongated or bizzare, and multiple in some areas resembling giant cells	Myxoma.
Female gaur–5 years old	Generalised enlargement of lymph nodes more particularly of mesenteric (Fig. 2), portal, mediastinal, bronchial, popliteal. Greyish white and spongy. Spleen enlarged Kidney and liver mottled.	No differentition between cortex and medulla due to proliferated neoplastic lymphoid cells in lymph nodes Sinuses of spleen; perivascular, peritubular and periglomerular spaces of kidneys (Fig. 3); periportal and intralobular spaces of liver and interstitial tissues of lungs had massive infiltration with neoplastic cells.	Lymphosarcoma.
Female nilgai–5 years old	Peritoneum moderately thickened with multiple, fleshy, greyish irregular tuft-like growths. Surface and substance of liver had similar lesions. Hydroperitoneum was marked.	Nodular lseions consisted of simple, occasionally multilayered cuboidal & or columnar cells or papillary branched growths supported by slender or dense fibrous tissue cores (Fig 4). Cells were highly pleomorphic. Liver cirrhotic with megalohepatocytes and metastatic growths of similar morphology, on Glisson's capsule. Other abdominal organs free from lesions.	Mesothelioma.

Contd......2

(2)

Species	Organs involved	Histopathological changes	Diagnosis
Male nilgai–9 years and 8 months old	Multiple greyish white nodular encapsulated growths throughout surface and substance of liver. Mediastinal lymph nodes moderately enlarg:d, yellow in colour and tough. Marked hydrothorax and hydroperitoneum.	Lymph node revealed broad sheets of undifferentiated large sized cells with oval, pale, vesicular nuclei and highly acidophilic vacuolated cytoplesm. Syncytial giant cells akin to Reed-Sternberg giant cells were encountered (Fig. 5). Foot's modification of Bielchowsky's stain revealed proliferating reticular fibres around neoplastic cells. Focal metastatic lesions of similar morphology seen in liver parenchyma.	Reticulum cell Sarcoma.

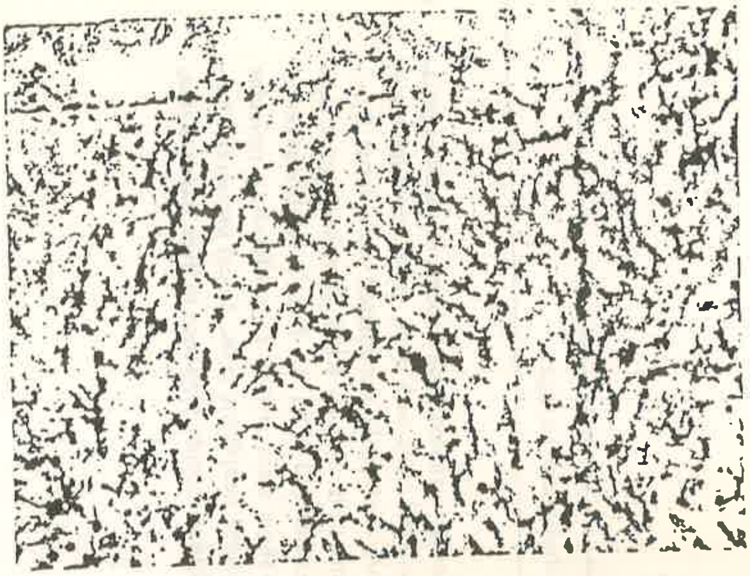

Fig. 1 Myxoma - leopard cub. Note the loosely dispersed cells with protoplasmic prolongations H. & E X 1 0

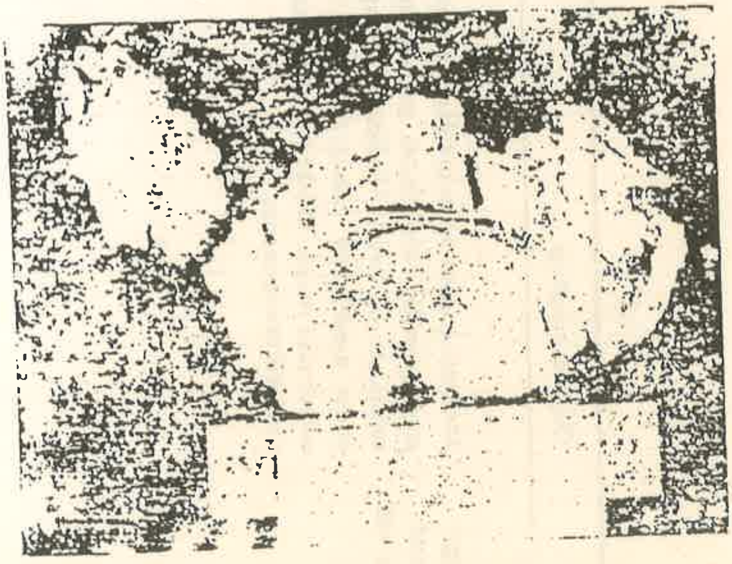

Fig. 2. Lymphosarcoma - gaur. Note the abnormal enlargement of lymph nodes.

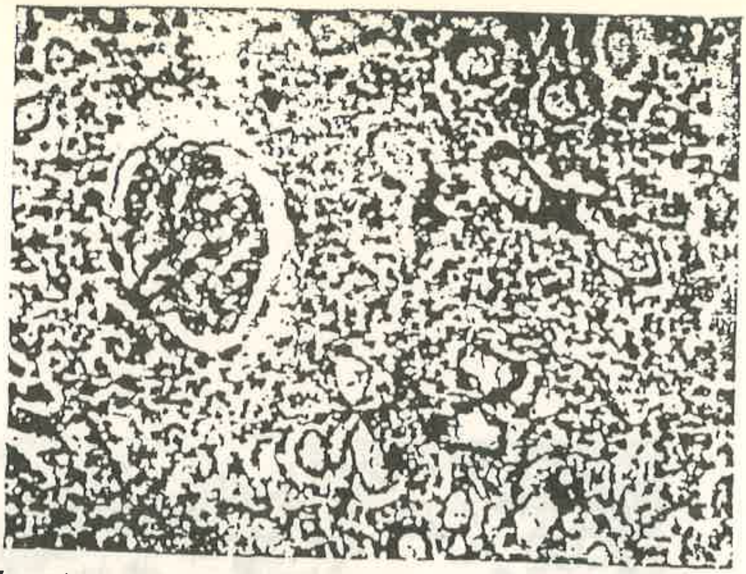

Fig. 3. Lymphosarcoma – gaur. Section of k.dney showing peritubular and periglomerular infiltration with the neoplastic cells. H & E × 180.

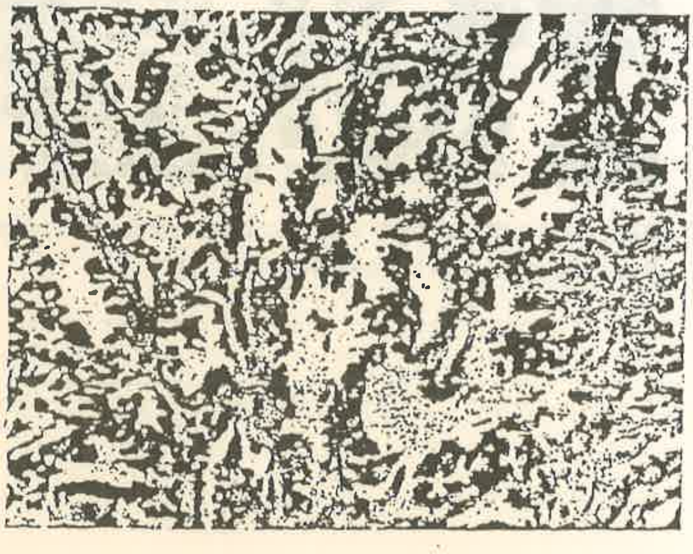

Fig. 4. Mesothelioma – n'lgai. Note the columnar cells supported by fibrous tissue stroma. H & E × 180.

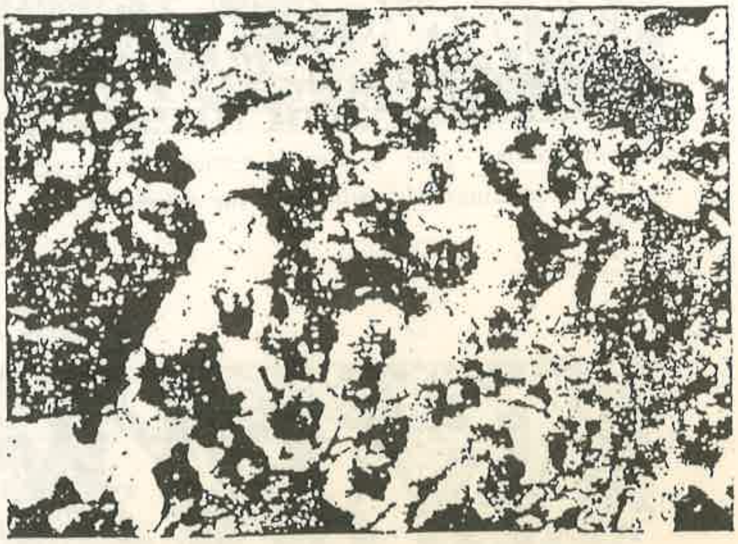

Fig 5. Reticulum cell sarcoma - nilgai. Note giant cell resembling Reed, Sternberg cell (arrow). H & E × 450.

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Short Communication

NOTES ON APPARENT CAUSES OF MORTALITY IN CAPTIVE SQUIRRELS AT NANDANKANAN ZOO

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Very little information is available on diseases and causes of mortality in free-living and captive squirrels. Fox (4) has described osteomalacia, diarrhoea and hydropic degeneration of kidneys with probable intoxication, multiple abscesses and gangrene of lungs, abscess in eye and massetor muscles, diaphragmatic defects and hypernephroma of kidneys in captive squirrels. Parasites like coccidia (5, 9), *Cysticercus fasciolaris* and some unidentified tapeworms in intestines of grey squirrels (6), larvae of *Monordotaenia, toxidensis,* highly pathogenic for ground squirrels (7), hydatid cysts in Indian giant squirrel and Indian giant flying squirrel (10, 11) and nematodes in Himalayan flying squirrel (1) have been reported. Twigg *et al.* (12) reported a titre of 1 : 30 to *Leptospira canicola* in a grey squirrel out of 14 specimens examined. Viruses belonging to encephalomyocarditis and myxo virus groups from apparently healthy red squirrels have been isolated (13). Davies *et al* (3) have described the pathology of adiaspiromycosis, fibromatosis, listeriosis and Eastern encephalitis in squirrels. Mycoplasma has also been isolated from squirrels (5). The purpose of this communication is to throw some light on some of the common causes of mortality in captive squirrels at Nandankanan Zoo.

For the purpose of exhibition at Nandankanan Zoo, adult common giant flying squirrels and Indian giant squirrels which are the common free-living animals at Simulipal National Park, Orissa, were procured while the adult red flying squirrels and Malayan giant squirrels were purchased from an animal dealer. The materials for this study were based on detailed necropsy examination of 53 Indian squirrels of 4 types which were maintained at the zoo and subsequently succumbed during August 1967 to March 1982. Records per-

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Table 1. Mortality in different age groups of squirrels at Nandankanan Zoo from August 1967-March 1982

A. Kinds of squirrels in captivity during August 1967-March 1982

Kind of squirrels	0-1 months	1-6 months	6 months-one year	More than one year	Maximum period of survival in captivity
1. Common giant flying squirrel	7	2	—	1	Not known
2. Indian giant squirrel	5	2	5	11	4 years 6 months
3. Red flying squirrel	4	1	—	1	Not known
4. Malayan giant squirrel	4	1	—	2	8 years 3 months
5. Zoo born Malayan giant squirrel	5	1	—	1	6 years 6 months

B. Mortality pattern and causes of mortality

Cause of death	Common giant flying squirrel	Indian giant squirrel	Red flying squirrel	Malayan giant squirrel	Zoo born Malayan giant squirrel
1. Gastritis/gastroenteritis	3	7	1	—	—
2. Pneumonia	1	5	—	—	—
3. Traumatic injuries	2	4	2	—	2
4. Debility and anaemia	2	—	1	1	5
5. Instussusception of intestine	1	—	—	—	—
6. Heat stroke	—	—	1	—	—
7. Impaction of stomach	—	2	—	—	—
8. Stress due to transport	—	—	1	—	—
9. Nonsuppurative myocarditis	—	1	—	—	—
10. Peritonitis	—	1	—	—	—
11. Undetermined	1	3	1	1	—

taining to the period of survival in captivity of individual animals were maintained.

The common causes of mortality and period of survival in captivity in different types of squirrels have been given in the table-1.

From this study, it was observed that the most frequent causes of death in squirrels were gastrointestinal disorders, pneumonia and trauma. The dietary factors might have been responsible for gastrointestinal disorders during captivity as the animals were fed in the zoo with boiled rice, ripe bananas, brinjals and sweet potatoes unlike their natural food. Flying squirrels can be easily tamed, but they do not live long in confinement (2). Similar observation has been made in this study with respect to common giant flying squirrels and red flying squirrels. Since they did not live long in captivity, they did not breed. Though the period of survival of Indian giant squirrels in captivity in the zoo was long, they also did not breed at all as reported (2). Two Malayan giant squirrels, however, survived long and bred in captivity, but majority of the newly born young ones died due to debility.

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Indian J. Vet. Path. 8, 55-57

Short Communication

TETRAMERIASIS IN SOME OF THE BIRDS AT NANDANKANAN ZOO

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Tetrameres is a spiruroid nematode parasitising the proven,riculus of chickens, quails and wild ducks (1), sparrow (4), pigeons (5) and turkeys (8). In India, the life cycle of *Tetrameres mohtedai* in domestic fowls (9) and gross and histopathology of the affected proventriculus (3,6) have been reported. Bhattacharjee and Doss (1) reported the histopathology of tetrameres infested proventriculus in domestic ducks, which were anaemic and emaciated.Histopathology of tetrameres infected proventriculus in a sarus crane has been reported earlier (7). During systematic necropsy examination of 1150 various species of birds died at Nandankanan zoo, incidence and pathology of tetrameriasis have been described in five varieties of captive birds which is reported in this communication.

In pea fowl chicks (5-6 months), there was ascites, enteritis, hydropericardium and congestion of liver and lungs. Proventriculus was markedly thickened and tough to cut. Histologically, the adult female worms with gravid uterus and slender male worms were detected in the gland lobules. The proventricular mucosa and submucosa revealed chronic inflammatory chonges, characterised by extenives fibrosis with marked infiltration of macrophages and lymphocytes. Sections of liver revealed multiple necrotic foci, whereas intestines revealed marked catarrhal enteritis.

In adult pintail and brahminy ducks, there was ascites and marked congestion of liver and lungs. Few dark spots were observed through the unopened proventriculus, the lumen of which contained thick tenacious mucus. Histologically, only few of the proventricular gland lobules were distended with gravid female tetrameres resulting in atrophy of tubular glands.

In the white ibis, the wall of the proventriculus was markedly thickened due to large number of both male and lamale tetrameres. The gravid females remained in the distended proventricular gland lobules (Fig, 1) causing pressure atrophy of the tubular glands, Many of the glands contained necrotic detritus in their lumina. Presence of male worms in the wall resulted in extesive necrotic granulomas surrounded by dense fibrous connective tissue and mononuclear cell infiltration. The arterioles in the submucosa were sclerosed and veins revealed numerous organised thrombi,

In two adult sarus cranes, numerous dark coloured uniform nodular elevations, measuring about 2mm projected into the luminal side of the proventriculus. On incising the nodules, blood red coloured fusiform or spherical spiruroid nematodes- were recovered. In one sarus crane, 124 and in another, 196 female worms were counted. Presence of innumerable parasites in the distended gland lobules resulted in atrophy of the tubular glands. The gland lobules invariably contained necrotic detritus in the lumen. The superficial mucosa revealed chronic catarrhal inflammation and the submucosa was markedly thickened due to fibrosis and mononuclear cell infiltration.

From this study, it is seen that different types of captive birds can be infected by these spiruroids,The intermediate hosts for these parasites are the grass hoppers, codkroaches and earth worms which are occasionally taken by the birds as the birds have an easy access to the intermediate hosts. The tissue reaction, however, varied from species to species which is probably due to variation in severity of infection, The gross and histopathology described herein is similar to these described by the earlier workers for tetrameriasis (1, 3, 6, 7).

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TETRAMERIASIS IN SOME OF THE BIRDS AT NANDANKANAN ZOO

A. T. Rao and L. N. Acharjyo

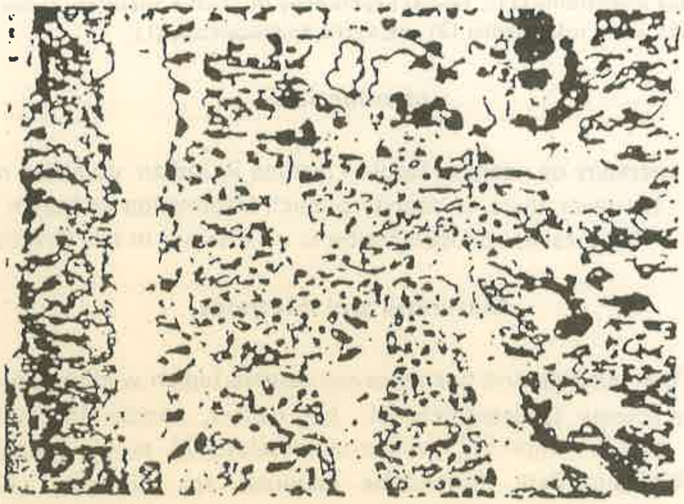

Fig. 1 : Section of proventriculus showing distention of gland lobule due to presence of adult tetrameres sp. H. E. X 85

Indian J. Vet. Path. 12, 18-22, 1988.

CARDIOVASCULAR LESIONS IN CAPTIVE INDIAN WILD RUMINANTS*

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Summary : The occurrence and pathology of spontaneous cardiovascular lesions in nine species of captive Indian wild ruminants have been described. The conditions encountered were : chronic pericarditis (4), sarcocystis (3), nonsuppurative myocarditis (11), medial hypertrophy of hepatic arterioles (7) thrombosis (2), aortic calcification (2) and aortic onchocercosis (1).

Introduction

Literature on cardiovascular lesions in Indian domestic ruminants are available[2,6,9,10]. However, there is paucity of such information on Indian wild ruminants in captivity. The present communication is an attempt in this direction.

Materials and Methods

Blackbuck - 31, One hundred and twenty seven captive Indian wild ruminants belonging to nine different species (spotted deer-34, hog dear-9, sambar-18, barking deer-14, mouse deer-3, gaur-3, nilgai-8, four-horned antelope-7) dying during 1967–84 at Nandankanan Biological Park, formed the materials for this study. Pieces of left ventricle at musculae papillae region and main branches of aorta collected during routine necropsy and fixed in 10% formol saline were processed to have paraffin sections. These were stained with haematoxylin and eosin Duplicate sections, wherever appropriate, were stained by vanGieson, Verhoeff's vanGieson and Von Kossa method.

Results and Discussion

Different cardiovascular lesions were observed in 30 out of 127 cases necropsied (Table). Mouse deer *(Tragulus meminna)* and gaur *(Bos gaurus)* did not

* Part of M V. Sc Thesis submitted by senior author to Orissa University of Agriculture and Technology, Bhubaneswar.

Table : Cardiovascular lesions occurring in wild ruminants

Animal species	Conditions encountered							
	Chronic pericarditis	Sarcosystosis	Non-Suppurativ myocarditis	Medial hypertrophy of hepatic arteriole	Thrombosis	Aortic ocalcification	Aortic onchocercosis	Total
Spotted deer (Axis axis)	—	—	—	7	2	—	—	9
Hog-deer (Axis porcinus)	1	—	—	—	—	—	—	1
Sambar (Cervus unicolor)	1	1	—	—	—	—	—	2
Barking deer (Muntiacus muntzak)	—	—	3	—	—	1	—	4
Nilgai (Bosophalus tragcamelus)	—	1	4	—	—	—	—	5
Black buck (Antilope cervicapra)	2	—	—	—	—	1	—	3
Four horned antelope (Tetracerus quadricornis)	—	1	4	—	—	—	1	6

show any lesion.

Chronic pericarditis : In black bucks, the active lesions on pericardium consisted of fibrinonecrotic debris associated with infiltration of degeneration and intact neutrophils while in older lesions thick granulation tissue adhered to the epicardium. In the hog-dear, the pericardium was markedly thickened due to proliferation of mature connective tissue. The underlying myocardial fibres showed loss of striations and fragmentation. In sambar, the markedly thickened and fibrosed pericardium showed a plate of metaplastic osseous tissue. ' Chronic pericarditis in animals is usually secondary to acute conditions and develops as a part of general infection or an extension from some other infectious process. In cattle, pericarditis is usually a sequelae of traumatic reticuloperitonitis. In this study, chronic pericarditis in hog-deer resulted from the extension of lesion from suppurative pneumonia resulting in adhesive pericarditis. In the sambar, the lesion was associated with pulmonary tuberculosis but without tuberculous granulomas. However, in the blackbuck, the etiology could not be traced out.

Sarcocystosis : Numerous sarcocysts with clearly demonstrable cell wall containing spherical, ovoid, elliptical to typical banana shaped bradyzoites were seen in the myocardial fibres (Fig. 1) and purkinje fibres without any reaction around them. The bradyzoites measured 10-14μ in length and 3-4μ in width Sarcocysts have also been reported earlier in Indian gaur[11] and goral[1]. It is opined that the animals in question must have acquired the infection through ingestion of feed contaminated with faeces of carnivores as suggested earlier[11].

Nonsuppurative myocarditis : Grossly, the hypertrophied left ventricle showed numerous pale streaks which were well demarcated from the abjoining apparently healthy tissue. Histological changes were characterised by nonsuppurative myocarditis associated with infiltration of mononuclear cells and oedema (Fig 2). The myocardial fibres showed fragmentation/myolysis/atrophy/hyalinization assocated with sarcolemmal proliferation. There was intermyceal oedema and congestion. In two cases fibrosis also occurred. These lesions were associated with an outbrek of bluetongue-like disease.

Medial hypertrophy and thrombosis : In 7 cases hepatic arterioles were markedly thickened due to medial hypertrophy resulting in partial to complete occlusion of their lumina in two such cases. There were organised thrombi in the portal veins. These animals were suffering from fascioliasis, hence the hypertrophic changes could be correlated with fascioliasis.. In one gaur, the pulmonary

Fig. 1 Sarcocyst in the cardiac muscle of sambar. H. E. X 63

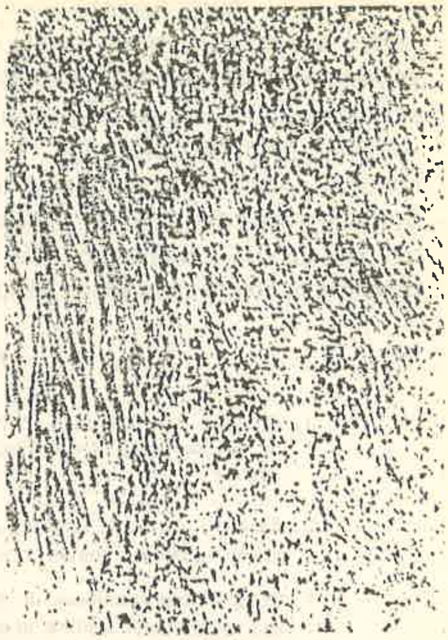

Fig. 2 Heart of a barking deer showing non-suppurative myocarditis H. E. X 25

vein showed thrombus.

Calcification : One of the barking deer affected with tuberculosis had intimal calcification of the capillaries in the mediastinal lymph node In a blackbuck which died of traumatic injuries, the intimal surface of the aorta at the base of the heart had four irregular elevated hard plaques protruding into the lumen. Incision of the plaques gave gritty sound Histologically, the internal elastic lamina of the tunica intima was impregnated with calcium deposits extending to medial coat Verhoeff's stained sections revealed fragmentation of elastic fibres in tunica intima while vanGieson stained slides showed proliferation of connective tissue replacing smooth muscles of medial coat. Fibrous calcified plaques have been found to be associated with Johne's disease[7], disturbed mineral metabolism[3], hypervitaminosis D[4] and normal aging process[5]. The exact cause of calcification in the present study could not be ascertained.

Aortic onchocerciasis : The intimal surface of the aorta of a four-horned antelope was rough due to nodular elevations and depressions. Histological section revealed cross sections of gravid nematodes containing numerous microfilaria simulating *Onchocerca* sp. in subintimal and medial coat. Cut sections of parasites were lying inside the fibrous ring. Verhoeff' vanGieson stained slides showed fragmentation of elastis fibres and partial fibrosis of the smooth muscles in the medial coat. Bovine onchocerciasis is one of the most common arterial lesions[8,9] but is comparatively rare in small ruminants[6]. The lesions described herein were similar to those described in bovine and caprine species

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Short Communication

INTESTINAL INTUSSUSCEPTION IN SOME CAPTIVE INDIAN WILD MAMMALS

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Intestinal intussusception occurs in all species but is more common in dogs, young horses, lambs and adult cattle[2]. Reports on intussusception in wildlife are scarce. Fox[1] encountered intussusception in one primate, two carnivores and an ungulate at Philadelphia Zoological Garden. During routine necropsy examination of about 1200 mammals which died at Nandankanan Biological Park during 1969-89, intussusception was encountered in 5 carnivores, 3 primates, an ungulate and a squirrel (Table).

Present study indicated that different mammals in captivity suffer from intussuscep-tion involving different regions of intestine. Due to problems in diagnosis during life the disease terminate fatally in all the cases. Except in leopard and sloth bear cubs, the

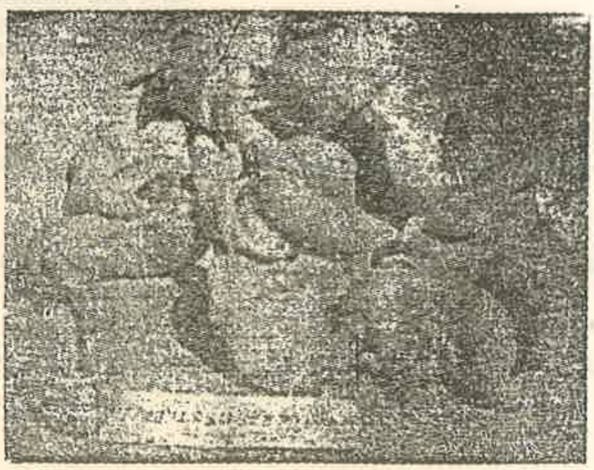

Fig. Small intestine of a ratel showing intussusception at 4 places.

Table : Details of intussusception in captive wild animals

Animal species	Age	Sex	Clinical history	Salient findings
Leopard cub *(Panthera pardus)*	1 mo	M	Sudden death	Intussusception at 2 places in small intestine associated with gangrene. Each of the distended intestine measured 6-8 cm.
Lepord *(Panthera pardus)*	3.5 yrs.	M	Suffering from paraplegia since several months	Stomach empty. Intussusception of small intestine at one place with marked hyperaemia Intussusception resulted in distension of intestine measuring about 18 cm. Outer most layer was greatly stretched and inner most greatly compressed. Numerous necrotic foci on liver.
Sloth bear *(Melursus urcinus)*	2 mo	M	Colic prior to death	Dilated portion of intestine measured 10 cm. with marked hyperaemia of mesenteric vessels.
Common otter *(Lutra lutra)*	Adult	F	Suddun deth	Intussusception of ileum (10 cm) without any inflammatory reaction. Stomach and intestin were empty.
Ratel *(Mellivora capensis)*	Adult	M	Dull and depressed 2 days prior to death	Blood clots in stomach and intestine. intussusception occurred at 3 places in small intestine without inflammatory reaction involving mesentery. Each of the distended areas measured 8 cm, 14 cm and cm (Fig.).
Common langur *(Presbytis entellus)*	Adult	M	Struggled prior to death	Intussusception of lieum (11 cm) associated with gangrene.
Slow loris *(Nycticebus coucang)* —2 cases	Adult	F	Sudden death	Small intestine away from ileocaecal valve had intussusception involving about 6 cm in length. Parts of intestine anterior to obstruction was congested. In one case there was severe catarrhal enteritis associated with large number of ronnd worms.
Barking deer *(Muntiacus muntjak)*	8 yrs	M	Sudden death	Jejunum gangrenous (20 cm),
Common giant flying squirrel *(Petaurista petaurista)*	Adult	M	Sudden death	Intussusceptian of large intestin (10 cm). Multiple abbscesses on liver.

the disease terminate fatally in all the cases. Except in leopard and sloth bear cubs, the condition was seen in adults unlike in human beings, horses and sheep where it is more common in young ones. Though the exact cause of intussusception remains uncertain, increased peristalsis/dysperistalsis precipitates the condition. It was observed that intestines were almost ampty in all the cases and consequently increased peristalsis would have occurred. Only in one slow loris, the enteritis was associated with round worm infestation. Single intussusception in common otter and multiple intussusception in ratel unassociated with any inflammatory reaction believed to be agonal as suggested by Jubb and Kennedy[2] .

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Short Communication

GENERALISED TUBERCULOSIS IN A WALLABY *(MACROPUS EQUGENI)*

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Though tuberculosis does occur in marsupials but it is not common[1-6]. This communication places on record a case of generalised tuberculosis in a female Damaor Tammar wallaby (*Macropus eugeni*) as there is no such report from this country.

Two females and a male wallabies were received from Texas, United States of America, on exchange basis at Nandankanan Biological Park on January 8, 1989. A week prior to death, the female developed coryza and anorexia. It became dull and died on September 1, 1989. On necropsy, lesions were characterised by numerous pin head to circumscribed firm grey nodules measuring 4-6 mm in diameter buldging from the surface or deeply embedded in the substance of liver, spleen and lungs (Fig. 1). The lesions in the former two organs were more extensive than the latter. The microscopic features of the nodules consisted of tubercles comprising of granulomas predominantly composed of massive aggregates of mononuclear cells (Fig. 2). Sections and smears from liver, lungs and spleen revealed acid fast organisms morphologically akin to *Mycobacterium tuberculosis*. Caseation, calcification, fibrous encapsulation and giant cell formation were not

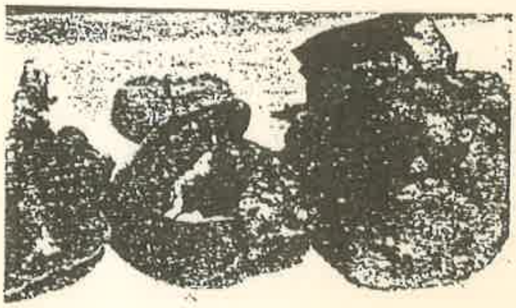

Fig. 1. Liver, spleen and lungs of a wallaby showing tuberculous lesions.

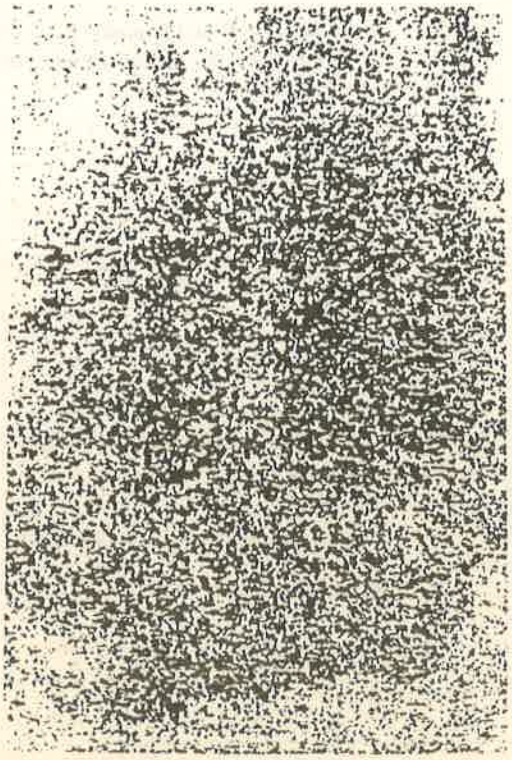

Fig. 2. Liver showing epithelioid granulomas without caseation. H.E. × 150.

encountered in tubercles differing from the classical lesions seen in bovines, antelopes, primates and porcines. The proliferative type of lesions observed herein was akin to those reported in horses and dogs[4].

Apart from tuberculous lesions, liver showed fibrinoid degeneration of sinusoidal walls, atrophy/necrobiotic changes in hepatic cells and infiltration of mononuclear cells in the periportal areas. Spleen had reticuloendothelial cell proliferation in red pulp and depletion of lymphocytes in the white pulp.

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Short Communication

MALIGNANT MELANOMA IN A WHITE TIGER

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Tumours of melanogenic system though common in gray horses and dogs are considered rare in other species of animals[1]. This paper records the occurrence of a case of malignant melanoma in a rare species of white tiger.

A male zoo born white tiger (Debabrata) of Nandankanan Biological Park, Orissa, aged about 10 years was suffering from intermittant diarrhoea and chronic ulceration of left elbow region since about 8 months. It finally died after showing clinical signs of respiratory distress. At necropsy, most of the lymph nodes notably prescapular, prefemoral, popliteal, precrural, mediastinal and bronchial were enlarged and dark black in colour. All the lobes of both the lungs were studded with numerous circumscribed soft dark black raised nodules of varying sizes.

Histologically, two types of neoplastic lesions were encountered in the lungs. In one type closely packed groups of tumour cells having round to polyhedral shape resembled epithelial cells,. Such cells had pleomorphic nuclei with prominent nucleoli and the cytoplasm contained minute fine black granules in Fontanna silver staining (Fig.1). In the second type, the cells were entirely composed of spindle cells with extensive pleomorphism resembling fibrosarcoma. The nuclei were mostly ovoid or elongated with less prominent nucleoli. Numerous tumour giant cells and mitotic figures were also seen. Most of the neoplastic cells were loaded with melanin pigments. In both the types of lesions, numerous necrotic foci were seen. The pleura was thickened due to oedema and its dilated veins and lymphatics were containing tumour emboli. Similar types of neoplastic lesions were seen occupying whole of the lymph nodes, afferent lymphatics and subcapsular lymphatic sinuses. Liver, kidneys, spleen and heart did not show any metastatic lesion except for diffuse staining of the lining cells of the portal vein in liver and tumour emboli in the lymphatics of pericardium.

Fig.1. Lung showing melanin pigments. Fontanna Silver staining x 128

It is well known that the tumours of melanogenic system are poorly understood and their histogenesis is almost entirely

1 and 2 Nandankanan Bilogical Park, Baranga, Cuttack

unknown. It would be a fascinating proposition to speculate that this non-albino mutant is more exposed to the abundantly available ultraviolet rays - a known carcinogenic agent which perhaps must have played an important role in genesis of this tumour. The exact origin of the tumour in question is debatable because of nonavailability of tissues such as skin, brain and other organs for pathological examination. Never the less, there was no difficulty in diagnosis of malignant melanoma because of abnormally large amount of melanin pigment in the cytoplasm of tumour cells as well as phagocytic cells apart from extreme pleomorphism of the neoplastic cells, deep black colouration of affected organs and lymph node metastasis.

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Short Communication

MORTALITY IN SOME INDIAN DEER AT NANDANKANAN

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Informations on causes of mortality in free-living/captive Indian deer are scanty[1,3-8,10]. This paper presents mortality in 5 species of Indian deer at Nandankanan Biological Park.

Epidemiological data pertaining to date of arrival/birth/death, sex, age and history were collected from the local zoo for the period from July 1967 to March 1989. A total of 351 deaths were recorded in 5 species of deer: 140 spotted, 29 hog, 83 sambar, 94 barking and 5 browantlered deer. The animals were broadly divided into 3 age groups : 0-1 yr, 2-5 yrs and over 5 yrs. Seasons were divided into summer (March-June), rainy (July-October) and winter (November-February). The causes of mortality were determined on the basis of history and pathomorphological changes observed at necropsy and on histopathological examination.

Table 1: Recorded causes of death in 5 species of captive Indian deer

Causes of death	Spotted deer	Hog deer	Sambar	Barking deer	Browantlered deer	Total (%)
Foot and mouth disease	2	-	1	-	-	3(0.9)
Blue tongue like disease	-	-	-	3	-	3(0.9)
Tuberculosis	17	1	6	9	-	33(9.4)
Colibacillosis	4	-	-	-	-	4(1.1)
Nocardiosis/zygomycosis	-	2	-	-	-	2(0.6)
Fascioliasis	4	-	-	-	-	4(1.1)
Traumatic injuries including predator killing	30	3	24	18	1	76(21.7)
Pneumonia	20	3	11	18	1	53(15.1)
Debility	9	-	10	8	-	27(7.7)
Captivity/heat stress	10	1	7	8	-	26(7.4)
Still birth	8	7	4	3	-	22(6.3)
Gastrointestinal disorders	3	1	3	6	-	13(3.7)
Drowning	3	3	4	5	-	15(4.3)
Hepatitis	6	1	4	6	1	18(5.1)
Septicemia/toxemia/pyemia	4	5	-	2	-	11(3.1)
Pericarditis	2	1	-	4	-	7(2.0)
Maternal rejection	1	-	1	-	2	4(1.5)
Miscellaneous causes	2	-	3	-	-	5(1.4)
Undertermined	5	1	4	4	-	14(4.0)

Non-infectious causes such as traumatic injuries, strees factors, still birth and drowning accounted for nearly 50.0% of the total deaths (Table 1). Of these, traumatic injuries were the single most important cause (21.67%) of mortality, and supported earlier observations recorded in other Indian zoos[4,6]. Traumatic injuries resulted mostly due to capture operations for management/disposal/transfer from one enclosure to other and inter-and intra-species fighting, fighting during the rutting season and predator killing. It is believed that improved management practices and capture procedures would considerable lessen the losses due to traumatic injuries. A high incidence of still-births (6.3%) was partly attributable to inbreeding which is practised at zoo and partly to disturbance to the pregnant mothers during advanced stages of pregnancy by the visitors. Deaths due to drowning were exclusively seen in fawns and was due to deer enclosure having a water moat. Among infectious causes (12.8%) tuberculosis was a major cause of death in most of the deer species. The disease has been recognised as one of the most common maladies in majority of Indian zoos, particularly in deer family[1,2,5,6,9,11]. Though a large number of parasites were detected in digestive system of deer during necropsy/faecal examination, the pathogenic effects produced on the host were not severe in nature except in hepatic fascioliasis suggesting a great deal of tolerance between the parasites and their hosts.

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Short Communication

CONGENITAL MALFORMATIONS IN WILD ANIMALS AT NANDANKANAN ZOO.

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Numerous congenital malformations have been reported in domestic animals. On the contrary there is woeful paucity of such informations in wildlife particularly in Indian. Therefore, a report on various malformations encountered during the last 25 years at Nandankanan Biological Park has been presented (Table). These defects does not seem to have been reported sofar.

Fig. 1. Absence of tail : white tiger cub.

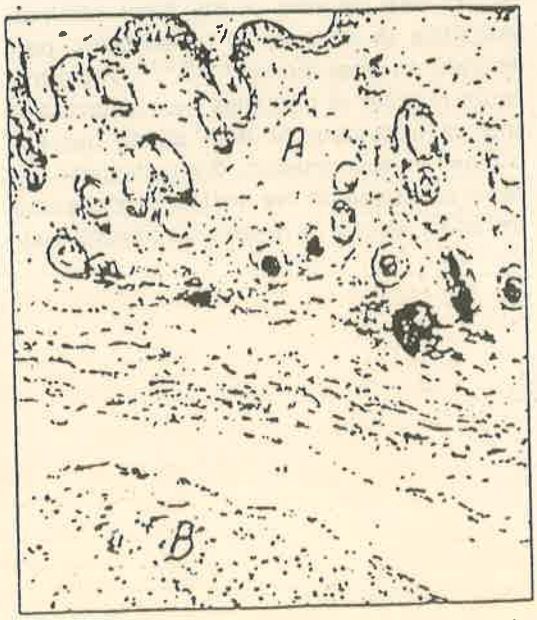

Fig. 2. Exencephaly : absence of cranium. A-skin, B-brain

Table : Details of malformation in different groups.

Groups	No. born at zoo	Types of malformation
1. Primates	28	Nil
2. Tiger		
Normal coloured	68	Nil
White	29	Aplasia of tail, still-born : one case (Fig.1)
3. Lion - Indian	16	Nil
African	83	Still born, abnormal stumpy tail, one case.
4. Panther	35	Still born with exencephaly, cranium not formed and brain seen just underneath the skin (Fig. 2).
5. Artyodactyla	200	i) Still born four horned antelope having an extra digit on right fore limb, polydactyla - one case.
		ii) Still born spotted deer having deformation of skeleton particularly jaw bones, vertebral column and limbs including the digits - one case.

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EPITHELIAL TUMOURS OF ETHMOID IN INDIAN WILD RUMINANTS

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SUMMARY

Epithelial tumours of the mucosa of the ethmoid were diagnosed in brow - antlered (1), sika (1), spotted deer (7) and black buck(1). All these animals gradually developed swelling in frontonasal region and exhibited intermittent epistaxis during the period of illness which ranged from 3 - 6 months. Three spotted deer showed unilateral or bilateral blindness whereas others had exophthalmos. One of the spotted deer exhibited epileptiform seizures a moth prior to death. Histologically, these tumours were classified as adenocarcinoma (7), squamous cell carcinoma (2) and anaplastic carcinoma (1).

Key words - Ethmoid tumour, wild ruminant, epithelial tumour.

INTRODUCTION

Though ethmoid tumours are known to occur in various species of domestic animals through out the world[8], the disease is uncommonly reported in wild animals. There are only two such reports, one in elk deer [1] and another in a spotted deer [7]. In this paper epithelial tumours occurring in ethmoid in Indian wild ruminants are reported.

MATERIALS AND METHODS

The details of wild ruminants necropsied at the Nandankanan Biological Park (NK) during 1967-1991 and Rajbhavan Deer Park (RB) from 1974-1991 are shown in table. Clinical symptoms exhibited by affected animals were recorded as a routine. Detailed necropsy of dead animals was conducted with particular reference to the ethmoid region, retropharyngeal lymph nodes and tumour metastasis in other organs. Appropriate tissues were collected and fixed in 10 per cent formal saline for histopathological examination.

RESULTS AND DISCUSSION

A total of 10 cases of ethmoid carcinoma was recorded in various wild ruminants examined at Nandankanan zoo and Rajbhavan Deer Park during 1967-91 (25 years period) out of 700 animals examined. This indicates the rare occurrence of this neoplasm in wild ruminants and support earlier observations [9]. As against its rarity in wild ruminants it is emerging as a common neoplasm in cattle, particularly in Southern Peninsula of the country[2,3,5,8,10]. Some of the earlier workers have opined about its infectious etiology[4,6,8] but it needs further elucidation.

Present address : 1- Ex-Senior Veterinary Officer, Nandankanan Zoo, Barang, Cuttack

Table : Details of tumour bearing animals

Ruminant species	No. examined	No. of tumour bearing animals
Spotted deer (*Axis axis*)	183 (NK) 164 (RB)	0 7
Barking deer (*Muntiacus muntzak*)	94 (NK)	0
Sambar (*Cervus unicolor*)	83 (NK)	0
Hog - deer (*Axis porcinus*)	29 (NK)	0
Brow - antlered deer (*Cervus eldi eldi*)	6 (NK)	1
Sika deer (*Cervus nippon*)	5 (NK)	1
Black buck (*Antelope cervicapra*)	120 (NK) 16 (RB)	0 1
Total	700	10

Spotted deer :

All the seven tumour bearing animals were aged (4-12 yrs) and exhibited spherical soft swelling on the frontonasal region since 3-6 mo prior to death. There was intermittent epistais and gradual deterioration of health during illness. Unilateral blindness developed in 3 animals due to atrophy of the eye balls and in rest of the animals there was unilateral or bilateral exopthalmos. One of the animals exhibited epileptiform seizures with typical nervousness one month prior to death.

Sagital section of the skull revealed greyish white soft neoplastic growth occupying most of the ethmoid region extending anteriorly towards the nasal chamber and posteriorly upto the orbital wall of the right eye resulting in atrophy of the eye ball. In two animals there were haematomas underneath the skin with rarefication of turbinate and frontal bones. Blood clots oozed out through the openings. In rest of the animals (5) the nasal chamber was filled with friable tumour mass admixed with blood clots. In one of the animals the tumour invaded the cranium resulting in its rarefication and the growth extended to olfactory lobes and cerebrum. Greyish white spherical metastatic lesions were seen in the retropharyngeal lymph nodes in two animals.

Histologically, the neoplastic picture in 6 spotted deer was more or less similar which consisted of numerous acini of varying sizes lined by single and/or multiple layers of cuboidal to columnar cells with hyperchromatic nucleus, basophilic cytoplasm and occasional mitotic figures. The lumen of the acini often contained desquamated epithelial cells. The acini were widely separated by abundant fibrous tissue stroma, infiltrating mononuclear cells and engorged capillaries. The retropharyneal lymph nodes revealed similar neoplastic acinar structures but the stroma was scanty. The tumours were classified as adenocarcinoma. In the last animal the tumour tissue consisted of anaplastic cells with extreme pleomorphism, tumour giant cells, numerous mitotic figures and hyperchromatism leading to the diagnosis of anaplastic carcinoma. The tumour had also invaded cerebrum.

Sika deer and black buck :

The zoo born sika deer aged 4 yrs. exhibited a gradually developing swelling on frontonasal region in between the eyes about 4 mo prior to death. The swelling was soft and when pressed bloody exudate oozed out through nasal openings. Trephining of frontonasal bone was performed twice during sickness to drain out the blood/exudate. Both the animals showed intermittent epistaxis.

The frontal and turbinate bones of both the animals were soft to cut. The nasal cavity and ethmoid region were filled with soft greyish white firm growths occluding the nasal passage. Microscopically, the tumour tissue consisted of islands of pleomorphic squamous epithelial cells (Fig. 1) which had pale vesicular nucleus and large amount of granular/acidophilic cytoplasm. There were also atypical cells with numerous mitotic figures. The islands of squamous cells often revealed central keratinisation and necrosis. The stroma separating the islands was in abundance. The tumour was diagnosed as squamous cell carcinoma.

Brow-antlered deer :

This 8 yrs. old animal was living in the zoo since 6 yrs. It exhibited abnormal breathing sounds initially followed by swelling on the frontonasal region between the eyes. The swelling gradually increased over a period of one year prior to death resulting in softening of frontal bones. During illness, the animal exhibited intermittent epistaxis, purulent rhinitis dysponea, respiratory rales and debility.

At necropsy, the nasal chamber was filled with fleshy smooth greyish white sessile/pedunculated growths admixed with purulent material. Microscopically, these growths essentially consisted of acini lined by single/multilayered cuboidal to columnar mucin producing epithelial cells (Fig. 2) which had uniform ovoid vesicular nuclei with occasional mitotic figures. In some acini the epithelium was thrown into the lumen in the form of branching papillary projections while the lumina of many acini were distended with pink stained proteinaeceous fluid resulting in

Fig. 1. Epidermoid carcinoma (Sika deer) : islands of squamous epithelial cells showing pleomorphism. HE X 66

Fig. 2. Cystadenocarcinoma (brow-antlered deer) : numerous acinar structures. HE X 330.

flattening of epithelium. The polypoid growths showed myxomatous tissue with oedema, congestion, neutrophilic infiltration and even abscess formation. The tumour was diagnosed as cystadenocarcinoma. The symptomatology and pathomorphology of the various neoplasms observed herein are akin to those described for ethmoid tumours in cattle by earlier workers [6,7].

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Short Communication

PLEURAL MESOTHELIOMA IN A TIGRESS

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Mesothelioma does not seem to have been reported in tigers[1,5] and hence the purpose of this communication. Of the 113 tigers born at Nandankanan Biological Park, Orissa, from 1962-1992, 20 adults and subadults were necropsied for determining the causes of death. Out of these, the tigress 'Rekha'aged 19.5 yrs. which died after protracted illness revealed congestion/consolidation of both the lungs and their firm adhesion to the chest wall due to multiple tuft-like solid firm creamy coloured fleshy growths of irregular sizes and shapes. Invariably the small nodules were sessile while the larger ones pedunculated. The enlarged and congested liver showed 4 greyish white spherical growths measuring 10x5 cm in size in its parenchyma. About 5 litres of straw coloured fluid was present in the abdominal cavity. The capsules of both the kidneys were very much thickened and firmly adhered to the parenchyma.

Histologically, the growth revealed neoplastic mesothelial cells arranged in epithelioid pattern in sheets (Fig.1) supported by abundant mature collagen fibres which were infiltrated with numerous lymphocytes. Similar neoplastic cells were seen in liver, lungs and peritoneum. Sections of kidneys showed typical lesions of chronic glomerulonephritis while the adrenals revealed fibrosis of corticomedullary junction and narrowing of zona glomerulosa.

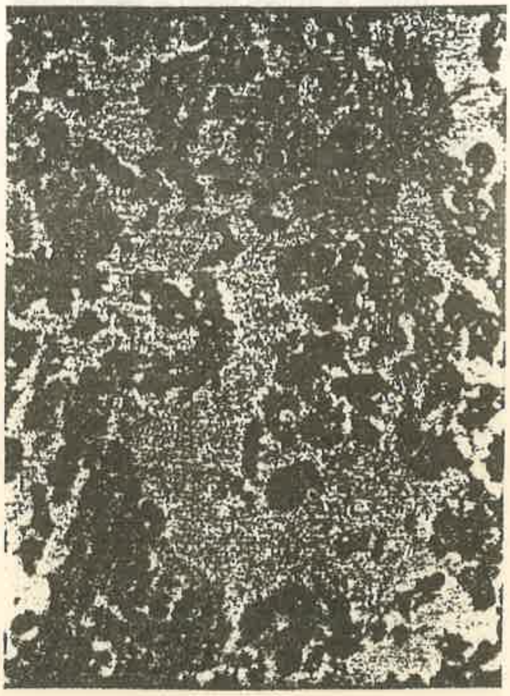

Fig. 1. Growth: sheet of neoplastic cells supported by collagen fibres. H.E x 66.

The gross and microscopic picture of growths described herein were akin to those reported earlier for mesothelioma. However, it has been stated[3] that primary tumours arising from pleura are rare in animals. Surveil-

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dankanan during the last 25 years[4] indicated that mesothelioma is common in aquatic birds like Muscovy ducks and cranes but occasional in nilgai. Possible etiology might be attributed to chronic irritation coupled with atmospheric and water pollution as the zoo is situated adjacent to a glass factory. Senility was perhaps responsible for chronic lesions in kidneys and adrenals.

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Short Communication

AN OUTBREAK OF INFECTIOUS FELINE ENTERITIS AT NANDANKANAN ZOO

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Infectious feline enteritis has been reported in a number of non-domestic felids like lion, tiger, jaguar, leopard and cheetal[1]. From India, the disease was reported in tigers[2,3] and panthers[4]. This paper reports an outbreak of the disease in lion cubs, white tigers and leopard.

Of the 10 lion cubs aged 3-6 mo, a subadult (10 mo) and 5 cubs (white tiger) aged 4-5 mo and 2 leopards aged 1 yr. at Nandankanan Biological Park, 5 lion cubs, all white and two leopards suddenly developed anorexia, vomition of blood tinged ingesta admixed with forthy mucus and bloody diarrhoea. Three lion cubs died on first day of illness and other 2 and subadult white tiger on second day during the end of October,1993. In the second outbreak all the white tiger cubs and a male leopard succumbed to death during the end of January, 1994.

Necropsy lesions in all the animals were comparable. The carcases were dehydrated and the blood was dak and tarry in colour. The entire gastric mucosa was hyperaemic and the stomach contained liquid ingesta. The mucosa of intestines through out was congested but the ileum and colon, in addition were covered with diphtheretic membrane and had numerous haemorrhagic and necrotic ulcers. The lumen contained hemorrhagic exudates admixed with necrotic debris and adult *Toxascaris canis.* The serosal and coronary vessels were engorged. In addition the wall of the intestines of all these animals had nodular lesions of. fibrous nature containing *Galonchus pernicious* in tunnels. The mesentric lymph nodes were markedly enlarged and edematous. Entire yellow bone marrow was red in colour and liquefied.

Characteristic histological changes were seen in intestine, mesentric lymph nodes and spleen. There was degeneration and desquamation of the lining epithelial cells of villi including the crypts and often covered by diphtheretic membrane associated with congestion and haemorrhages in the submucosa. Basophilic intranuclear inclusion bodies with margination of chromatin were invariably seen in the desquamated lining epithelial cell of mucosa and crypts (Fig.1). Section of the spleen and lymph nodes showed necrosis and depletion of lymphocytes of most of the follicles associated with reticuloendothelial cell hyperplasia, edema and congestion. Inclusion bodies similar to those seen in intestines were also seen in reticuloendothelial cells of these organs.

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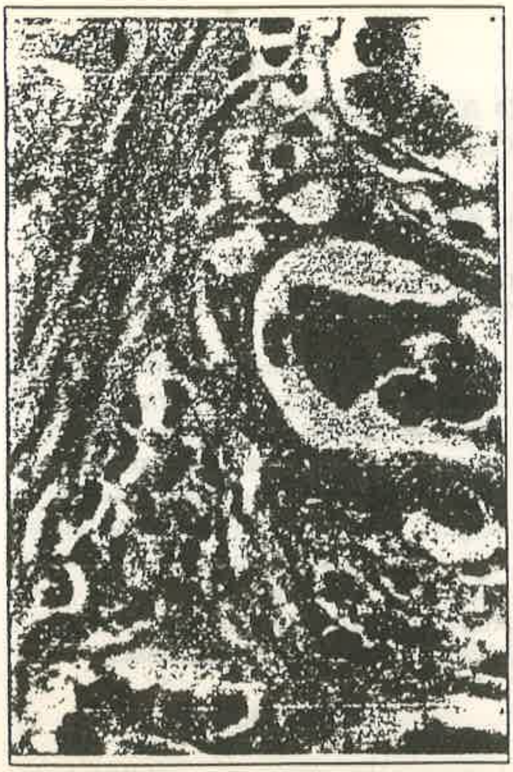

Fig. 1. Intestine : intranuclear inclusion bodies (arrow)in crypts H E X 132.

The disease was diagnosed on the basis of rapid onset, typical clinical signs and post mortem lesions coupled with histopathology and presence of characteristic inclusion bodies as per earlier description [1].

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Short Communication

FOREIGN BODIES IN ZOO ANIMALS AND BIRDS AT NANDANKANAN ZOO

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Comprehensive information relating to the occurrence of foreign bodies in different varieties of animals and birds dying during 1967-1992 at Nandankanan Biological Park, Bhubaneswar has been reported as no such data is available from this country.

The type of foreign bodies along with other details have been given in Table. Foreign bodies were comparatively common in adult males in digestive tract particularly the rumen in ruminants, intestines of carnivores and gizzard of aves. In ruminants except sika deer, foreign objects were noticed without causing any untoward effects even if they were metallic in nature but in aves even sharp vegetable sticks caused serious damage. Fowler [1] also expressed similar opinion as far as the aquatic and non-aquatic birds was concerned. Since a number of non biological materials are important constituents of cages/enclosures and some organic/inorganic materials are unscrupulously thrown into the cages/enclosures by visitors in the zoo, it is recommended that extreme care should be taken to keep the exhibits away from such materials that might cause damage, if swallowed by zoo animals/aves.

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Table : Foreign bodies in different zoo species

Sl No.	Kind of animals/birds	Age/sex	Types of foreign body with description	Site of lodgement	Remarks
	A.Ruminants				
1.	Spotted deer	6 Yrs/M	A smooth trichobezoar (6 cm in diameter) and rough trichobezoar (8x6 cm) each weighing about 50g	Rumen	Without ruminal injury
2.	Sika deer	4 Yrs 4mo/M	Metallic wire 10 cm in length	Heart	Died due to purulent percarditis[3]
3.	Mouse deer	10 Yrs/M	Trichobezoar 4.8 x 4.5 cm in size and weighing 20g	Rumen	Without any ruminal injury
4.	Barkig deer	Adult/F	Phytoconcretion, ball-like, 4.5 cm diameter weighing 43g	-do-	-do-
5.	Sambar	Adult/M	Iron pieces and stones weighing 60g	-do-	-do-
6.	Gaur	7Yrs/M	Iron nails, broken knife, fountain pen clip, a ten paise coin, Iron washer, broken iron, pieces of stones altogether weighing 370g indicating pica	-do-	-do-
7.	Nilgai	5Yrs/M	Four iron nails weighing 14.5g	-do-	-do-
8.	-do-	Adult/M	trichobezoar	-do-	-do-
9.	-do-	-do-	Phytoconcreation 8x3x2 cm, hard stone like-35g in weight	-do-	-do-
10.	Black buck	5Yrs/M	Bundle of ropes and clothes weighing 50g indicating pica	-do-	-do-
11.	Chinkara	Adult/M	Phyto-and piliconcretion each having 4.0 ocm diameter and weighed 287g	-do-	-do-
12.	Mithun	4.5Yrs/M	Two big sheets of thick plastic sheets weighing about 200g	-do-	-do-
13.	Four-horned antelope	Adult/M	A number of plastic bags	-do-	-do-

Sl No	Kind of animals birds	Age/sex	Types of foreign body with description	Site of lodgement	Remarks
	B. Carnivores				
14.	Himalayan throated marten	5Yrs/M	Four pieces of iron nails weighing 18g	Stomach	Traumatic gastritis as these pierced through stomach
15.	Indian lion	Adult/M	Hair ball	Small intestine	
16.	African lion	17Yrs/M	-do-	-do-	
17.	Tiger	14Yrs/M	Sharp pointed bony splinter pierced through wall of jejunum	Jejunum	peritonitis
18.	Sloth bear	4Yrs/M	Two elongaed masses 14.5 and 16.0 cm in length with tapering ends consisting of tufts of hair	-do-	Dull, listness disinclined to move prior to death
19.	Binturong	10Yrs/M	Large intestine packed with straw and hair balls	Large intestine	Intestinal obstruction gangrenous enteritis
	C. Avian				
20.	Green pigeon	5-6Yrs/F	Thorn of plant about 2 cm in length	Small intestine	Traumatic entero-peritonitis
21.	White ibis	23 days/M	Three iron wires 2-3 cm in length	Gizzard	One wire pierced through gizzard and adhered to peritoneum Fibrionopurulent oeritonitis
22.	Adjutant stork	5-6Yrs/M	Stick of vegetable origin 8.0 x 2.0 cm	-do-	Traumatic vetriculo-peritonitis
23.	Common pigeon	2Yrs/F	L-shaped staple wire pierced through peritoneum	-do-	-do-
24.	White peacock	12Yrs/M	Stick of vegetable origin 4.3 x 0.3 cm	-do-	Empty gizzard
25.	Pea hen	4Yrs/F	Rusted iron wire 4 cm in length	Heart & peritoneum	Dull, depresed fibrinopurulent pericarditis peritonitis[2]
26.	Domestic goose	Adult/F	Impaction with dry sand	Proventriculus, Gizzard and duodenum	Death due to impaction

M = Male F = Female. The observations at Sl. No. 2 and 25 have already been published.

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Short Communication

CAUSES OF MORTALITY IN LEOPARDS AT NANDANKANAN ZOO

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Though leopards or panthers are widely distributed throughout the Indian subcontinent in free-living state and are also kept for exhibition in Zoological parks, diseases and causes of mortality are poorly understood except for few case reports on some of the infectious diseases such as rabies[2], inclusion body hepatitis[3,11], infectious feline enteritis[10], tuberculosis[8], anthrax[9], salmonellosis[4,13], trypanosomiasis[12] and certain neoplasms[14]. The purpose of this communication is to highlight the common causes of death in leopards at Nandankanan zoo.

Data in relation to mortality of 108 leopards (59 zoo born and 49 procured) at Nandankanan Biological Park were collected including informations pertaining to date of arrival/birth/death, sex/age from October, 1967 to October, 1992. The animals were broadly divided into 3 different age group[8] viz., neonates (day old to 1 mo.), young (1 mo to 1 yr.) and adult (above 1yr). The specific cause of mortality was determined on the basis of history, gross pathoanatomical changes observed at necropsy and histopathological examination, wherever found necessary.

Maximum deaths (60%) occurred during neonatal period (Table 1) mostly due to non-infectious causes such as infantophagia, maternal rejection, transit/captivity stress, still-birth, aspiration pneumonia, etc. Infantophagia is a common vice in leopards. Death due to maternal rejection occurred in zoo born cubs as a result of lack of care by the mother. Similar pattern of mortality has also been observed in tigers[5], lions[6] and lesser cats[7] at this zoo. Transit/captivity stress also contributed in neonatal death as most of the young ones procured died within a week of captivity. Aspiration pneumonia in neonates occurred due to faulty artificial feeding. Nearly 70% of the deaths in general occurred during May - June and September - December. Incidentally majority of births occurred during this period at the zoo.

Deaths due to senility occurred when the animals attained the age of 18-23 yrs. Chronic nephritis was a common ailment in these animals as was stated in non-domestic felines[1]. Concomitantly cirrhosis and heart worms in right ventricle were seen in 2 leopards. Heart worms were also seen in 2 leopards which died of haemorrhagic cystitis and suppurative pleuritis. The adult leopard which died of paralysis had lesions of non-suppurative menignitis with perivascular cuffing by mononuclear cells, though suggestive of rabies, remained unconfirmed. A case of myxoma in a 2 - month old cub was confirmed on biopsy of shoulder skin growth which did not reoccur after surgical extirpation. Infectious feline enteritis in leopards occurred as a part

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of the outbreak of disease in other feilds like tigers and lions in the zoo.

From the table (1) it appears that out of a total death of 108, the death due to noninfectious etiology (maternal rejection - 27, transit/captivity stress - 20, canibalism - 14, traumatic injuries - 4 and intussusception of intestine - 4) accounted for 69 (64%) leopards. Thus it may be concluded that since noninfectious cases were responsible for major losses, due improvement in husbandry practices and management care may help in reducing these losses.

Table 1: Cause specific mortality in leopards

Sl. No.	Causes of mortality	Sex		Age of animal species			Total
		M	F	Neonate	Young	Adult	
1.	Maternal rejection	8	19	27	-	-	27
2.	Transit/captivity stress	7	13	19	-	1	20
3.	Canibalism	9	5	6	7	1	14
4.	Senility	4	3	-	-	7	7
5.	Still-birth including congenital defects	3	2	5	-	-	5
6.	Feline infectious enteritis	3	2	-	5	-	5
7.	Pneumonia	3	2	4	-	1	5
8.	Traumatic injuries	2	2	-	3	1	4
9.	Intussusception of intestine	3	1	1	2	1	4
10.	Suppurative pleuritis/pneumonia	2	2	-	-	4	4
11.	Toxaemia/septicaemia	2	1	-	-	3	3
12.	Nephritis	-	2	2	-	-	2
13.	Haemorrhagic cystitis	-	1	-	1	-	1
14.	Ulcerative gastritis	1	-	-	1	-	1
15.	Paralysis	1	-	-	-	1	1
16.	Peritonitis	-	1	-	-	1	1
17.	Myxoma (Biopsy)	1	-	-	1	-	1
18.	Autolysed	2	1	-	2	1	3
		51	57	64	22	22	108

M = Male F = Female

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PATHOLOGICAL CONDITIONS IN AQUATIC BIRDS AT NANDANKANAN ZOO - AN OVERVIEW

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SUMMARY

A study was undertaken to elucidate the causes of mortality in 131 aquatic birds of 16 varieties which died at Nandankanan Biological Park during 1968-1993 based on gross and histopathology. The important conditions encountered in decreasing order of frequency were neoplasms (21.3%), hepatitis (11.5%), aspergillosis and visceral gout (8.4% each), tetrameriasis (7.6%), nodular lesions caused by *Chaunocephalus ferox* (6.1%), traumatic injuries (5.3%), transit stress and pneumonia (4.9% each) tuberculosis, amyloidosis and impaction of digestive tract (1.5% each) and other miscellaneous conditions. It was concluded that non-infectious diseases formed nearly 45% of the total deaths followed by parasitic lesions (14.5%) and tuberculosis (1.5%). Such consolidated information covering long period of time would be of considerable value in combating the losses in captive birds.

Key Words: Causes of mortality, aquatic birds, non-infectious, parasitic and infectious diseases.

INTRODUCTION

Though aves form an important group of exhibits in any Biological Park, very less is known about the causes of death/diseases in indian Zoos. Information on diagnosis particularly based on gross and histophatology of the common diseases has been lacking though sporadic reports of diseases such as tuberculosis[7,24,25], parasitic diseases[2,10,11,25], Newcastle disease[25], gout[9] and amyloidosis[8] have been reported.

MATERIALS AND METHODS

Materials for this study were based on detailed necropsy and histopathological examination of 131 aquatic birds : Muscovy ducks (*Cairina moschata*)-23, Pintail (*Anus acuta*)-10, Brahminy duck (*Tadorna tadorna*)-6 and other ducks such as lesser whistling teal (*Dendrocygna javanica*)-2: comb duck (*Sarkindiornis melanotos*)-1: black swan (*Chenopis atrata*)-1: gadwal (*Anas strepera*)-1: wigeon (*Anas penelope*)-2: pochard (*Netta rufina*)-3: geese (*Anser* sp.)-46: cranes (*Grus* sp)-11: storks (*Anastomus oscitans*), herons (*Ardea cinerea*), paddy birds (*Ardeola gravii*)-17 and white ibis (*Threskiornis melanocephala*)-7) died during 1968-1993 at Nandankanan Biological Park. Apart from routine haematoxyline and eosin stain, special staining techniques such as Periodic acid Schiff's reaction for aspergillus species, Perl's prussian blue stain for haemosiderin, DeGalantha's stain for urates, Zeihl Neelsen's carbol fuchsin staining for acid fast organisms, Oil red O for fat, phosphotungstic acid haematoxyline (PTAH) for fibrin and congo red staining for amyloid were employed, wherever necessary.

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RESULTS AND DISCUSSION

The list of diseases and causes of death have been given in Table 1. Table 2 shows check list of neoplasms in various species of birds[1]. Among all the species the incidence of neoplasms in muscovy ducks was curiously examined since the arrival of the parent stock at the zoo in January, 1970. Initially two muscovy ducks were purchased from the local dealer. Six more were procured in January, 1973. From this parent stock fertile eggs were incubated, hatched and 31 ducks were successfully reared upto adult stage during 1975 - 1992 of which 17 birds died of neoplasia a frequency unparallel among other birds. Though the average life span of muscovy ducks particularly in captivity under Indian conditions is not available, the so called "Cancer age" appears to be 5 - 8 years. Majority of the tumours originated from mesothelium of pleura/peritoneum and bronchial/bile duct epithelium. It was further noticed that the aquatic birds had much higher incidence of neoplasms than non-aquatic ones and malignancy predominated over benign. There was a direct co-relationship between occurrence of cirrhosis and neoplasia in muscovy ducks as in case of humans suggesting the possible etiological role of chronic inflammation[5] coupled with possible atmospheric[25] and water pollution[3] might be contributing factors for high incidence of some of the tumours e.g. mesothelioma as the zoo is adjacent to a glass factory.

Pulmonary aspergillosis with or without involvement of thoracoabdominal air sacs was encountered in 11 adults (geese-4, pintail-4, pochard, stork and rosy pelican-1 each). In the rosy pelican there was generalised involvement of intestines and pelvic muscles apart from lungs and air sacs characterised by presence of numerous irregular plaques measuring 2-3mm in diameter. In all the other birds solitary/multiple yellowish white black/greenish nodules in one or both the lungs which were invariably congested and edematous were seen. Diagnosis in all these cases was based on demonstration of branched septate hyphae with or without conidia in the epithelioid granuloma with or without caseation. It was opined that aspergillosis was one of the most common diseases in captive birds[1,19] and was seen in past at several zoos[12,16,18,23]. Though it is a fatal disease of young but at this zoo it occurred only in adults in sporadic form.

Parasitic proventriculitis caused by *Tetrameres* sp. was encountered in 7.6 of birds necropsied (Brahminy duck, Sparus crane (*Grus antigon*) and strok-2 each, pin tail, wigeon, white ibis and pochard-1 each). At necropsy numerous dark coloured uniform nodular elevations were detected in the luminal side of proventriculus. On incision of the nodules blood red coloured, fusiform or spherical spiruroid nematodes admixed with mucous exudates were seen, confirming the details given earlier[6]. Tetrameres parasitizing the proventriculus of wild duck and quails was also reported from Assam[4].

Visceral gout was reported in 11 adult geese in which kidneys were invariably affected followed by heart (8), liver (5), joints (3) and pleura (1). The serosal surfaces were covered with chalky white crystals of urates where as the kidneys were swollen, light in colour due to chalky white materials. Tubules had distinct markings and uraters were distended with urates. Sections of kidneys showed chronic glomerulonephiritis associated with gouty tophi. Kronberger and schuppel[17] also considered gout to be one of the important diseases of captive birds.

Nodular lesions in the postduodenal part of small intestine caused by *Chaunocephalus (c) ferox* in the form of epizootic disease were

Table 1 Diseases/causes of death in aquatic birds

Disease/condition	Moscovy duck	Pitail	Brahminy duck	Other ducks	Geese	Crane	Herons, storks paddy bird	Ibis	Percentage
	Different species of aquatic birds								
1. Neoplasms	17	2	1	2	3	3	-	-	21.3
2. Aspergillosis	-	3	-	2	4	-	2	-	8.4
3. Parasitic proventriculitis	-	1	2	2	-	2	2	1	7.6
4. Nodular lesions by C.ferox	-	-	-	-	-	-	8	-	6.1
5. Parasitic serositis	-	-	1	-	-	-	-	-	0.8
6. Visceral gout	-	-	-	-	11	-	-	-	8.4
7. Hepatitis	4	1	2	1	2	3	2	-	11.5
8. Bumble foot	1	-	-	-	1	1	-	-	2.3
9. Egg peritonitis	-	1	-	-	1	-	-	-	1.5
10. Traumatic injuries	-	-	-	-	5	-	1	1	5.3
11. Transit stress	-	-	-	-	4	-	-	2	4.9
12. Pneumonia	-	-	-	1	4	-	1	-	4.9
13. Tuberculosis	-	-	-	2	-	-	-	-	1.5
14. Amyloidosis	-	-	-	1	1	-	-	-	1.5
15. Impaction in digestive tract	-	-	-	-	2	-	-	-	1.5
16. Senility	-	-	-	-	-	1	-	-	0.8
17. Lameness	-	-	-	-	-	-	1	-	0.8
18. Traumatic ventriculo peritonitis	-	-	-	-	2	-	-	1	2.3
19. Ulcerative enteritis	-	-	-	-	-	-	-	1	0.8
20. Pericarditis	-	-	-	-	1	-	-	-	0.8
21. Undetermined	1	-	-	-	5	1	-	-	6.9

Table 2: Neoplasms diagnosed in avians at Nandankanan

Species of bird	Cholangio-cellular carcinoma	Mesothelioma	Bronchogenic carcinoma	Carcinoid Lung	Carcinoid Intestine	Aortic body tumour	Myxosarcoma	Fibroma	Haemangioma
Moscovy duck	6	6	4	-	-	-	-	-	1
Pintail	-	-	-	2	-	-	-	-	-
Brahminy duck	-	-	-	-	-	1	-	-	-
Geese	-	-	-	-	-	-	1	1	-
Cranes	-	3	-	-	1	-	-	-	-
Female comb duck	-	1	-	-	-	-	-	-	-
Crested pochard	-	-	1	-	-	-	-	-	-

recorded in open billed storks[20].

The serosa of gastrointestinal tract starting from proventriculus to caeca of a Brahminy duck was studded with numerous discrete pin-head sized greyish white nodules which on microscopic examination showed sections of parasites surrounded by monocytes, foreign body giant cells and fibrous connective tissue. The parasites causing serositis remained unidentified.

During routine necropsy/faecal sample examination *Tetrameres* sp., *Petasiger antigonus*, *Echynoparyphium* sp. *Opisthorchis* sp. in sarus crane, *C.ferox*, *Synhimantus laticeps* from open-billed storks, *Patagifer wesleyi*, *Patagifer chandrapuri* and *Tetrameres* sp. from white ibis, *Microsoma canthus*, *filirostris* from spoon bills and *Fimbriaria facioloaris* and *Tetrameres* species from pin tail were recovered. The pathology of some of which has been described[20] but the others did not cause any visible alternations.

Toxic/necrotic hepathtis was one of the most common lesions observed in most of the aquatic birds. The lesions varied from cellular swelling of hepatocytes to frank necrosis and cirrohosis. The latter being the most common in all the aves affected with neoplasia. In one goose there was metaplastic ossification having numerous bony spicules surrounded by a zone of infiltrating macrophages, foreign body giantcells, heterophil and lipid cysts in cirrhotic liver. In one of the muscovy ducks the enlarged liver had diffuse areas of brownish discolouration amongst two non-parasitic cysts and greyish white foci. The brownish discolouration was due to hemosiderosis of the hepatocytes whereas the greyish white foci were due to cirrohosis accompanied by biliary hyperplasia.

Non-specific pneumonia characterised by congestion/ consolidation of lungs and stress due to transport resulting in death within a week of arrival at the zoo was seen in 4.9% each of the total deaths.

Tuberculosis was reported in domestic duck and lesser whistling teal involving the spleen, lungs and liver with caseous nodules surrounded by epithelioid cells and foreign body giant cells without calcification. Liver exhibited fibrin deposits in teal while in the duck there was amyloidosis. The disease was diagnosed on the basis of demonstration of acid fast organisms morphologically indistinguishable from *Mycobacterium tuberculosis*. Earlier tuberculosis and amyloidosis in a sarus crane was reported from Madras zoo[7] and tuberculosis in wide varieties of birds from Alipore zoo[24,25]. Highest annual mortality of 4% out of 127 birds of 22 orders at National Zoological Gardens, Washington[18] had tuberculosis of which 20% had amyloidosis. During routine histopathological examination in this study, a case of possible primary amyloidosis involved majority of glomeruli of both the kidneys, liver and thyroid was reported in a black swan without any other pathological involvement[21].

Infighting resulting in multiple traumatic injuries in different parts of the body and death due to haemorrhagic shock was found (5.3%) in heavy birds particularly geese and stroks. It has been stated that trauma is one of the most common causes of death in captive birds[15]. Highest number of deaths (32%) due to external injuries among aves at Kanpur zoo was reported during 1982-1985[14]. Geese and ducks were killed by infighting due to adverse weather conditions like violent tornadoes and abrupt changes in wind direction[5]. The aquatic birds particularly those having long legs are prone to injuries and abnormalities[13].

Duodenal obstruction due to enterolith causing ulcerative enteritis was noticed in a female white ibis. A female domestic goose was found to be dull, depressed, anorectic and reluctant to walk before death. At necropsy the whole proventriculus, gizzard and anterior one fourth of deodenum were over distended and packed with dry sand occupying entire abdominal cavity. The liver and spleen were atropied. In one of the gooslings (3 weeks), 3 pieces of iron wires measuring 2 - 3 cms in length had pierced through the gizzard and one of the nails was adhered to peritoneum causing fibrinopurulent peritonitis. In one of the male adjutant storks aged 5 - 6 years a piece of vegetable origin measuring 8 x 2 cm had pierced through the gizzard causing ventriculoperitonitis. It was opined[13] that the ingestion of foreign bodies could cause gizzard impaction, diarrhoea, vomition, partial/ total obstruction of the digestive tract.

It has been concluded from the study that non-infectious causes of death such as neoplasms, gout, traumatic injuries, stress, amylodiosis, impaction, senility, etc. formed nearly 46% of the total deaths at this zoological Garden, followed by parasitic conditions and infectious diseases, predominated by aspergillosis and rarely tuberculosis. Nonspecific hepatitis and pneumonia were also quite common lesions in aquatic birds. Thus it gives a consolidated information which is not available from any Indian zoos.

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A note on the histopathology of lungs of a leopard cat (*Felis bengalensis*) due to *Filaroides osleri* (Cobbold, 1879) Skrjabin, 1933

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Received: August 27, 1970

The present communication records for the first time the occurrence of *Filaroides osleri* in a leopard cat (*Felis bengalensis*). A leopard cat was caught from Simulipal National Park (Mayurbhanj district, Orissa) and was immediately sent to Nandan Kanan (State Biological Park) on March 18, 1968. After developing dyspnoea it died on March 20, 1968. On post-mortem examination pieces of lesioned portions of lungs were fixed in 10 per cent formalin for subsequent histologic study. Serial sections, 5 μ thick, were prepared from portions of pulmonary nodules from different lobes, and were stained in Ehrlich's haematoxylin and eosin.

Gross pathology

The lungs revealed multiple, greyish, pea-sized hard nodules. Two or three of such nodules had coalesced together to form larger nodules. Fragments of adult nematodes were recovered on incision. The general appearance of the lungs was one of interstitial pneumonia. The bronchial mucosa was rough and slightly elevated. A few adult parasites, admixed with exudates, were encountered in the bronchi and bronchioles.

Histopathology

Viviparous adult females in coiled position were found inside parasitic nodules (Figs 1, 2). Characteristic features of the rounded tail and the position of the vulva close to the anus in a depression were evident from a reconstruction of the sections of female worm (Fig. 2). The embryonated eggs measured 60–67 $\mu \times 35$–$40\ \mu$ (av 65 $\mu \times 38\ \mu$) in size. The first-stage larvae, hatched out in the pulmonary tissue and 250–270 μ long and 9·6 μ wide, revealed typically S-shaped undulating tail (Fig. 3). These features tallied fully with the description given for *F. osleri* (Soulsby, 1965; Levine, 1968). Males were, however, not encountered in the tissues.

The parasitic nodules, essentially of a thick but highly vascular granulation tissue, with abundant collagen fibres, exhibited at places hyalinization, and infiltration with macrophages, lymphocytes, plasma cells, eosinophils and a few giant cells. In some of the sections, the bronchial lumen was much narrowed due to the pressure of the adjacent nodules. In others it was distended with exudates along with inflammatory cells and first-stage larvae. The peribronchial mucous glands revealed extensive hyperplasia and a marked hypertrophy of the peribronchial musculature. The interalveolar septa were thickened due to the presence of varying amounts of oedematous fluid. The interalveolar capillaries were distended. The infiltrating macrophages were heavily loaded with haemosiderin.

The gross lesions observed in this host greatly differed from those seen in dogs. In the latter the tracheal and bronchial nodule formation was more prominent and only occasional nodules were described in the lungs. In the present study, slightly rough nodular elevations were detected at the tracheal

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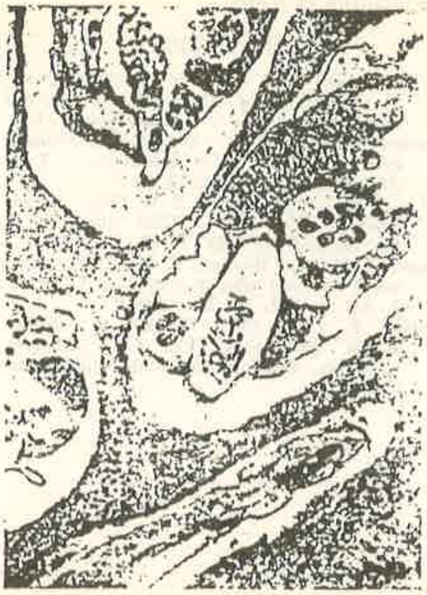

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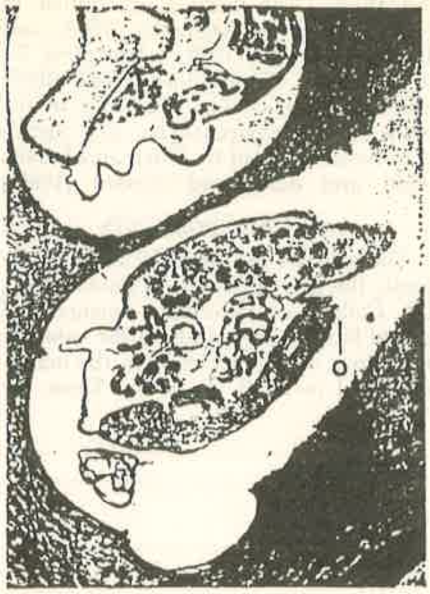

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Fig. 1. Part of a section of a pulmonary nodule showing portions of gravid females with an anterior end. × 90.

Fig. 2. Part of a section of a pulmonary nodule showing vulvar opening (o) in the posterior end of a female worm. × 85.

Fig. 3. Part of a section of a pulmonary nodule showing two first-stage larvae (one complete with characteristic S-shaped tail) in the lung parenchyma. Note the cellular infiltration and groups of red blood cells. × 480.

bifurcation. The findings are similar to those recorded by Malherbe (1954) and Mills and Nielsen (1966). Excepting for the presence of prominent eosinophilic infiltration, the cellular reactions in the nodules and the parenchyma were identical to those reported by Óslen and Braken (1959) and Mills and Nielsen (1966).

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Parotitis in captive *Panthera pardus* and *Panthera leo persica*

The Nandan Kanan Biological Park. Orissa maintained 13 panthers and two lions. On 2.8.81, one male Indian lion and 3 black panthers were marked off feed and dull. Subsequently, profuse frothy salivation, disinclination to move and swelling either on right or left side of the throat at the base of the jaw were noticed in all cases. The animals were mostly found at resting position with their eyes closed and head down. Physical examination showed acute painful swelling of the parotid gland in 3 panthers that could be examined. The condition was clinically diagnosed as parotitis.

The animals were treated with tetracycline hydrochloride. pheneramine maleate and vitamin C daily for 3 days orally in drinking water, the doses depending upon the size.

The acute clinical signs subsided in all animals 48 hr after initiation of treatment. The animals appeared active and the swelling of the salivery gland reduced considerably. There was slight improvement in the appetite. Complete clinical cure was obtained a week after completion of the treatment except one lion where signs of parotitis reappeared 5 days after treatment. The lion was again treated as per previous schedule for 3 days. Complete recovery was noticed 48 hr later. No further recurrence or extension of the ailment in new animals was rec-rded.

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preparations. The Mithun started ruminating 3 days after administration of Berenil with gradual development in appetite. Peculiarly enough, coffee coloured urine appeared again on 30.7.82 without any other abnormal clinical signs. A second dose of Berenil was given on the same day. The urine became clear after 18 hours. The animal showed normal appetite, rumination and picked up health by next 10 days.

Babesiosis has been recognised in most of the domestic animals and many wildlife such as Jackals, Zebra, Reindeer, spotted Deer, Square-lipped Rhinoceros and Bandicoot (Dissanaike, 1963 ; Denning, 1966 ; Nilsson *et. al.* 1965 ; Manwell and Kuntz, 1964 ; Bigalke *et. at.* 1970). Wildlife acting as reservoir host for domestic animals is mainly as speculation with little ivestigational data (Ristic and Lewis, 1977).

Clinically detectable haemolysis (haemoglobinuria) is ordinarily seen after an incubation period of 7-20 days in affected animals and the total course of the disease is about 3 weeks (Blood *et. al.*, 1979). In the present case, the duration of the disease was more than 40 days. This may be due to the milder from of the disease in which parasitaemia might have been suggested by Mahony (1977). Haemoglobinuria appeared after the body resistance of Mithun went down due to prolonged anorexia.

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BABESIOSIS IN A MALE MITHUN (*BOS FRONTALIS*)

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The Mithun or Gayal (*Bos frontalis* is a semiwild animal found in the North-eastern states of India. It is similar to Gaur (*Bos gaurus*) excepting that the horns project almost horizontally with only a slight curve.

A pair of Mithuns procured for Nandankanan Biological Park, Orissa, during April, 1981 from Arunachal Pradesh, were kept in an enclosure away from other herbivorous animals and were maintained on concentrate ration, green grass and tree fodder. The present paper records a clinical case of babesiosis and its successful treatment in the male Mithun.

The male Mithun showed signs of sluggish movement, inactiveness and partial anorexia on 15.6.1982. The Mithun was treated immediately with stomachic powder, Liv-52 tablets, Tonophosphan injection and vitamin preparations without any improvement on appetite. It was again treated with Distodin (Pfizer) on 3.7.82 and on 10.7.82 (administered mith banana) as the faecal examination showed presence of amphistome ova. At that time the animal was found to be very dull and could be easily handled. The Mithun was further treated with Dextrose (5%) and Mifex (intravenously), Livogen (Intramuscularly) and Complex B liquid, Yeast tablets, Vitablend AD_3 and lactic acid (orally). Forced feeding of gruel and concentrates was done for about 18 days without significant improvement in appetite.

The Mithun developed temperature (104°F) on 26.7.82 morning and was found to be extremely dull, red coloured urine appeared few hours later. Peripheral blood smear showed *Babesia* piroplasms in about 10% of red blood cells. The haemoglobin content of blood was found to be 9 g%. Immediately, the animal was treated with 4 g of Berenil (Hoechst) intramuscularly. Forced feeding and general treatment continued. The urine appeared to be normal 24 hours after administration of Berenil and the animal started taking some concentrates and grass of its own. About 2 liters of rumen content was given orally daily for 7 days along with vitamin

Indian J: Vet. Med. 2 (2) : 84-86, December 1982 Letters to the Editor

CHRONIC ANOREXIA IN A FEMALE HIMALAYAN BLACK BEAR (*SELENARECTOS THIBETANUS*)

A pair of Himalayan Black Bears is being maintained at the Nandan Kanan Biological Park, Orissa since 1.7.78. They are fed with a diet of boiled rice, bread, milk, pumpkin, sweet potato and occasionally sugar cane Unlike the sloth bear, this species of bear freely gets into water for bath. Mating of this pair of bears was observed on April 24th to 30th, 1981.

The female bear showed partial anorexia from 6.12.81—12.12.81 followed by complete anorexia for about 33 days i.e. upto 7 1.1982. The other signs noticed were sluggish movement, constipation, and disinclination to get into the water. Repeated examination of stool during the period did not reveal helminthiasis. The bear was treated with Hostacycline water soluble powder (Hoechst), Carmozyme, Liv. 52 drops (Himalayan Drug Co.), Glucone-D (Glaxo), Complex B liquid (Glaxo), Electral powder in drinking water and Uniazyme (UNICHEM) and Celin 500 mg (Glaxo) tablets with honey from 6.12.81 (the starting of the ailment) to 2.1.82. The medicines were mostly refused and occasionally partly taken by the animal.

She was put inside the squeeze cage from 13.12.81 to 16.12.81 and again from 23.12.81 to 30 12.81 and was given a course of Dicrysticin—S 2.5g (Sarabhai), Betamyl (Sarabhai) and Vibelan (Glaxo) injections besides lukewarm soap water enema (on two occasions). No improvement could be seen in the appetite of the bear and she continued to refuse food totally.

The bear gave birth to two male cubs including one stillborn on 3 1.82. The mother bear was seen lying on one side in a curled up condition keeping the newborn cubs inside. No treatment was given after 3 1.82

The bear started taking some quantity of bread on 6th day after delivery. Slowly, her appetite improved and full quantity of food was taken from 15.1.82 onwards. (12 days after delivery)

From the above observation a question arises whether the long standing anorexia in the Himalayan Black Bear could be usual during the pre and post parturient period.

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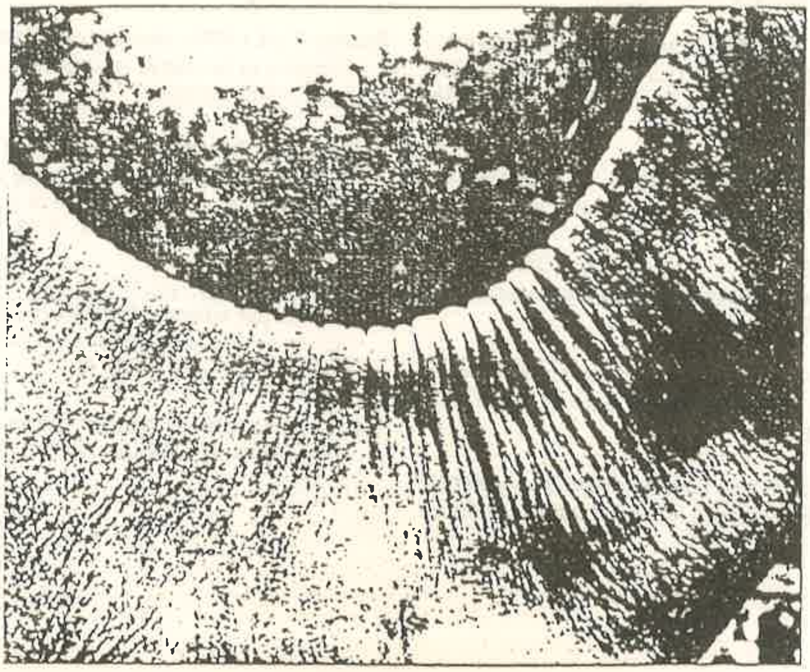

Fig 5. Male camel after treatment with 0.1% asuntol showing very little improvement

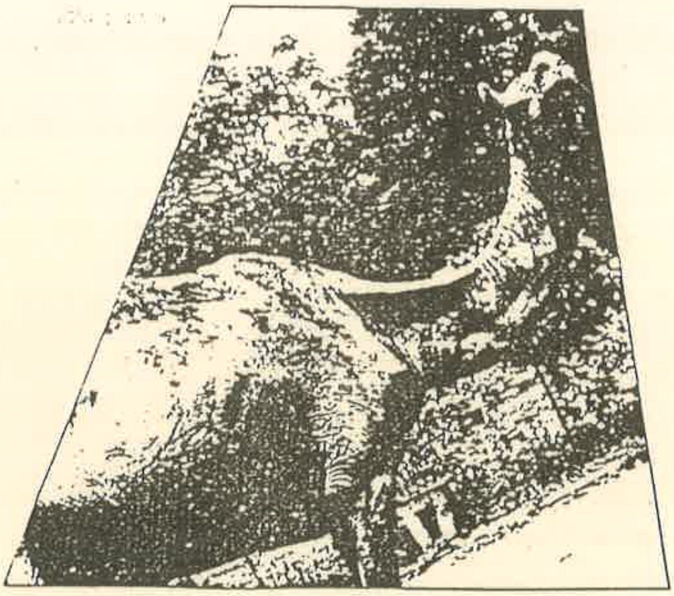

Fig 6. Female camel after 3rd application of HIMAX (lotion) showing marked improvement.

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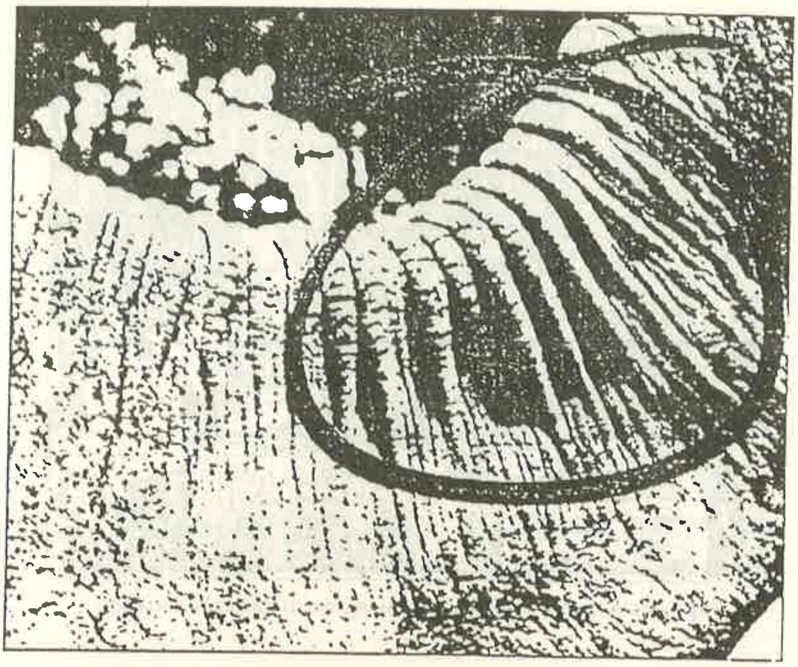

Fig 3. Male camel showing thickening & corrugation of skin over neck due to sarcoptic mange

Fig 4. Female camel showing thickening & corrugation of skin at brisket area with generalised alopecia

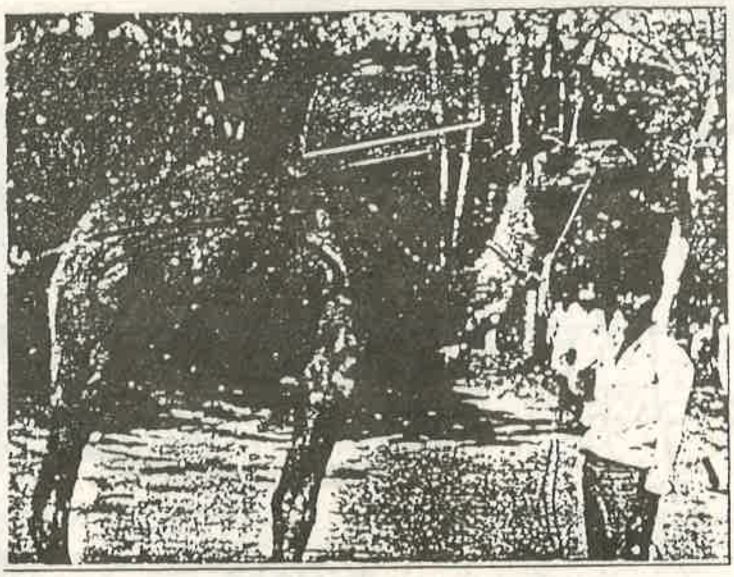

Fig 1. Male camel showing initial lesion of sarcoptic mange

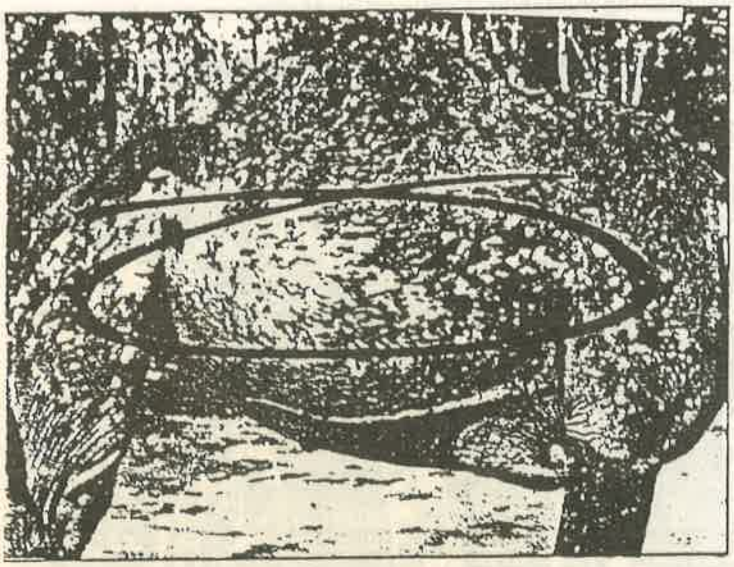

Fig 2. Female camel showing initial lesion of sarcoptic mange

There was not much improvement in the Asuntol treated male camel though the lesions were slightly suppressed. Examination of skin scraping after the treatment revealed the presence of mites (Fig. 5). On the other hand the female camel being treated with **HIMAX LOTION** showed appreciable improvement (Fig. 6). The body coat was smooth and no pruritus was evident. No mites could be detected in the skin scrapings.

Discussion

Sarcoptic mange, caused by *Sarcoptes scabiei* var *cameli* (Soulsby. 1978) has been described as a serious, contagious, debilitating and most damaging skin disease of camel (Higgins, 1987). It has been reported to be prevalent in camel with low plain of nutrition (EL Bihari. 1985) and seen mostly during winter (Lodha. 1966; Rathore and Lodha, 1973). The disease is found to be of zoonotic importance (Leese. 1927). Topical application of hexachlorocyclohexane (HCH) or diazinone at 10 days interval for 4 times has been reported to be effective (Higgins, 1984). Similarly, report of successful use of "I vermectin" @0.2mg/1kg subcut has been reported by Ibrahim *et al* (1931) and Chellappa (1989). Lang (1982) has mentioned about use of 0.05% solution of Lindane, 2.5% solution of Neguvon and 5% solution of Alugon in camel with successful result. Since none of them were available locally at that time, they could not be tried.

From the result of the trial, it is clear that 4 or more applications of HIMAX LOTION could be used for successful treatment of sarcoptic mange in camels as has been reported by Tripathy et al. (1986) on sarcoptic mange of dog, Tripathy *et al.* (1988) on demodectic mange of dog and Tripathy (1989) on Psoroptic mange of cattle. Topical application of **HIMAX LOTION** appears to be suitable for treatment of sarcoptic mange in camels.

Summary

The study was conducted in 2 adult, one-humped camels (*Camelus dromedarius*). Topical application of **HIMAX LOTION**, a herbal preparation (IH-SRE), on one camel for 4 times at 3-10 days interval brought clinical recovery without any adverse effect. Spray of 0.1% Asuntol solution 4 times at 7 days interval had no significant therapeutic effect in another camel.

Acknowledgement

The authors are very much thankful to Dr. P.K. Das, Lecturer, Department of Medicine and Sri S.K. Mohanty, Forest Range Officer, State Biological Park for rendering all possible help in this study and for the photographs.

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SARCOPTIC MANGE IN CAMEL AND ITS TREATMENT

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Two adult camels *(Camelus dromedarious)* one male and one female were brought to the State Biological Park, Orissa from Rajasthan during August, 1988. The animals were housed in a spacious open shed with sandy floor and were being fed with crushed bajra and Lompati. Both the camels were looking weak and dull from the time of arrival, which was thought to be due to stress of transportation and change of weather.

About 3 months after their arrival, the female developed some dermatitic patches on the side of the body and few pimples like red swelling on the perineal area. About 10 - 12 days later, similar lesions were observed in the male camel also. Sulphur liniment was applied on the affected area once daily for 15 days without any cure. About a month later, patchy - dermatitis and alopecia with pruritus were detected on many parts of the body (Fig. 1 and 2). Examination of skin scrapings by KOH mount were negative for parasites. However, both the camels were sprayed thoroughly with 0.1% Asuntol solution supported with parenteral administration of Siolan @ 10ml. I/M (milk with iodine on alternate days for 4 injections) and Minamil @ 25 gm daily (a vitamin-mineral mixture) with feed for 15 days but no improvement was noticed.

The dermatitic lesions and itching gradually increased and within one and a half months thickening and corrugation of skin with crusts were detected in many parts of the body specially on neck, brisket area and perineal area (Fig. 3 & 4). Examination of skin scrapings revealed *Sarcoptes* mites.

As preparations like Mitaban, Ivermectin etc., were not available locally, the female camel was treated with **HIMAX LOTION**[3] and the male with Asuntol (0.1% solution). **HIMAX LOTION** was applied 4 times at 3 - 10 days interval all over the body by a brush and Asuntol was sprayed all over the body at 7 days interval, 4 times. Minamil[4] was continued with feed and antihistaminic[5] was given intramuscularly for first 3 days of treatment to each camel.

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3. Himax (lotion) was supplied by M/s. Indian Herbs. Saharanpur for trial on other domestic animals

4. A mineral vitamin preparation of M/s. Brihans Laboratories. Bombay was given @ 25 gms. daily with feed

5. Zeet injection, a preparation of M/s. Alembic was given @ 5 ml. intramuscularly

consumption of large amount of grass in nature (Prater, 1971).

In artificial rearing condition, in the Deer Park, probably a negative balance was created leading to such condition. It is also known that rutting season begins with the full growth of antlers which means negative calcium balance during breeding period making the animal more vulnerable to physical deformity.

Vitamin-mineral mixture helped to replace the deficiency and LIVOL probably helped in the better assimilation of nutrients and improving feed efficiency.

Summary

Paraplegia-like syndrome was recorded in the stags of a Deer Park, which had a population of 87 spotted deer (*Axis Axis*) and 22 black buck (*Antelope cervicapra*) of various age groups (1 month to 15 years) and of either sex. Death of 7 stags of 4-13 years age at different stages of velvet on thegrowing antlers, was recorded during March to June, 1989. Post mortem examination revealed no pathognomonic lesions except fracture of long bones which was thought to be due to violent struggling after falling down, showing clinical signs of lumber weakness for a day or two.

Addition of 450 g vitamin-mineral mixture and 500 g of LIVOL, a herbal liver tonic (IH-SRE), in the feed mash of animals daily for 10 days at 2 months interval checked the condition indicating the syndrome to be due to mineral deficiency during the growing stages of antlers with velvet.

Acknowledgement

The authors are thankful to the Forest Department Officials incharge of the Park for their cooperation.

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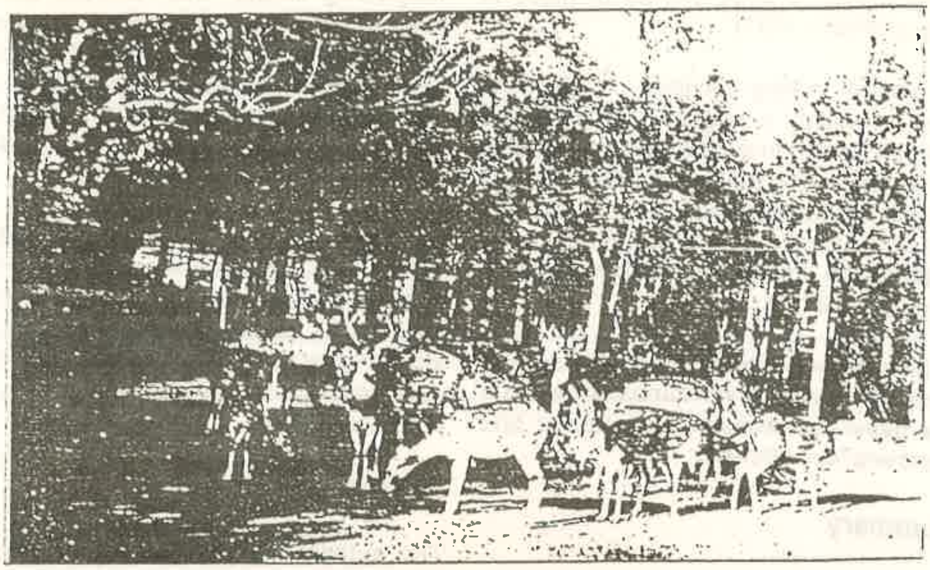

Fig 1. Spotted deer within wire fencing

Fig 2. A solitary healthy male spotted deer with growing antler

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PARAPLEGIA - LIKE SYNDROME IN STAGS *(AXIS AXIS)* AND ITS TREATMENT

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Paraplegia-like signs were seen in healthy wellgrown adult stags (spotted deer) in the Deer Park of Bhubaneswar during March to June. 1989.

There were 87 spotted deer (38 male and 49 female) and 22 black buck *(Antelope cervicapra)* of various age groups (1 month to 15 years) at that time in the Deer Park. The animals were kept inside a wire fencing (Fig. 1) over hard rock (Fig.2) and were fed a mixture of crushed ragi, kulthi, groundnut oil cake, fine rice bran and mineral-vitamin supplement @ 1% of the mash.

Case History

Death of 5 adult stags out of 27 was recorded during the period March and April, 89. All the animals showed common clinical signs before death *viz.* lumber weakness, change in posture, staggering gait, reduced movement with more or less normal appetite. Finally, they became recumbent and showed violent struggling movement. Death of the stags occurred within 3 days of exhibiting the above clinical signs. Post mortem examination did not reveal any pathognomonic lesions except fracture of long bones at various sites which was thought to be secondary due to violent struggling. All the dead animals showed various stages of velvet on the growing antlers.

Treatment and Result

It was recommended to give extra vitamin-mineral mixture @ 450 g daily along with LIVOL[2] a herbal liver tonic, @ 500 g per day for 10 days along with the feed for all the animals.

The animals accepted the feed very well and their condition improved within 10 days. The treatment was continued for another 7 days. No such clinical signs were noticed for about 1 1.2 months and then suddenly 2 stags died exhibiting same signs. Above treatment was repeated for another 10 days and no trouble has occurred since then.

Discussion

Results of the treatment indicated that there was mineral deficiency. It has been reported that the calcium requirement of the animal increases tremendously during formation of new antlers which usually is met by

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2. Livol, a herbal liver tonic, produced by Indian Herbs, Saharanpur (U.P.)

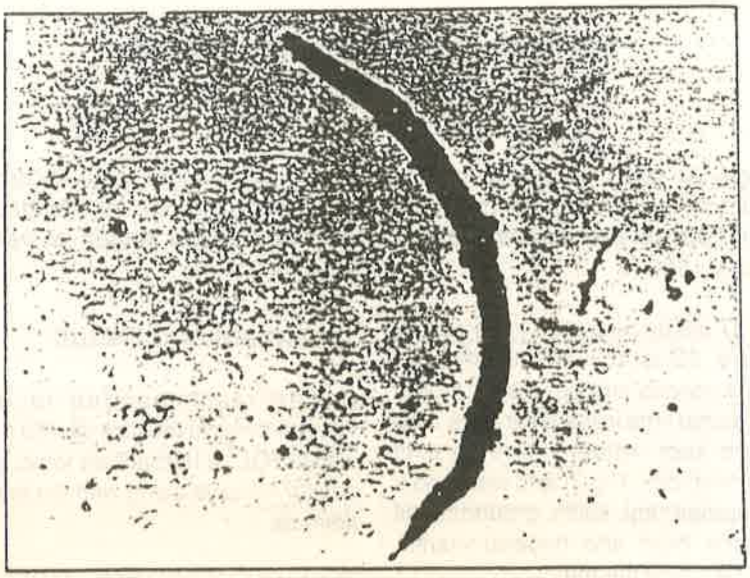

Fig. 1. Unsheathed Microfilaria present in the skin scraping of affected toes of left foot.

the epidermal layer was also noticed. However, the examination did not reveal the presence of the microfilaria or the adult parasites. The dermal layer showed an extensive inflammatory reaction - with presence of eosinophils, lymphocytes, neutrophils and macrophages. Signs of oedema in this layer were also seen. Granulomatous reaction and perivascular cuffing were also detected.

Diagnosis

Taking into account the case history, the nature of the lesions seen on the body of the animal as well as the presence of the unsheathed microfilarae in the skin scrapings and the blood oozing from the lesions, it was diagnosed to be a case of stephanofilarial dermatitis. Non response of the lesions to antibacterial therapy also supported this view. The occurrence of stephanofilarial dermatitis in elephants has been reported by Bhattacharjee (1967) and by Chatterjee (1984).

Treatment

All the lesions were thoroughly cleaned with soap and water and dried and 8% Metrifonate ointment was applied on them. The ointment was prepared by mixing Metrifonate either with vaseline or with Himax ointment (Das, 1988). Application of vaseline base Metrifonate ointment was done on the lesions of the left foot while the Himax ointment base Metrifonate ointment was applied on the lesions of the right foot and right side of the abdomen. Application was done once daily.

The treatment was continued till the animal showed signs of clinical cure. Such evidence was noticed after 15 days in those lesions which were treated with Himax base Metrifonate ointment while the lesions treated with vaseline base Metrifonate ointment showed similar improvement after a treatment of 22 days. There has been no evidence of recurrence of the condition upto one year after discontinuation of the aforesaid treatment.

From the above record it is evident that Metrifonate with Himax base was a superior therapeutic agent in the treatment of Stephanofilarial dermatitis in this trial in an elephant.

Summary

A case of chronic dermatitis caused by *Stephanofilaria* in an Asian elephant (*elephas maximus*) has been discussed. The lesions were seen on the toes and heels of the two hind feet and on the right abdomenal wall. An examination of the skin scrapings from the lesions and of the blood oozing from the lesions, showed the presence of microfilariae. Histopathological examination of the skin of affected region revealed signs of hyperkeratosis, parakeratosis, acanthosis, granulomatous reaction and perivascular cuffing.

Application of 8% Metrifonate ointment in Himax and vaseline brought clinical cure in 15 and 22 days respectively.

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TREATMENT OF MICROFILARIAL DERMATITIS IN AN ASIAN ELEPHANT (*ELEPHAS MAXIMUS*) : A CASE REPORT.

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Case History

A 32 year old female Asian elephant, Prema, of Nandan Kanan Biological Park, Barang showed ulcerative lesions on the toes of the left hind foot. The appearance of these lesions caused difficulty in walking. Prior to the appearance of the lesions, the animal was seen scratching the affected area, for about 15 days. On a thorough examination of the body of the animal, a dermatitic patch of about 25 cm, was also detected on the right side of the abdomen. A palpation of the affected toes revealed signs of pain to the elephant.

Treatment of the condition started by cleaning the affected toes with 1% Dettol lotion. This was followed by application of Furacin ointment (SK&F); Nemlent (Domesto) and Himax ointment on the lesions twice daily, for a week each. Simultaneously, with the local application of ointments, intramuscular injections of LAP Penidure LA-(John Wyeth) @ 120 lacs were given at weekly intervals for 3 times.

The treatment brought only a slight reduction in the severity of the condition and itching when Himax ointment was being applied. No other change was noticed. Instead, similar lesions appeared on the toes of the right hind foot. A closer examination of the hind feet revealed the presence of ulcerative lesions on the heels of both the hind feet. Pruritus was marked. Cracks were present on the sole, corresponding to the toes which showed the lesions. A few abscesses were seen on the superior surface of the affected toes.

When the animal was made to walk, it was seen to limp visibly. Several dermatitic patches were seen on various parts of the body - with hyperkeratosis, minor cracks on the skin and nodule formation.

Laboratory Examination

Examination of deep skin scrappings in normal saline and stained ozing blood smears collected from lesions revealed the presence of a few microfilariae. Morphologically, these resembled the microfilaria of *Stephanofilaria* (Fig.1).

A histopathological examination of the skin tissue collected from around the toe lesions and abdomenal lesions revealed evidence of hyperkeratosis; parakeratosis, acanthosis, elongated retepegs and microabscesses. Accumulation of exudate on

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birds at the level of metacarpals below the carpal joint.

various surgical maladies in zoo animals have been reported and some of them successfully treated by various workers such as umbilical hernia of reducible type in an elephant (Singh. 1971), spindle cell sarcoma in between the thights of a jackal (Dutt *et al.* 1972), horn cancer in rhinoceros (Nandi and Deb. 1972). non healing suppurative wound in a lion (Nayar and Hirudayavasan. 1974). chronic fistula of an elephant (Angelo *et al.* 1974). recurrent prolapse of rectum in a lion (Khan *et.al.* 1975), granuloma from stifle joint of an elephant (Angelo *et al.* 1976). caesarian section in a viper (Vandenvanter and Schmidt. 1977) and amputation of penis of a tortoise (Ojeh and Adetunji, 1980).

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Table 1 : Details of surgical maladies observed in zoo animals and birds.

Surgical malady	Number affected						
	Mammals						
	Ruminants	Carnivores	Primates	Others	Birds	Reptile	Total
1. Traumatic injuries	35	6	9	—	3	1	54
2. Fracture of limbs snout	19	1	1	1	17	1	40
3. Amputation of limbs/wing/beak	10	2	1	—	12	—	25
4. Excessive growth of hooves	15	—	—	1	—	—	16
5. Abscesses/bumble foot	11	—	3	16	5	1	36
6. Pinioning of birds	—	—	—	—	359	—	359
7. Broken horn/antler	8	—	—	—	—	—	8
8. Dystocia	6	1	—	—	—	—	7
9. Prolapse of genitals/intestine	4	1	—	—	—	1	6
10. Tumour/tumour like growth	—	2	—	2	3	—	7
11. Fistulous/sinus/gangrenous wounds	2	2	—	5	—	2	11
12. Castration	2	—	—	—	—	—	2
13. Knuckling of fetlock	1	—	—	—	—	—	1
14. Non-parasitic cyst	—	—	—	1	—	—	1
Total	113	15	14	26	399	6	573

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A note on common surgical maladies in zoo animals and birds

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The common surgical maladies encountered among mammals ; birds and reptiles of Nandankanan Biological Park, Orissa, during the period from May, 1961 to March, 1983 are placed on record.

The number of animals and birds maintained during the study period varied from about 200 to 1000 depending on new arrivals/births/deaths. The details of common surgical maladies have been given in Table 1.

Fourteen kind of surgical maladies in 573 cases were recorded. The captive wildlife affected with surgical maladies included 168 mammals, 399 birds and 6 reptiles. The mammals included 8 species of ruminants (barking deer, spotted deer, mouse deer, sambar, black buck, Nilgai, four-horned antelope and Ladakhi goat), 6 species of carnivores (leopard, leopard cat, tiger, African lion, common palm civet and Himalayan palm civet), 6 species of primates (rhesus monkey, stump-tailed monkey, pig-tailed monkey, capped langur, slow-loris and gibbon) and 7 species of other mammals like guinea pig, rabbit albino rat, elephant, camel, Indian giant squirrel and porcupine). Forty species of birds included various species of storks, cranes, pigeons, pea-fowl, jungle-fowl, ducks, geese, swan, hornbill, eagle, vulture, flamingo etc. and the 4 species of reptiles included land monitor, gharial, mugger crocodile and fresh water turtle.

Traumatic injuries (29.8%) appeared to be the major surgical malady. In ruminants, they were due to intraspecies fighting and in carnivores and primates due to bitting with canine teeth. Next in importance was abscesses (17.9%) and fracture of limbs (13.1%). Dystocia in tigress was due to 3 dead foetuses, in Nilgai due to prolapse of uterus with a dead foetus and in a sambar due to breech presentation. Pinioning was the most common operation performed in wildlife of this park. The site selected in 277 birds was capal joint and in 82

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Reprint request : Dr. A. T. Rao

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TABLE 1. (*Concluded*)

S. No.	Species	Distribution in India and elsewhere	Hosts, etc. recorded to Orissa
26.	*Rhipicephalus sanguineus* Latreille	India : Almost all over the country, Orissa (Cattack, Keonjhar, Puri). Elsewhere : Distributed on all the continents of earth	Dog, jackal
27.	*Rhipicephalus turanicus* Pomerantzev	India : Andhra Pradesh, Gujarat, Kashmir, Madhya Pradesh, Maharashtra, Orissa (Puri), Tamil Nadu, West Bengal. Elsewhere : Middle East, U.S.S.R.	*Rattus r. arboreus*

SUMMARY

Ten species of Ixodid ticks associated with zooanimals in Nandankanan, Orissa are discussed. In addition, the distribution, hosts, and key to all the genera and species so far recorded from Orissa are given.

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The authors are grateful to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta for facilities. Thanks are also due to the field staff of the Pathology Department, Orissa Veterinary College, for assisting in collection of tick specimens.

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TABLE 1. (Continued)

S. No.	Species	Distribution in India and elsewhere	Hosts, etc. recorded in Orissa
20.	*Hyalomma dromedarii* Koch	India : Andhra Pradesh, Delhi, Gujarat, Orissa (Dhenkanal). Elsewhere : Afganistan, Africa, Algeria, Argentina, Ethiopia, Iran, Mongolia, Morocco, Pakistan, Tibet, Tripoli, Tunisia, U.A.R., U.S.S.R.	Not known
21.	*Hyalomma hussaini* Sharif	India : Andhra Pradesh, Bihar, Delhi, Goa, Gujarat, Madhya Pradesh, Maharashtra, Orissa (Dhenkanal, Ganjam, Puri), Tamil Nadu, West Bengal. Elsewhere : Pakistan	Cattle, buffalo, sheep, goat
22.	*Hyalomma kumari* Sharif	India : Assam, Bihar, Delhi, Gujarat, Kerala, Orissa (Bolangir, Puri), Punjab, Madhya Pradesh, Tamil Nadu, Uttar Pradesh. Elsewhere : Nepal, Pakistan, Tibet	Goat, sheep, dog, *Mus saxicola*
23.	*Hyalomma marginatum isaaci* Sharif	India : Andhra Pradesh, Arunachal Pradesh, Bihar, Delhi, Gujarat, Jammu and Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Orissa (Balasore, Bhubaneswar, Dhenkanal, Ganjam, Kalahandi, Koraput, Phulbari, Puri, Sambalpur), Tamil Nadu, Uttar Pradesh. Elsewhere : Sri Lanka, Nepal, Pakistan	Buffalo, cattle, goat, *Centropus sinensis*, Indian hare (*Lepus nigricollis*), palm civet cat, rabbit
24.	*Nosomma monstrosum* Nuttall and Warburton	India : Bihar, Karnataka, Maharashtra, Orissa (Dhenkanal, Ganjam, Koraput, Puri, Sambalpur), West Bengal. Elsewhere : Bangladesh	Buffalo, cattle, *Mus booduga*
25.	*Rhipicephalus haemaphysaloides* Supino	India : Distributed all over the country, Orissa (Bolangir, Dhenkanal, Ganjam, Koraput, Sambalpur). Elsewhere : Burma, China, Indonesia, Sri Lanka, Taiwan, Thailand, Vietnam	Jackal, buffalo, cattle, *Lepus* sp., *Felis viverrina*, *Mus saxicola*, *Centropus sinensis*, *Mus booduga*, *Rattus r. arboreus*, *Rattus cutchicus*, *Suncus murinus*, forest vegetation

TABLE 1. *(Continued)*

S. No.	Species	Distribution in India and elsewhere	Hosts, etc. recorded in Orissa
10.	*Haemaphysalis canestrinii* (Supino)	India : Assam, Madhya Pradesh, Orissa (Bolangir, Ganjam, Koraput, Puri). Elsewhere : Burma, Nepal, Pakistan, Taiwan, Thailand, Vietnam	Leopard, jackal, snake (?), *Rattus blanfordi*, *Rattus cutchicus*
11.	*Haemaphysalis indica* Warburton	India : Bihar, Gujarat, Karnataka, Orissa (Bhubaneswar, Puri), West Bengal. Elsewhere : Sri Lanka, Nepal, Pakistan	*Lepus* sp., *Mus booduga*, ratel, palm civet cat
12.	*Haemaphysalis intermedia* Warburton and Nuttall	India : Andhra Pradesh, Bihar, Karnataka, Maharashtra, Orissa (Bhubaneswar, Bolangir, Ganjam, Koraput, Puri), Tamil Nadu. Elsewhere : Sri Lanka	*Centropus sinensis*, cattle, goat, sheep, tiger, barking deer, forest undergrowth
13.	*Haemaphysalis minuta* Kahls	India : Karnataka, Madhya Pradesh, Orissa (Koraput, Sambalpur). Elsewhere : Sri Lanka	Forest undergrowth
14.	*Haemaphysalis silvafelis* Hoogstraal and Trapido	India : Andhra Pradesh, Maharashtra, Orissa (Puri)	Hare (*Oryctolagus* sp.)
15.	*Haemaphysalis spinigera* Neumann	India : Andaman and Nicobar Islands, Andhra Pradesh, Assam, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa (Puri), Tamil Nadu, West Bengal. Elsewhere : Sri Lanka	Under stones and on bushes
16.	*Haemaphysalis turturis* Nuttall and Warburton	India : Karnataka, Kerala, Maharashtra, Orissa (Bhubaneswar), Tamil Nadu, Uttar Pradesh. Elsewhere : Sri Lanka	Indian wild boar
17.	*Haemaphysalis wellingtoni* Nuttall and Warburton	India : Andaman Islands, Assam, Karnataka, Maharashtra, Orissa (Koraput). Elsewhere : Burma, China, Indonesia, Malayasia, New Guinea, Thailand	Forest undergrowth
18.	*Hyalomma anatolicum anatolicum* Koch	India : Andhra Pradesh, Delhi, Gujarat, Himachal Pradesh, Madhya Pradesh, Maharashtra, Orissa (Bolangir, Keonjhar, Koraput, Puri, Sambalpur), West Bengal. Elsewhere : Afganistan, Africa, Pakistan. U.A.R., U.S.S.R.	Cattle, buffalo, sheep, forest undergrowth, pasture land
19.	*Hyalomma brevipunctata* Sharif	India : Andhra Pradesh, Bihar, Delhi, Gujarat, Madhya Pradesh, Maharashtra, Orissa (Dhenkanal, Ganjam, Koraput), Tamil Nadu, West Bengal. Elsewhere : Pakistan	Cattle, *Rattus blanfordi*, *Mus saxicola*

TABLE 1. (*Continued*)

S. No.	Species	Distribution in India and elsewhere	Hosts, etc. recorded in Orissa
3.	*Amblyomma javanense* (Supino)	India : Andhra Pradesh, Bihar, Gujarat, Karnataka, Maharashtra, Orissa, (Bhubaneswar), Punjab, Uttar Pradesh, Rajasthan, (Personal communication), West Bengal. Elsewhere : Bangladesh, Burma, China, Indonesia, Malayasia, Pakistan, Philippines, Thailand, Vietnam.	*Manis crassicaudata* (Indian Pangolin)
4.	*Amblyomma testudinarium* Koch	India : Arunachal Pradesh, Aassam, Karnataka, Maharashtra, Orissa (Bhubaneswar, Balasore), Sikkim, Tamil Nadu, West Bengal. Elsewhere : Bangladesh, Sri Lanka, China, Formosa, Indonesia, Japan, Malayasia, Philippines, Vietnam	Indian wild boar, gour, Indian Rhinoceros, grass
5.	*Aponomma lucasi* Warburton	India : Andaman and Nicobar Islands, Assam, Bihar, Madhya Pradesh, Orissa (Puri), Uttar Pradesh, West Bengal. Elsewhere : Burma, Sri Lanka, Indonesia, Malayasia, Thailand, Vietnam	*Lutra macrodus*
6.	*Aponomma laeve* Neumann	India : Karnataka, Maharashtra, Orissa (Puri), Tamil Nadu. Elsewhere : Sri Lanka, Argentina	Snake
7.	*Boophilus microplus* (Canestrini)	India : Almost all over the country, Orissa (Bolangir, Ganjam, Kalahandi, Keonjhar, Koraput, Puri, Bhubaneswar). Elsewhere : Australia, Central and South America, Southern part of Florida, South and East Africa, Oriental region	Cattle, buffalo, sheep, goat, ratel, barking deer, vegetation
8.	*Dermacentor auratus* Supino	India : Andaman Islands, Arunachal Pradesh, Assam, Bihar, Karnataka, Maharashtra, Orissa (Bhubaneswar, Ganjam), Uttar Pradesh, West Bengal. Elsewhere : Burma, Sri Lanka, Formosa, Indonesia, Japan, Korea, Philippines, Vietnam	*Rattus blanfordi*, *Suncus murinus*, Indian wild boar
9.	*Haemaphysalis bispinosa* Neumann	India : Almost all over the country, Orissa (Bhubaneswar, Dhenkanal, Ganjam, Koraput, Puri, Sambalpur). Elsewhere : Australia, Burma, Sri Lanka, China, East Africa, Indonesia, Japan, Malayasia, Nepal, New Zealand, Pakistan, Tasmania, Thailand .	Cattle, buffalo, goat, dog, sheep, jackal, *Coracius bengalensis* (Indian Roller), barking deer, tiger cub, grass

Genus Rhipicephalus

MALES

1. Adanal shields sickle-shaped ; punctations fine : cervical grooves short converging pits ; spiracle comma-shaped. ... *haemaphysaloides*

— Adanal shields triangular ; punctations large ; cervical grooves oval or elongated semicircles ; spiracle elongated oval or comma-shaped. 2

2. Internal margin of adanal shields with a small conical spur-like projection ; eyes flat ; cervical grooves form oval semicircles ; spiracle elongated oval. ... *turanicus*

— Internal margin of adanal shields without conical projection ; eyes slightly convex ; cervical grooves form elongated semicircles ; spiracle comma-shaped... *sanguineus*

FEMALES

1. Punctations few, sparsely scattered, finer ones hardly visible ; scutum oval ; cervical grooves deep. ... *haemaphysaloides*

— Punctations numerous, close-set, irregular, finer ones visible ; scutum usually elongated ; cervical grooves shallow. 2

2. Stigmal plates with short and wide dorsal projection ; posterior contour rounded. ... *turanicus*

— Stigmal plates with narrow dorsal projection, posterior contour slightly convex or almost straight. ... *sanguineus*

TABLE 1. species of ticks so far repoted from Orissa with their distribution and hosts reported.

S. No.	Species	Distribution in India and elsewhere	Hosts, etc. recorded in Orissa
1.	*Amblyomma helvolum* Koch	India : Andaman and Nicobar Islands, Orissa (Bhubaneswar), West Bengal. Elsewhere : Australia, Indonesia, Malayasia, New Guinea, Philippines, Singapore, Taiwan, Thailand, Vietnam	Land monitor (*Varanus flaviscens*), King cobra (*Ophiophagus hannah*)
2.	*Amblyomma integrum* Karsch	India : Goa, Karnataka, Kerala, Orissa (Dhenkanal, Ganjam, Puri), Tamil Nadu. Elsewhere : Sri Lanka	Buffalo, cattle, *Felis viverrina*, *Viverricula malaccensis*, on bushes, under stone

3. Punctations large, few : median and paramedian grooves deep ; spiracular plates elongate oval. ... *hussaini*

— Punctations small, numerous ; median and paramedian grooves indistinct ; spiracular plates comma-shaped. ... *brevipunctata*

4. Lateral grooves long ; punctations variable ; cervical grooves deep ; parma absent ; legs with white rings near the joints. ... *marginatum isaaci*

— Lateral grooves short or absent ; punctations few ; cervical grooves deep or shallow ; parma present ; legs without rings. ... 5

5. Subanal shields exterior to axis of adanal shields ; adanal shields curved ; posteromedian groove reaching parma ; cervical grooves deep. ... *dromedarii*

— Subanal shields on the axis of adanals ; adanal shields straight ; posteromedian groove not reaching parma ; cervical grooves shallow. ... *anatolicum anatolicum*

FEMALES

1. Adanal shields broad ; subanal shields absent. ... 2

— Adanal shields elongate ; subanal shields present. ... 4

2. Operculum profile slightly bulging ; punctations few ; tarsus IV humped. ... *kumari*

— Operculum profile distinctly bulging ; punctations numerous ; tarsus IV flat. ... 3

3. Operculum wide, depressed medioposteriorly ; punctations large ; cervical grooves distinct. ... *hussaini*

— Operculum elongate oval, not depressed medioposteriorly ; punctations few ; cervical grooves indistinct. *brevipunctata*

4. Operculum profile depressed posteriorly ; scutum with few large punctations ; cervical grooves almost shallow ; legs with or without rings. ... 5

— Operculum profile depressed posteriorly ; scutum with few large punctations ; cervical grooves deep ; legs with rings. ... *marginatum isaaci*

5. Operculum almost 'V' shaped, surrounded by a narrow raised integumental fold ; scutal surface frequently rugose ; legs usually ringed. ... *dromedarii*

— Operculum knob like ; scutal surface with few large punctations ; legs usually without rings. ... *anatolicum anatolicum*

4.	Basis capituli dorsally 2.5 times as broad as long ; dorsobasal margin of palpal segment 3 without spur ; coxa I with round spur. ...		*indica*
—	Basis capituli dorsally 2 times as broad as long ; dorsobasal margin of palpal segment 3 with median triangular spur ; coxa I with long pointed spur. ...		*spinigera*
5.	Profile of capitulum usually broadly deltoid ; palpal segment 3 with sharp dorsobasalinternal retroverted long spur. ...		*wellingtoni*
—	Profile of capitulum not broadly deltoid ; palpal segment 3 usually without spur, if present, spur short. ...	...	6
6.	Palpal segment 3 with small dorsal spur. ...	...	7
—	Palpal segment 3 with distinct retroverted dorsal spur. ...	...	8
7.	Cervical grooves deep, converging anteriorly and diverging posteriorly ; punctations less numerous, large, deep ; spiracular plate subcircular with extended dorsal projection ; infrainternal setae of palpi broad and number 7. ...		*silvafelis*
—	Cervical grooves small, posterior extension shallow ; punctations numerous, small, shallow ; spiracular plate subcircular with short, blunt dorsal projection ; infrainternal setae of palpi narrow and number 4 or 5. ...		*turturis*
8.	Punctations of scutum few and shallow ; dorsobasal spur of palpal segment 3 situated internally ; ventral spur of segment 3 small ; well spaced infrainternal setae. ...		*bispinosa*
—	Punctations of scutum numerous and deep ; dorsobasal spur of palpal segment 3 situated medially ; ventral spur of segment 3 large ; close set infrainternal setae. ...		*intermedia*

Genus Hyalomma

MALES

1.	Adanal shields broad ; subanal shields absent. ...	...	2
—	Adanal shields elongate ; subanal shields present. ...	...	4
2.	Lateral grooves short or absent ; punctations few ; tarsus IV humped. ...		*kumari*
—	Lateral grooves long ; punctations discrete ; tarsus IV flat. ...	...	3

4. Basis capituli dorsally 2 times as broad as long : scutum 1.5 to 1.7 times as long as broad ; scapulae rounded ; punctations very few. ... *indica*

— Basis capituli dorsally 1.5 times as broad as long : scutum 2.0 to 2.2 times as long as broad ; scapulae pointed ; punctations numerous. ... *canestrinii*

5. Salience broad, round ; palpal segment 3 without dorsal spur ; dorsal posterointernal angle of palpal segment 3 produced into a retroverted process. ... *wellingtoni*

— Salience illdeveloped ; palpal segment 3 usually with a dorsal spur ; dorsal posterointernal angle of palpal segment 3 without retroverted process. 6

6. Palpal segment 3 without distinct dorsal spur. 7

— Palpal segment 3 with distinct dorsal spur. 8

7. Lateral grooves long ; scutal punctations large ; rudimentary ventral spurs on trochanters ; infrainternal setae of palpi broad and number 7. ... *silvafelis*

— Lateral grooves shallow ; scutal punctations small ; pronounced ventral spurs on trochanters ; infrainternal setae of palpi narrow and number four or five. ... *turturis*

8. Scutum elongate, punctations few and shallow ; infrainternal setae slender, well spaced ; dorsobasal spur of palpal segment 3 situated internally ; ventral spur of segment 3 small. ... *bispinosa*

— Scutum ovate, punctations numerous and deep ; infrainternal setae feathery, close set ; dorsobasal spur of palpal segment 3 situated medially ; ventral spur of segment 3 large. ... *intermedia*

FEMALES

1. Salience broad, palpal segment 2 broader than long. 2

— Salience usually not broad, palpal segment 2 not broader than long. 5

2. Palpal segment 3 with ventral spur reduced. ... *minuta*

— Palpal segment 3 with ventral spur prominent. 3

3. Ventrobasal margin of palpal segment 2 with a reduced spur. ... *canestrinii*

— Ventrobasal margin of palpal segment 2 with a sharp spur. 4

FEMALES

1. Scutum inornate ; coxa I with two short, flat spurs ; coxae II-IV each with a broad salient ridge like spur ; hypostome 3/3. ... *javanense*
— Scutum ornate ; coxa I with both short and long spurs ; coxae II-IV with triangular or ridge like spur : hypostome 3/3 or 4/4. 2
2. Narrow triangular spur on coxae II and III. ... *heivolum*
— Broad salient ridge-like spur on coxae II and III. 3
3. Coxa I with two unequal spurs, internal one stout and blunt, external one longer and pointed : hypostome 3/3. ... *integrum*
— Coxa I with two stout subequal spurs ; hypostome 4/4. ... *testudinarium*

Genus Aponomma

MALES

— Scutum ornate with brown stripes and spots ; punctations large ; coxae I with two subequal spurs. ... *lucasi*
— Scutum inornate with yellow-ocher to brick-red colour ; punctations fine ; coxa I with one short pointed spur. ... *laeve*

FEMALES

— Scutum ornate with metallic green colour ; densely punctated ; coxa I with two subequal spurs. ... *lucasi*
— Scutum inorante with brown colour ; sparsely punctated ; coxa I with one short pointed spur. ... *laeve*

Genus Haemaphysalis

MALES

1. Salience broad, palpal segment 2 developed into a spur or projection. 2
— Salience usually not broad, palpal segment 2 rounded. 5
2. Coxa IV with a single greatly elongated spur. ... *spinigera*
— Coxa IV without greatly elongated spur. 3
3. Dorsal external margin of palpal segment 2 round. ... *minuta*
— Dorsal external margin of palpal segment 2 with prominent spur. 4

4. Ventral shields present in male ; usually inornate ; eyes spherical and orbital. ... *Hyalomma* Koch

— Ventral shields absent in male ; scutum usually ornate : eyes usually flat and non-orbital. ... *Amblyomma* Koch

5. Basis-capituli rectangular dorsally, lateral saliences absent ; scutum ornate ; ventral sheilds, when present 6 in male. ... 6

— Basis-capituli hexagonal dorsally, lateral saliences present ; scutum usually inornate ; ventral shields 4 in male. ... 7

6. Ventral shields 6 in male ; coxae subequeal. ... *Nosomma* Schulze

— Ventral shields absent in male ; coxa IV much larger than others. ... *Dermacentor* Koch

7. Spiracle oval ; festoons and groove faint or obsolete : setiferous ventral plate on palpal article I absent. ... *Boophilus* Curtice

— Spiracle sub-triangular or commashaped ; festoons and anal groove well developed ; setiferous ventral plate on palpal article I present. ... *Rhipicephalus* Koch

Key to the species of ticks from Orissa

Genus Amblyomma

MALES

1. Marginal grooves present and continuous ; two stout spurs on coxa I ; punctations coarse, irregular : falciform stripe present ; hypostome 3/3. ... *integrum*

— Marginal grooves absent ; coxal spurs small ; punctations usually regular ; falciform stripe present or absent ; hypostome 3/3 or 4/4. ... 2

2. Scutum inornate ; two short flat sub-equal spurs on coxa I ; coxae II—IV each with a broad flat spur ; eyes indistinct ; hypostome 3/3. ... *javanense*

— Scutum ornate : two unequal spurs on coxa I ; coxae II—III each with triangular or round spur ; eyes almost distinct ; hypostome 3/3 or 4/4. ... 3

3. Scutum deep brown with six pale coloured spots ; falciform stripe absent ; coxae II and III each with short triangular spur ; eyes indistinct ; hypostome 3/3. ... *helvolum*

— Scutum yellowish with dark brown ornamentation ; falciform stripe present ; coxae II and III each with broad round spur ; eyes large, flat ; hypostome 4/4. ... *testudinarium*

Remarks : *H. intermedia* is a parasite of domestic and wild mammals in India. This tick species is also reported to carry KFD virus. Two new arboviruses *viz.*, 'Bhanja' and 'Ganjam' were isolated from this species (Dandawate and Shah, 1969 ; Shah and Work, 1969).

9. Haemaphysalis turturis Nuttall and Warburton

1915. *Haemaphysalis turturis* Nuttall and Warburton, *Ticks-Mongr. Ixodoidea*, pt. 3 (Cambridge Univ. Press) : 410.

1928. *Haemaphysalis turturis* : Sharif, *Rec. Indian Mus.*, 30 : 250.

1963. *Haemaphysalis turturis* : Trapido, *et al.*, *J. Parasit.*, 49 (4) : 678.

Material examined : 1 ♂, 1 ♀, 17.i.1974, from groins of Indian Wild Boar.

Remarks : It is a common tick parasitizing wild and domestic mammals including man. The species is also known as carrier of KFD virus. This haemaphysalid tick is reported here for the first time from Orissa.

Genus 5. Hyalomma Koch

10. Hyalomma marginatum isaaci Sharif

1928. *Hyalomma aegyptium isaaci* Sharif, *Rec. Indian Mus.*, 30 : 307.

1963. *Hyalomma marginatum isaaci* : Kaiser and Hoogstraal, *J. Parasit.*, 49 (1) : 130.

1964. *Hyalomma marginatum isaaci* : Kaiser and Hoogstraal, *Acarologia*, 6 (2) : 257.

Material examined : 6 nymphs, 15.xii.1982, from ear and body of Indian Hare (*Lepus nigricollis*).

Remarks : This species is recognised as pest and vector of diseases to animals. Grebov (1946) isolated the Crimean haemorrhagic fever virus from the nymphs of this tick species.

Key to the genera of ticks from Orissa

1.	Eyes absent.	... ...	2
—	Eyes present.	... ...	3
2.	Capitulum long, no lateral salience on palpal article II ; dorsal retroverted spur absent on trochanter I ; Coxa I usually bifid.	...	*Aponomma* Neumann
—	Capitulum short, with lateral salience on palpal article II ; blade-like dorsal retroverted spur on trochanter I ; coxa I never bifid.	...	*Haemaphysalis* Koch
3.	Capitulum long with long narrow palps.	... ...	4
—	Capitulum short with short broad palps.	... ...	5

Genus 3. Dermacentor Koch

5. Dermacentor auratus Supino

1897. *Dermacentor auratus* Supino, *Atti. Soc. Veneto-Trent. Sci. Nat.*, 3 (2) : 235.

1928. *Dermacentor auratus* : Sharif, *Rec. Indian Mus.*, 30 : 292.

Material examined : 2 ♂ ♂, 17.i.1974, from groins of Indian wild Boar.

Remarks : *D. auratus* is chiefly reported in India from domestic and wild mammals including man. Rao (1964) isolated KFD virus from this species.

Genus 4. Haemaphysalis Koch

6. Haemaphysalis bispinosa Neumann

1897. *Haemaphysalis bispinosa* Neumann, *Mem. Soc. zool. Fr.*, 10 : 341.

1928. *Haemaphysalis bispinosa* : Sharif, *Rec. Indian Mus.*, 30 : 255.

1966. *Haemaphysalis bispinosa* : Hoogstraal and Trapido, *J. Parasit.*, 52 : 1188.

Material examined : 7 ♂ ♂, 10 ♀ ♀, 27.viii.1972, from axilla and groins of Barking Deer (*Muntiacus muntjak*) and 1 ♂, 29 ♀ ♀, 27 nymphs, 24.viii.1982, from ear and body of Tiger cub (*Panthera tigris*).

Remarks : The species is responsible for transmitting the KFD viruses in mammals.

7. Haemaphysalis indica Warburton

1910. *Haemaphysalis leachi* var. *indica* Warburton, *Parasitology*, 3 : 403.

1915. *Haemaphysalis leachi* var. *indica* : Nuttall and Warburton, *Ticks-Mongr. Ixodoidea*, pt. 3 (Cambridge Univ. Press) : 467.

1928. *Haemaphysalis leachi* var. *indica* : Sharif, *Rec. Indian Mus.*, 30 : 264.

1970. *Haemaphysalis indica* : Hoogstraal, *J. Parasit.*, 56 (5) : 1013.

Material examined : 2 ♂ ♂, 3 ♀ ♀, 25.viii.1972, from body of Ratel.

Remarks : The common hosts of this species are carnivore animals and occassionally rodents and insectivores are also parasitized.

8. Haemaphysalis intermedia Warburton and Nuttall

1909. *Haemaphysalis bispinosa* var. *intermedia* Warburton and Nuttall, *Parasitology*, 2 : 69.

1915. *Haemaphysalis bispinosa* var. *intermedia* : Nuttall and Warburton, *Ticks-Mongr. Ixodoidea* pt. 3 (Cambridge Univ. Press) : 433.

1928. *Haemaphysalis bispinosa* var. *intermedia* : Sharif, *Rec. Indian Mus.*, 30 : 258.

1963. *Haemaphysalis intermedia* : Hoogstraal and Trapido. *J. Parasit.*, 49 (5) : 838.

Material examined : 9 ♂ ♂, 18 ♀ ♀, 1 nymph, 7.vi.1968, from ear of Tiger and 7 ♂ ♂, 10 ♀ ♀, 27.viii.1972, from axilla and groins of Barking Deer.

Remarks : This species is not serious from economic aspect but hosts like large snakes and lizards, if attacked feel discomfort. The species is reported here for the first time from Orissa.

2. **Amblyomma javanense** (Supino)

1897. *Rhipicephalus javanensis* Supino, *Atti. Soc. Veneto-Trent. Sci. Nat.*, 3 (1) : 233.

1968. *Amblyomma javanense* (Supino) : Hoogstraal *et al.*, *Ann. ent. Soc. Am.*, 61 (3) : 722.

Material examined : 18 ♂♂, 4 ♀♀, 5 nymphs, 2.viii.1969, from underneath the scales of the limbs of Indian Pangolin (*Manis crassicaudata*) ; 1 ♂, 8 nymphs, 25.viii.1972, from body of Ratel (*Mellivora capensis*) and 16 ♂♂, 5 ♀♀, 6 nymphs, 16.ii.1973, from body of Hyena cub (*Hyaena hyaena*).

Remarks : The species is not much important as a disease carrier. It mainly attacks wild mammals. This tick species is recorded here for the first time from Orissa.

3. **Amblyomma testudinarium** Koch

1844. *Amblyomma testudinarium* Koch, *Arch. Naturgesch.*, 10 (1) : 226.

1926. *Amblyomma testudinarium* : Robinson, *Ticks-Mongr. Ixodoidea*, pt. 4 (Cambridge Univ. Press) : 257.

1928. *Amblyomma testudinarium* : Sharif, *Rec. Indian Mus.*, 30 : 330.

Material examined : 56 ♂♂, 2 ♀♀, 17.i.1974, from groins of Indian Wild Boar (*Sus scrofacristatus*) ; 9 ♂♂, 10 ♀♀, 17.i.1979, from dewlap of Gour (*Bos gaurus*) and 1 ♂, 15.ix.1982, from neck region of Indian Rhinoceros (*Rhinoceros unicornis*).

Remarks : The species was first reported from Orissa by De (1976) from grass. Krijgsman and Ponto (1932) mentioned that this tick transmits piroplasmosis and anaplasmosis. Sharif (1938) also recorded the species as a possible vector of some diseases.

Genus 2. **Boophilus** Curtice

4. **Boophilus microplus** (Canestrini)

1887. *Haemaphysalis micropla* Canestrini, *Atti. Soc. Veneto-Trent. Sci. Nat.*, 11 : 104.

1943. *Boophilus microplus* : Fairchild, *Am. J. trop. Med.*, 23 : 586.

1960. *Boophilus microplus* : Arthur, *Ticks-Mongr. Ixodoidea*, pt. 5 (Cambridge Univ. Press) : 207.

Material examined ; 1 ♂, 2 ♀♀, 25.viii.1972, from body of Ratel.

Remarks : This species attacks most of the domestic and wild animals causing red water fever, anaplasmosis to cattle and sheep. The species is very common in Orissa.

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ACARINA : METASTIGMATA (TICKS)

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INTRODUCTION

While going through the tick specimens collected from zoo-animals in Nandankanan Biological Park, Bhubaneswar, Orissa, by the third and fourth authors of the present paper, some interesting observations related to new records of species and hosts were noted. The present contribution deals with the study of the above mentioned material which has great significance in veterinary research. It also includes a list of all the tick species so far reported from Orissa giving their distribution and hosts from which recorded and also a key to the genera and species for easy identification.

The tick fauna of Orissa was first studied by Sharif (1928) who reported 15 species under 8 genera. Later Pattanayak and Hiregoudar (1973), De (1976) and Kaul *et al.* (1979) reported 9 more species. The present material contains 10 species of which 3 *viz.*, *Amblyomma helvolum*, *A. javanense* and *Haemaphysalis turturis* are new to the state. Thus the total number of species so far known from Orissa stands at 27 in 8 genera (Table 1). Material presently studied is deposited in the National Zoological Collection of Zoological Survey of India, Calcutta.

SYSTEMATIC ACCOUNT

Family Ixodidae

Genus 1. **Amblyomma** Koch

1. **Amblyomma helvolum** Koch

1844. *Amblyomma helvolum* Koch, *Arch. Naturgesch.*, 10 (1) : 230.

1926. *Amblyomma helvolum* : Robinson, *Ticks-Mongr. Ixodoidea*, Pt. 4 (Cambridge Univ. Press) : 216-219.

1928. *Amblyomma helvolum* : Sharif, *Rec. Indian Mus.*, 30 : 325.

Material examined : 12 ♂♂, 53 ♀♀, 22.viii.1982, from neck and body of land monitor (*Varanus flaviscens*) and 38 ♂♂, 3 ♀♀, 5 nymphs, 15.iv.1981, from body of King Cobra (*Ophiophagus hannha*).

Case : 3

This was about a zoo born lion "Suryakanth" aged about 8 years and 6 months. This animal manifested paralytic signs on 25th March 1980 and died after 5 days of sickness. Initially there was weakness of lower hind limbs which extended to hind quarters as a result the animal was lame. This weakness progressed to sagging and swaying of hind quarters and knuckling of hind fetlocks as such the animal was dragging the hind limbs and unable to walk properly. It was growling at times when disturbed and was not going inside the house. Due to its unsteady gait, the animal had fallen into an empty water pool. Unlike the other two animals, this animal was not roaring during its entire period of illness. Prior to its death, the animal was completely anorectic, unable to sit, and lying on one side.

DISCUSSION

From one (first case) out of three cases, impression smears stained with Seller's method from hippocampus revealed eosinophilic intracytoplasmic inclusion bodies in the neurons indistinguishable from Negri bodies. Histopathological examination of cerebrum, and hippocampus collected from all the three cases revealed mild non-suppurative meningitis, mild perivascular cuffing with lymphocytes, neuranophagia and satellitosis. Intracytoplasmic inclusion bodies were detected in the neurons in the Stoval black stained sections. The brain material collected from the first case was sent to Kasauli and was reported to be positive for Rabies by Fluorescent antibody technique.

Since the inception of the zoo in 1960, there was not a single case of confirmed rabies in any kind of animal. Hence, it was baffling to trace the epidemiology of the disease in lions. However, the presence of a dead mongoose inside the enclosure a fortnight prior to the death of "Savitri" may be the possible source of infection as mongooses are the known carriers of rabies virus in India (Sikes, 1970).

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Cheiron (1980) 9 : 6 : 355-357, 1980 SHORT COMMUNICATION

RABIES IN LIONS OF NANDANKANAN BIOLOGICAL PARK, ORISSA

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INTRODUCTION

Rabies in zoo animals is extremely rare. Search of available literature failed to show the occurrence of this fatal disease in lions. However, Burton (1960) had reported two cases of rabies in tiger which had Negri bodies in the brain. This communication places on record 3 cases of rabies in lions belonging to Nandankanan Biological park.

CLINICAL OBSERVATIONS

Case : 1

An 8-year-old-lioness "Savitri" had exhibited typical clinical signs of Rabies on 11th February 1980 and died on 13th February 80. Prior to its death, it had bitten and injured her two-year-old daughter and another lion which were remaining in the same enclosure. During its illness, the lioness "Savitri" was seen biting the iron bars of observation window, chain-link mesh fence, water trough and a tree trunk. It was seen frequently dashing against the chain link and climbing the tree. During this process, the animal had lost her lower canine teeth. Because of the violent movements of this animal, the lions of the adjoining enclosure were much afraid and running away from the chain-link mesh fence.

Initially the animal was taking water but refused its normal feed i.e. beef but before its death, it had stopped even drinking water. It was unusually roaring, restless and panting. The animal was salivating profusely with partial protrusion of tongue. In later stages, the animal failed to respond to the call of the keeper. At necropsy, there was compound fracture of the lower mandible and all the canines were broken. The lower lips and tongue had lacerated wounds.

Case : 2

This was about the daughter of "Savitri". This animal exhibited clinical signs on 26th February and died on 1st March 1980. Initially the animal had partial anorexia and was showing unusual behaviour like holding with teeth the lower portion of one of the fore limbs just above the paw and peculiar jumping movements. It was roaring excessively without causing any injuries to itself. These signs were more pronounced in the forenoon than in the afternoon. A day prior to its death, the animal had conjunctivities and partial protrusion of the tongue but was responding to the call of the keeper. However, it was having restricted movements with occasional leaning on a wall probably due to weakness of the hind quarters. Violent signs were noticed prior to its death.

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TABLE 2

CAUSES OF NEONATAL DEATHS IN 5 GROUPS OF CAPTIVE WILD MAMMALS

Group of Animals	Causes of death																
	Still-birth	Cannibalism	Traumatic injuries	Rejection by mother	Debility	Hydrocephalus	Pneumonia	Peritonitis	Intussusception	Gastro enteritis	Drowning	Killing by predator	FMD	Pyemia	Tympanites	Heat stroke	Unknown
Felids	12	43	1	25	16	1	4	1	1	3	—	—	—	—	—	—	6
Ruminants	30	—	1	4	31	1	17	2	1	2	3	7	1	1	2	2	6
Bear and Otter	3	—	—	—	1	—	3	—	—	—	—	—	—	—	—	—	—
Primates	1	—	—	1	1	—	—	—	—	—	—	—	—	—	—	1	—
Squirrels	—	—	—	—	5	—	—	—	—	—	—	—	—	—	—	—	—

some mothers might rear their subsequent litters. Deaths due to rejection by mother tigresses in this study belonged to this category.

The age specific mortality among captive mammals during neonatal period in Indian zoos is lacking. According to Pant and Dhariyal (1979), mortality of tiger cubs in Delhi zoo was mainly due to either still-births or due to neglect by mother after birth. Out of 193 tiger deaths, 32% occurred during the first year of life. According to Saharia (1979) the mortality of tigers was 39% in 0-1 year age group. In a nationwide survey of causes of mortality among tigers, Rathore and Khera (1979) recorded 42 cub deaths (unspecified age) out of 62 tiger deaths which included still-births, navel ill, malnutrition, debility and infant mortality. Bhattacharya and Chattopadhyaya (1979) while studying mortality among blackbucks and spotted deer at Ballavpur wildlife sanctuary stated that the neonatal deaths accounted to 23-24% of the total 34 deaths. Schaller (1967) reported a fawn mortality of about 50% in spotted deer, sambar and Indian bison at Kanha National Park. This study revealed considerable loss during neonatal period and in ruminants and felids majority of deaths occurred during hebdomadal period.

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We thank the Dean, Faculty of Veterinary Science and Animal Husbandry, Bhubaneswar and Wildlife conservation officer, Orissa, for providing facilities.

TABLE 1

NEONATAL DEATHS RECORDED AMONG 20 SPECIES OF CAPTIVE WILD MAMMALS

Sl. No.	Species	Total deaths	Neonatal deaths: Still-birth	Immediate hebdomadal	Hebdomadal	Post Hebdomadal	Total	Percentage
A.	FELIDS							
1.	Tiger	28	6	4	4	5	19	67.86
2.	Lion	22	1	5	3	2	11	50.00
3.	Leopard	61	3	10	9	14	36	59.02
4.	Leopard cat	27	–	–	1	10	11	40.74
5.	Golden cat	14	–	4	3	2	9	64.29
6.	Jungle cat	45	2	–	21	4	27	60.00
	Total	197	12 (10.62%)	23 (20.35%)	41 (36.29%)	37 (32.74%)	113 (57.36%)	
B.	WILD RUMINANTS							
7.	Hog deer	16	6	–	–	1	7	43.75
8.	Mouse deer	15	–	3	–	1	4	26.67
9.	Spotted deer	113	8	5	6	7	26	23.01
10.	Sambar	67	4	6	7	9	26	38.82
11.	Barking deer	80	3	2	3	10	18	22.50
12.	Fourhorned antelope	34	1	1	1	2	5	14.71
13.	Nilgai	17	3	2	–	–	5	29.41
14.	Blackbuck	83	5	2	9	4	20	24.10
15.	Indian Bison	6	–	–	–	2	2	33.33
	Total	431	30 (26.55%)	21 (18.58%)	26 (23.01%)	36 (31.86%)	113 (26.22%)	
C.	BEAR AND OTHER							
16.	Sloth bear	27	1	–	–	3	4	14.82
17.	Common otter	9	2	–	–	1	3	33.33
	Total	36	3 (42.86%)	–	–	4 (57.14%)	7 (19.44%)	
D.	PRIMATES							
18.	Rhesus monkeys	20	1	1	1	–	3	15.00
19.	Slow loris	24	–	–	1	–	1	4.17
	Total	44	1 (25.00%)	1 (25.00%)	2 (50%)	–	4 (9.09%)	
E.	SQUIRREL							
20.	Malayan giant squirrel	14	–	2 (40%)	3 (60%)	–	5	35.71
	Grand total	722	46 (19.01%)	47 (19.42%)	72 (29.75%)	77 (31.82%)	242	(33.52)

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MISCELLANEOUS NOTES

1. NEONATAL MORTALITY AMONG SOME CAPTIVE MAMMALS AT NANDANKANAN ZOO

The purpose of this communication is to highlight the importance of neonatal mortality data for animals in captivity.

Data on neonatal mortality of 20 species of animals belonging to 5 groups based on postmortem examination and relevant history were obtained from Nandankanan zoo, Orissa, for the period 1967-1983. Most of the species included in this study were of Indian origin except lions which included lions of both Indian and African subspecies. The neonatal deaths were broadly divided into 4 types on the basis of deaths occurring at different periods of neonatal life. They were (1) still-births — born dead, (2) immediate hebdomadal deaths – deaths occurring within 24 hours of birth, (3) hebdomadal deaths — deaths occurring in 2-7 days of birth, and (4) post hebdomadal deaths — deaths occurring in 8-28 days of life.

Out of 722 deaths recorded in 20 species of animals (Table 1) belonging to different age groups, 242 (33.32%) deaths occurred during neonatal period. Among the species studied (Table 1) highest percentage of neonatal deaths ranging from 40.74 to 67.86 per cent occurred in members of felidae. Next in importance was in wild ruminants which ranged from 14.71 to 43.75 per cent. The results in other species were inconclusive as the number of observations were meagre. It was further seen that majority of deaths occurred during hebdomadal period in members of felidae and ruminants.

The common causes of mortality in different groups have been given in the Table 2. It was seen that still-births and debility were common in most of the groups and cannibalism and rejection by mother were frequently seen among wild felids apart from pneumonia and other miscellaneous conditions. It is possible that the high incidence of still-births in this study may be due to inbreeding as has been suggested by Roychoudhury (1980) and Roychoudhury and Sankala (1979). Apart from inbreeding, any disturbance during advanced stage of pregnancy may result in still-births and hebdomadal mortality. Therefore, to minimise the incidence of still-births, it is necessary to avoid inbreeding in captive animals by introducing fresh blood frequently into the existing livestock by exchange programme with other zoos/sanctuaries. Further, any disturbance to the pregnant/nursing mothers should be avoided by keeping them away from visitors.

According to Cooper (1942) and Schaller (1967), lioness in captivity occasionally eat their young ones but in the present studies cannibalism was observed in all 6 species of felids under study but not in other species. Street (?) stated that zoo mothers often refuse to rear their offspring of the first litter though bulbous dilatations with irregular branching. The necrotic tissue in the nasal chamber also showed similar organisms. The mycelia which were 10-12 microns in diameter were significantly broader than the filamentous tissue of *Aspergillus* sp. and *Candida* sp. Since the organisms are known to be widely distributed in nature, it is logical to assume that the primary infection must have occurred in the nasal chamber through inhalation and then extended into the lungs.

Hydatidosis :—In spotted deer a solitary fertile hydatid cyst measuring 4×2 cm in size in one and in another animal two similar systs measuring 10×9 cm and 5×5 cm in size were seen in the left diaphragmatic lobe of lung. In the four horned antelope, the right apical and diaphragmatic lobe of lung contained 3 fertile hydatid cysts of ping pong to tennis ball size replacing lung parenchyma. In India, hydatidosis in domestic ruminants is quite common. They usually do not cause any pathological changes unless they are very large in number. Death due to shock may result due to rupture of cyst.

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spotted deer (3 cases) and samber (3 cases) numerous ragged irregular cavities in lungs simulating vomicae in dog and man were seen. The pleura was invariably thickened due to fibrin strands and induration as a result the lungs were adhered to the thoracic wall. Histologically, the affected organs revealed tubercles which consisted of caseation necrosis with central calcification surrounded by epithelioid cells, giant cells and lymphocytes (Fig. 1). The discrete nodules were encapsulated while there was extensive fibrosis around coalesced nodules. Exudative fibrinous pleuropneumonia and fibrosis were seen in 71% cases. In the black bucks, numerous greyish white caseous nodules 2-5 cm in diameter involved all lobes. Calcification was absent. Duplicate sections and impression smears from lesions stained with Zeihl-Neelsen's technique revealed acidfast organisms morphologically indistinguishable from *Mycobacteriam tuberculosis*.

Tuberculosis is found to be one of the most common diseases in majority of Indian zoos (Liston and Soparkar, 1924 ; Sengupta, 1974 ; Basak *et al.* 1975 ; Rathore and Khera, 1981 ; Baruah, 1983 ; Singh *et al.* 1986). This study confirms the above findings at Nandankanan zoo. The lungs have been involved in all cases suggesting respiratory route of infection. The lesions in general resembled classical tuberculosis in bovines. Calcification and caseation necrosis with Langhan's type of giant cells have been found to be common indicating signs of host's resistance.

Nocardiosis :—Both the lungs of an year old male hog-deer revealed multiple greyish white circumscribed nodular lesions 2-6 cm in diameter scattered throughout the surface and substance. Histologically, the nodules consisted of epithelioid granulomas (Fig. 2) with central caseation necrosis surrounded by a few foreign body giant cells. The lung tissue adjoining the nodule revealed hypertrophied and desquamated alveolar cells admixed with syncitial giant cells in the alveolar lumens. The interstitial tissue showed prominent perivascular cuffing with lymphocytes. The diagnosis of necardiosis was based on demonstration of gram positive branching filaments (Fig. 3) morphologically akin to *Nocardia* Sp. in the caseonecrotic areas and within the epithelioid cells and giant cells. Since the organisms are known to be soil saprophytes in their habitat, the animal must have acquired the infection through inhalation. Among wild mammals nocardiosis resulting in pleurisy has been reported in a red fox and a small mongoose (Loupal *et al.* 1982).

Zygomycosis :—An emaciated adult male hog-deer exibited swelling in the frontal region of head in between the eyes and intermittent epistaxis a month prior to death. On necropsy both the nasal chambers were filled with friable caseonecrotic mass admixed with blood clots as a result, there was dissolution and rarefication of turbinate bones. The frontal and jaw bones were soft and pliable. The lungs had a marbled appearance with areas of grey hepatisation involving both diaphragmatic and apical lobes.

Histologically, the hepatised areas of lungs consisted of necrotising lesion surrounded by epithelioid cells. Most of the acini were filled with exudates, alveolar macrophages (Fig. 4) and occasional giant cells. PAS stained sections revealed numerous broad and thin walled hyphae with non parallel sides akin to zygomycetes. They were often empty and had

Table 1 : Pulmonary lesions in wild ruminants : conditions encountered

Animal Species	Broncho-pneumonia	Interstitial pneumonia	Suppurative pneumonia	Fibrinous pneumonia	Granulomatous bronchitis	Congestion	Tuberculosis	Nocardiosis	Zygo mycosis	Hydatidosis	Total
Spotted deer (*Axis axis*)	2	1	2	—	—	—	14	—	—	2	21
Hog-deer (*Axis porcinus*)	—	—	—	—	—	—	—	1	1	—	2
Sambar (*Cervus unicolor*)	1	—	—	—	—	—	5	—	—	—	6
Barking deer (*Muntiacus muntzak*)	—	—	1	—	1	6	6	—	—	—	14
Mouse deer (*Tragulus meminna*)	—	1	—	—	—	—	—	—	—	—	1
Black buck (*Antilope cervicapra*)	—	2	1	1	—	5	1	—	—	—	10
Gaur (*Bos gaurus*)	—	—	—	—	—	—	1	—	—	—	1
Four-horned antelope (*Tetracerus quadricornis*)	—	—	1	—	—	—	1	—	—	1	3

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PULMONARY LESIONS IN CAPTIVE RUMINANTS

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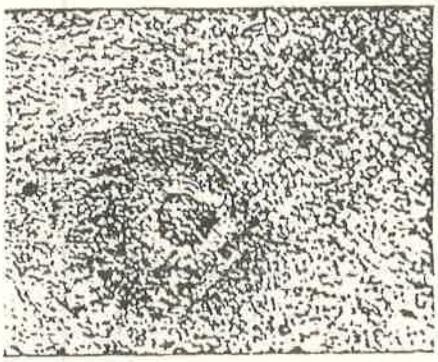

Fig. 1

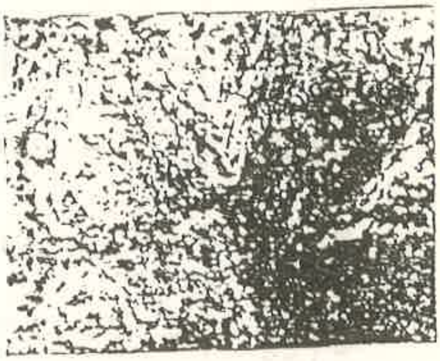

Fig. 3

Fig. 2

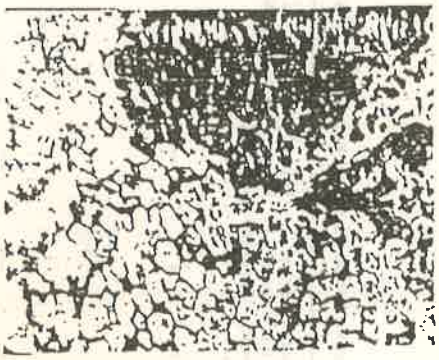

Fig. 4

Legends :

Fig. 1. Tuberculosis. Spotted deer. Lung nodule showing calcification and caseation surrounded by epithelioid cells. H & E × 250

Fig. 2. Pulmonary nocardiosis. Hog-deer. Showing granulomatous nodule. H & E × 250

Fig. 3. Pulmonary nocardiosis. Hog-deer. Note clumps of filamentous gram positive organisms. Grams × 1000.

Fig. 4. Pulmonary zygomycosis. Hog-deer. Note the necrotising lesion with epithelioid cells in the alveoli. H & E × 250

Interstitial pneumonia :—Sections of lungs revealed thickening of interalveolar septa due to congested capillaries and accumulation of oedematous fluid and infiltration of neutrophils, monocytes and lymphocytes. The alveolar and bronchial lumens were free from exudates but the hypertrophied lining cells of the alveoli showed occasional desquamation. The exact cause of the pneumonia in captive ruminants was not determined.

Suppurative pneumonia :—In the spotted deer, the lungs revealed numerous pin-head to pea-size suppurative foci and greyish patches of consolidation. The mediastinal lymph nodes were enlarged due to presence of cream coloured pus. Histologically, the suppurative lesions in lymph nodes and lungs consisted of caseonecrotic tissue amidst intact and degenerating neutrophils. The lymph node abscesses were calcified and encapsulated whereas the lung tissue adjoining the abscesses showed grey hepatisation. Gram stained sections of lungs revealed clumps of Gram positive cocci resembling *Staphylococcus* sp. The pleura and interlobular septae were thickened due to fibrosis.

The consolidated right lung of a barking deer with a history of injury was firmly adhered to the thoracic wall. The pleura was thickened, dull, dry and had shaggy appearance. Sections of lungs had necrotic ulcers intermingled with neutrophils, inflammatory fluid and Gram positive diphtheroids in active lesions whereas diffuse areas of fibrosis were noticed in the healed up areas.

The lungs of black buck and four horned antelope revealed large areas of caseation necrosis associated with intact degenerating neutrophils surounded by a zone of hyperaemia. Most of the acini were filled with exudates predominated by neutrophils. No causative agent was demonstrated in the tissue sections.

Fibrinous pneumonia :—The left apical lobe of lung was consolidated due to presence of fibrin, leucocytes and erythrocytes in most of the alveolar lumens and interalveolar septae. No causative agent could be demonstrated in tissue sections though pasteurellosis is endemic in domestic ruminants of this region and an important cause of fibrinous pneumonia.

Granulomatous bronchitis :—Grossly, the smaller bronchioles were prominent due to thickening of their walls resulting in obliteration of their lumens. Histologically, the thickening was due to proliferation of epithelioid cells and formation by numerous giant cells and fibroplasia associated with caseation necrosis. The sections were negative for acid-fast organisms/other bacteria/fungal hyphae/spores.

Congestion :—Marked congestion of interalveolar capillaries and interlobular vessels were seen in a number of cases. Congestion was not related to a specific cause of death. The distension of alveolar capillaries considerably reduced the air space. Oedematous flooding of alveoli sometimes accompanied congestion. Leakage of erythrocytes into the alveolar lumina/interalveolar septa occurred in few cases.

Tuberculosis :—Lungs were primarily affected in all cases. The gross lesions were characterised by multiple discrete encapsulated nodules of varying sizes. The smaller nodules had coalesced to form bigger ones, the incision of which gave gritty sound. In

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HISTOPATHOLOGICAL DIAGNOSIS OF PULMONARY LESIONS IN CAPTIVE INDIAN RUMINANTS

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The occurrence and pathology of spontaneous pulmonary lesions in nine species of captive wild ruminants have been described. The conditions encountered were tuberculosis (28), congestions (12), interstitial and suppurative pneumonia (4 each), bronchopneumonia and hydatidosis (3 each) and fibrinous pneumonia, granulomatous bronchitis, nocardiosis and zygomycosis (1 each).

Pulmonary lesions in domestic ruminants through mostly abattoir survey are well recognised and documented in different parts of the country but there is paucity of such information in their counterparts in captive wild Indian ruminants. The present communication is an attempt in this direction.

Materials and Methods

One hundred seven captive Indian wild ruminants belonging to 9 different species (spotted deer - 34, hog deer-9, sambar - 18, barking deer - 14, mouse deer - 3, gaur - 3, nilgai - 8, black bucks-31 and four-horned antelopes - 7) died during 1967-84 at Nandankanan biological park formed the materials for the study. Pieces of lungs from different lobes of both the sides collected during routine necropsy and fixed in 10 per cent formal saline were processed to have paraffin sections. These were stained with haematoxylin and eosin. Duplicate sections, wherever appropriate, were stained by Grams, Ziehl-Neelsen's and periodic acid Schiff's technique.

Results and Discussion

Different pulmonary lesions (Table—1) were observed in 58 out of 127 animals necropsied. Nilgai (*Bosephalus tragocamelus*) did not show any lesion.

Bronchopneumonia : Grossly, the lungs had a marbled appearance. Microscopically, the pleura and interlobular septae were thickened due to congested capillaries, oedema, fibrin and neutrophilic infiltration. Most of the alveolar and bronchial lumens were filled with exudates predominated by neutrophils. The bronchial mucosa revealed degeneration and desquamation of the lining epithelial cells. Acute bronchopneumonia in animals is almost invariably be the result of bacterial infection or inhalation of irritant gases. The etiology of the condition here was not traced out. Though bronchopneumonia is considered as the commonest form of pneumonia in domestic animals (Jones and Hunt, 1983 ; Jubb Kennedy, 1970) the incidence of this form of pneumonia is generally low in captive mamals in this study.

parasitic diseases in general constituted (21.55%) one of the major problems in variety of animals in captivity. The common site of predilection of most of these parasites were gastrointestinal tract, liver and lungs. Among ungulates, fluke infestation causing considerable damage to liver was detected. The present survey indicated that traumatic injuries contributed (17%) a single important cause of deaths among wild ungulates. Many of these injuries resulted in suppuration in the system. In many instances (about 12%), the cause of death could not be ascertained because of the absence of gross/microscopic lesions. Neoplasms encountered in this survey were myxoma in a leopard cub, lymphosarcoma in a gaur, mesothelioma in a nilgai, reticulum cell sarcoma and hepatoma in a nilgai and fibrosarcoma in a baby elephant and an albino rat. Among the various systems, pathological lesions were frequently encountered in tissues of digestive system including liver. Next in importance was the lungs. This investigation has positively contributed for the control of many diseases as a result, the losses in the zoo were prevented in subsequent years by improved mangemental practices.

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2. Deaths due to undetermined causes i. e. absence of gross and microscopic lesions—26

3. Liver diseases :
   a) Toxic hepatitis—1
   b) Granulomatous hepatitis – 1
   c) Cirrhosis with fatty changes—2

4. Gastrointestinal diseases :
   a) Haemorrhagic gastroenteritis—4
   b) Ulcerative enteritis—4
   c) Intussuception and twisting of intestines—5
   d) Peritonitis—4

5. Diseases of lungs :
   a) Pneumonia —19
   b) Pleurisy —1
   c) Death due to drowning and asphyxia—2*

6. Diseases of urinary system :
   a) Cystic kidneys —3
   b) Ulcerative cystis – 1
   c) Interstitial nephritis—2
   d) Uraemia —2

7. Cardiovascular diseases :
   a) Haemorrhages on mycardium—3
   b) Atherosclerosis—1

8. Diseases of nervous system :
   a) Paraplegia—1
   b) Hydrocephalus—1

9. Other diseases :
   a) Blindness—1
   b) Fibrosis of spleen —1
   c) Starvation syndrome —4
   d) Transit sickness —2
   e) Canibalism —1

Table—2. Classification of diseases according to the system :

	No. of Animals affected
1. Digestive system :	
a. Diseases of gatrointestinal tract	37
b. Diseases of liver	45
c. Peritoneal cavity	21
d. Mesentery	3
e. Pancreas	1
2. Respiratory system	38
3. Urinary system	12
4. Haemopoetic systm :	
a. Spleen	3
b. Lymph node	2
5. Skin and subcutaneous tissues	2
6. Cardiovascular system	11
7. Nervous system	2
8. Eye	1

2. Assamese monkey	1	Liver	Gram+ve diptheroids in tissue sections
3. Albino rats	4	Liver (1), thoracic cavity (2), Abdominal cavity & Liver (1)	Staphylococci in tissue sections
4. Guinea pigs	2	Cirrhosis in liver	Gram +ve cocci in clumps
5. Red pandas	5	(a) Saw dust liver (3) (b) Liver, lungs spleen (2)	-do-
6. Barking deer	3	a. Pleura and lungs b. Liver & cervical, inguinal and portal lymphnodes c. Skin under sternum, abdomen, serosa of small and large intestine mesentery and lungs	Injuries
7. Black buck	1	Kidneys	—
8. Spotted deer	3	Abdominal cavity (1) Liver (1) Lungs and mesenteric lympn node (1)	—

(c) **Neoplastic conditions :**

Name of animal	*Type of Neoplasm*	*Tissue involved*
1. Baby elephant	Fibrosarcoma	Skin
2. Albino rat	Fibrosarcoma	Liver
3. Leopard cub	Myxoma	Skin
4. Gaur	Lymphosarcoma	Lymph nodes, kidneys and lungs
5. Nilgai	Reticulum cell sarcoma and hepatoma	Lymph node and liver
6. —do—	Mesothelioma	Peritoneum and liver

(d) **Miscellaneous conditions :**

1. Deaths due to traumatic injuries — 37
   - (a) Spotted deer —16
   - (b) Barking deer — 8
   - (c) Sambar — 8
   - (d) Black bucks — 2
   - (e) Nilgai — 1
   - (f) Hog deer — 1
   - (g) Mouse deer — 1

WEASEL FAMILY			
Hog badger	1	*Anthrocephalus longispiculum*	Pancreas
Otter	1	Gravid segments of tape worms (unidentified)	Intestine
PANGOLIN			
Indian Pangolin	1	Hydatid cyst	Lung
PIG			
Wild boar	6	*Stephanurus dentatus*	Liver and kidneys
-do-	1	Hydatid cyts	Peritoneal cavity
ELEPHANT			
Elephant	1	Round worms (unidentified)	Stomach
RODENTS			
Common giant flying squirrels	2	Round worms (unidentified)	Intestines
-do-	1	Parasitic cyst	Peritoneal cavity
-do-	1	Hydatid cyst	Lung
Albino rat	1	*Cysticercus faciolaris*	Liver

B. Bacterial and suppurative conditions.

Name of the animal	*No. affected*	*Organs affected*	*Remarks*
(a) Tuberculosis			
1. Stump tailed macaque	1	Lungs	Acid fast organisms in tissue sections
2. Assamese monkey	1	Lungs Liver & kidenys	-do-
3. Wild boars	4	Lung, liver kidneys, pleura and lymphnodes	-do-
(b) Suppurative conditions			
1. Elephant	1	Liver, stomach, intestines and abdominal cavity	Gun shot wound

(Contd.)

Table—1. Classification of diseases

A. Parasitic diseases

Animal infected	*No. infected*	*Name of the parasite*	*Organ involved*
ANTELOPES AND DEER :			
Spotted deer	12	*Fasciola gigantica*	Liver
Black bucks	3	*Fasciola gigantica*	Liver
Spotted deer	1	Hydatid cyst	Lungs
Sambar	4	*Paramphistomum explanatum*	Liver
Chausingha	1	a. *Sarcocyst*	Heart
		b. Parasitic arteritis (unidentified)	Aorta
CAT, CIVET, MONGOOSE and FOX			
African lion cub	2	*Galonchus perniciosus*	Intestine
Leopard cat	2	*Filaroides osleri*	Lungs
Leopard cat	1	*Ancylostoma caninum*	Intestine
Golden cat	1	*Paragonimus westermanil*	Lungs
Tiger	1	*Paragonimus westermanil*	Lungs
Common palm civet	1	*Echinoparypium* sp.	Intestine
Common mongoose	2	*Paragonimus* sp.	Lungs
Common mongoose	2	*Paragonimus* sp.	Lungs & Intestine
Jackal	1	*Echinococcus granulosus*	Intestine
	1	*Ancylostoma caninum*	Intestine
Fox	1	a. *Dirofilaria immitis*	Heart, Pulmonary artery, Lungs, Kidney.
		b. *D. repens*	Skin and subcutaneous tissue.
BEAR			
Sloth bear cub	2	*Ancylostoma caninum*	Intestine
MONKEYS AND LEMURS			
Slow loris	1	Tape worms (unidentified)	Intestine
Slow loris	1	Round worm (unidentified)	Intestine
Slender loris	1	Parasitic nodules (unidentified)	Mesentery

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DIAGNOSIS AND CLASSIFICATION OF COMMON DISEASES OF CAPTIVE ANIMALS AT NANDANKANAN ZOO IN ORISSA (INDIA)

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A survey on common diseases on captive animals at Nandankanan Zoo indicated that parasitic diseases posed one of the major problems (21.55%) in different species of zoo animals. Pathological changes due to parasites were mostly confined to the gastro-intestinal tract including liver. In a few cases, other organs like lungs, kidneys, heart and skin were involved. Traumatic injuries contributed a single important cause of deaths (17.0%) among wild ungulates. Among neoplasms, myxoma in a leopard cub, lymphosarcoma in a gaur, mesothelioma in a nilgai, reticulum cell sarcoma and hepatoma in a nilgai and fibrosarcoma in a baby elephant and an albino rat were encountered.

Very little information is available on common diseases affecting Indian wild animals in captivity. Though various Zoos and Sanctuaries located in different parts of the country provide valuable source of material, unfortunately efforts to study the disease problem in such areas are scanty and some rare species of animals are facing the threat of extinction.

The purpose of the present communication is to report the results of a survey of common diseases affecting wild animals captivated at Nandankanan Zoo.

MATERIALS AND METHODS

The diagnosis and classification of diseases were based on detailed necropsy examination and subsequent histopathological examination on 218 animals and on necropsy examination alone of further 128 animals during the period from July, 1967 to July, 1974. Diagnosis was based on clinical classification like parasitic diseases, bacterial diseases etc., while classification was also attempted based on the frequency distribution of different systems showing lesions.

RESULTS AND DISCUSSION

The results of survey of common diseases of wild animals are presented in Table—1 and 2.

Detailed necropsy examination of the animals that were having natural death at Nandankanan Biological Park were conducted during the period under report. Morbid materials that were collected with or without lesions were subjected to detailed gross and histopathological examination at the Department of Pathology, Orissa Veterinary College, with a view that the lesions which were missing on gross examination might be detected on microscopical examination. The results of the present survey indicated that requirements of different crocodiles. Heatwole (1976) indicated that the critical maximum temperature of *Crocodylus porosus* is 38^{0}C. The body temperature of American Alligator is 32-35^{0}C. There is no record of the temperature requirements for the associates of the Gharial. Singh (1978) has recorded in case of the Gharial that for hatchlings measuring less than 55 cm in length the cloacal temperature is exactly similar to the medium in which the animal remains, and for larger individuals, due to increased size and metabolism there is a rise of over 2^{0}C, and that, decreased ambient temperature and heavy rainfall lead to reduced apetite and other activities.

The high rainfall and cloudy weather associated with minimum ambient temperature reading below 18-22^{0}C in the first few months of life are probably the main factors in reducing the resistance and consequent mortality. This is also substantiated by the fact that when the hatchling pools were covered properly to prevent coolness and direct rain, the Gharials thrived well.

Although over-crowding may also be a general contributing factor for increased mortality among crocodilian hatchlings, it is our feeling that for the present mortality there was no scope for such apprehension.

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Table 1 : Monthwise record of mortality rate, temperature, rainfall and relative humidity at GRACU.

Month	Temperature °C (Mean)	Rainfall in mm.	Relative humidity in % (Mean)	Mortality
1977				
Jul. (20th-31st)	22.0.35.5 (28.75)	205.9	57.0-96.0 (76.5)	6
Aug.	22.5-33.5 (28.0)	206.9	58.0-96.0 (77.0)	14
Sep.	22.0-34.5 (28.25)	205.7	42.0-96.0 (69.0)	112
Oct.	13.0-36.0 (27.0)	14.4	31.0-97.0 (64.0)	2
Nov.	16.0-35.2 (25.6)	69.3	20.0-99.0 (59.0)	1
Dec.	6.5-32.0 (19.25)	2.1	17.0-100.0 (58.00)	Nil
1978				
Jan.	6.5-32.0 (20.0)	9.5	20.0-100.0 (57.5)	1
Feb.	11.5-35.0 (23.7)	75.4	9.0-100.0 (69.4)	Nil
Mar.	14.0-37.5 (31.4)	53.4	19.0-98.0 (63.1)	1
Apr.	20.0-47.7 (31.2)	19.5	0-100.0 (43.9)	Nil
May	22.0-45.2 (34.2)	30.1	0-100.0 (54.1)	Nil
Jun.	20.0-46.0 (30.2)	135.2	4.0-100.0 (66.3)	Nil
Jul.	23.5-34.2 (27.6)	226.9	44.0-99.0 (69.2)	1

During this period, most of thehatchlings showed shivering in early morning and evening which, however, disappeared when they were exposed to sun for basking. The pools were receiving sunshine only from 9 A.M. to 3.30 P.M. due to high mountains on either side. Glaxose D (0.5g), Liv-52 (2 drops) and Ostocalcium syrup (10 drops) were given to each hatchling once a day for seven days as supportive therapy. As the mortality did not stop, the hatchlings were again teated with Hostacycline (Hoechst) @ 1 g each daily for four days. The number of deaths had started declining by then. By 80th day, 132 hatchlings were already dead. On the advice of the F.A.O. Consultant, the remaining 83 hatchlings were treated with 25 mg per hatchling of ampicillin once a day intramuscularly for five days. No mortality was recorded following the day ampicillin was administered. The shivering, however, continued for about ten days.

By that time the rainfall had declined appreciably and winter had set in. As such, all the time the pools were kept covered on the roof with transparent polythene sheet, and straw padding on the sides of the pool during cooler periods.

From these observations it is seen that there has been a direct relationship between heavy rainfall and mortality of hatchlings. Due to heavy rainfall, the basking of the reptiles were disturbed, which has also a great bearing on health. Probably due to decreased assistance for the above reasons in the early part of their life, some enteric infection has set in at the beginning. Later on inclement weather has probably played a greater role in causing mortality. Mortality resulting from similar signs and symptoms was also recorded among the baby Gharials stationed at Hyderabad (Choudhury, 1979).

Not much information about the diseases, treatment and the control methods of crocodilians in general, and Gharial in particular, are available in literature. However, enteric infection with enterobacteria and leptospirosis (Schroder and Karasec, 1970 and Srisoimdoon, 1971) and deficiency diseases like calcium and vitamin (Hans, 1964) have been reported in crocodiles. Post-mortem examination of 51 day-old hatchlings suggested enteric bacterial infection (possibly *E. coli*). Such lesions were not encountered in dead hatchlings after treatment with Furasol etc.

Available informations suggest that in comparison to its sympatric Crocodilian, Mugger (*Crocodylus palustris*), Gharials are difficult to be reared in captivity (Singh, 1978). Only about 10% of them may survive (F.A.O., 1975). Lang (1974) has indicated for the American Crocodile (*Crocodylus acutus*) that in nature about 80-90% of hatchlings, which are not in company with an adult, die within first six weeks following hatchling.

Adverse weather conditions may be one of the additional factors responsible for such high early mortality, as has been seen in the present investigation.

Sun basking is the most striking feature of crocodilians, and this is essential for them in order to regain the calories lost during the previous night's stay in water (Cott, 1961; Singh and Bustard, 1977 and Singh, 1978). However, very little is known about the exact temperature growth of algae. Foot bath at the entrance of the pool house was always kept filled with potassium permanganate lotion. No outsiders were allowed to get into the pool house except the attendants and the officer in-charge looking after them.

Two hatchlings died during transit and another four died within seven days of reaching Tikerpada. These deaths were attributed to transit shock. No post-mortem examination was conducted. Immediately after receiving the hatchlings, they were administered with ABDEC drop (Parke-Davis) and Liv-52 drops (Himalaya Drug Co.) oraly for three days.

After a gap of seven days (14 days after reaching Tikerpada) mortality of hatchlings started. On recommendation of the near by Veterinary Officer, the hatchlings were treated with Stechlin (Sarabhai) soluble granules orally (@ 12mg per hatchling) for five days. The mortality stopped for about 20 days and then again started following heavy rainfall for 2-3 days. This time the hatchlings were treated with Diadin (Pfizer) @ 1g/4.5kg body weight orally once a day for three days along with multivitamin drops without much improvement. The sick hatchlings were kept in a separate pool and were attended by a separate attendant. Due to cloudy weather and constant rainfall since the arrival of the hatchlings, the surroundings of the pool remained damp most of the time. The mortality pattern alongwith rainfall, humidity and temperature of the area are given in Table-1. The hatchlings did not show their usual basking behaviour and most of the time remained inside the pool.

One to two days prior to death, the sick hatchlings showed signs of dullness, off feed, intermittent convulsions and hyperexcitement to slight disturbance. Post-mortem examination of three 51-day old dead hatchlings showed numerous minute greyish white necrotic foci throughout the surface of liver. The stomachs were completely empty and had catarrhal exudates. The intestines showed distension with catarrhal exudates. The kidneys were markedly congested. Basing on this, it was tentatively diagnosed to be some enteric bacterial infection which has been precipitated by adverse weather conditions.

Accordingly, each individual hatchling was treated with Furasol (SK &F) @ 20mg with 2ml of water, Vimeral (Glaxo) @ 2 drops and Ostocalcium syrup (Glaxo) @ 1 ml daily orally for ten days. The mortality, however, continued till it reached its peak on 58th day of their life. The high rainfall, high humidity and low temperature also continued during the period of heavy mortality.

In the laboratory, culture of heart blood, pieces of kidney and liver did not show any growth in the nutrient broth or blood agar. However, culture of faecal material showed a heavy growth of *Escherichia coli* in MacConkey's agar in pure culture.

By about 64 days it was felt that the hatchlings were not taking adequate amount of fish. As such, hand feeding of the individual hatchlings was practiced. Post-mortem examination of eight dead hatchlings revealed congested lungs in one, and ascitis in another. Marked congestion of kidneys were seen in seven hatchlings. Faecal sample examination did not suggest any helminthic infection. Impression smear of liver and kidneys did not show presence of any bacteria. So also did the culture of affected organs.

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INVESTIGATION INTO THE MORTALITY OF GAVIALIS GANGETICUS (GMELIN) HATCHLINGS IN GHARIAL RESEARCH AND CONSERVATION UNIT, TIKERPADA, ORISSA (INDIA)

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During April 1975, the Government of India initiated a Gharial Research and Conservation Unit (GRACU) at Tikerpada, Orissa, with the technical consultancy from. Food and Agriculture Organisation of the United Nations and financial assistance from the United Nations Development Programme. The Gharial (*Gavialis gangeticus*) was then regarded as critically endangered reptile, in its remaining natural habitats in Nepal and Uttar Pradesh, Madhya Pradesh, Rajasthan and Orissa in India. The unit operated in a four-phased plan viz., collection of eggs from nature, incubation of the eggs under hatching conditions, rearing of the juveniles and rehabilitating suitable sized juveniles in the River Mahanadi of Orissa.

During the months of July to September, 1977, a number of Gharial hatchlings died in GRACU. The observation on the mortality has been presented in this paper for record with a view to invite other information that could form a valuable guidance for development of a successful rearing technique for this endangered crocodilian species of which very little is known.

Four hundred thirtyeight Gharial hatchlings, three to four days old, were flown to Hyderabad from Nepal in three different batches with a night stay at New Delhi during transit. Before tansfer to India all Gharial hatchings had spent 24-72 hours in bath tubs of a hotel in Nepal. Eight hatchlings died during the transit. After a week's stay at Hyderabad, 215 hatchlings were flown to Bhubaneswar, Orissa and then transported by jeep to Tikerpada on 20.07.77, a distance of about 220 km.

At GRACU, the hatchlings were housed in 14 pools having the size 2m x 2m x 0.3m. The pools were fenced by heavy wire netting so that no predator could enter. Each pool had a basking area filled with sand around it and was separated from each other by a wire netting of 45cm. high. The hatchlings were provided with small live fish to feed on. The pool water was replaced once in a week with water collected from the adjacent river Mahanadi. The pools were cleaned thoroughly by scrubbing with bleaching agent once in two weeks to prevent

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successful. This was indicated by the results of the examination of feces for the second time during March '69 to June '69 (Table 1). However, the members of the cat family showed high percentage of Toxocara infection in the second examination also. All the animals and birds showing different infections during March to June 1969 were similarly treated with the drugs used earlier.

Helminths occupy an important place among the parasites in the pathology of wild animals (Hediger, 1964). He advocated periodic treatment to reduce the percentage of infection to the minimum since it is difficult to eradicate completely. The present observations are in close confirmation with that of Hediger (*loc. cit.*). In many occasions in the past, heavy infections of fasciola, coccidia, round worms and intestinal flukes in spotted deers, mongoose, pea fowls and open-billed storks, respecctively, were encountered during routine post mortem examination in which no clinical signs were observed during life. Similarly, in present investigation also, no clinical signs were noticed even in heavy infections.

SUMMARY

A survey of intestinal parasitic infections in different animals and birds of the State Biological Park, Orissa was conducted through examinations of feces i. e. during Dec '68 to June '69. The results obtained by this survey indicated that periodic examination of feces and suitable treatment is an essential part for the management of zoo animals and birds, so far the intestinal parasitic infections are concerned.

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The authors are thankful to Wild Life Conservation Officer, Orissa, for his co-operation in conducting this study.

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Variety	Severity of infection* 1st	2nd
Jungle cat (1)	Coccidia-rare Trichuris+ Hookworm+	Toxocara+
Loopard cat (1)	Capillaria+	Toxocara+
Indian Giant Squirrel	Tapeworm++	
Albino rats	Tapeworm++	
Crab-eating Mongoose.	Coccidia+ Tapeworm++	
Small Indian Mongoose	Coccidia+	
White rabbits	Coccidia++	
Common Mongoose	Coccidia++	
Spotted Deer	Fasciola++	Fasciola++
Tiger cub (2)		Toxocara+
Calf		Ascaris++

* *1st = Fecal examination during December '68 to February, '69.*
2nd = Fecal examination during March, '69 to June, '69.

Collection of feces :—About 1-2 gms. of fresh droppings of birds and feces of animals were collected in the morning. Composite samples were collected in cases where groups of animals and birds of the same varieties were housed together. The collected samples were examined in the same day by sugar floatation technique (Coffin, 1953), and directly with normal saline and Lugol's iodine. The examinations were repeated for 3 consecutive days. Presence of helminthic ova, protozoan cysts, mature parasites and segments for one time or more were taken as positive infections.

Treatment :—The commonly available drugs were used for the treatment whereever appropriate. Bifuran soluble tablets (Smith, Kline & French), Sulmet drinking water solution 12.5%(Cyanamid) and Codrinal (Hoechst) were used in different groups of birds for the treatment of coccidiosis. Antepar tablets (Burroughs Wellcome) and Dicestal tablets (May & Baker) were used for the treatment of round worms and tapeworms, respectively, in birds.

Alcoper and Antoban (Burroughs Wellcome), Diadin tablets (Pfizer) and Discestal were used for the treatment of hook worm and round worm, coccidial and tape worm infections, respectively, in animals.

These drugs were used as per the recommended doses of the manufacturers.

RESULTS & DISCUSSION

The results of the fecal examination of birds and animals are given in Table 1. The results of the treatment during Dec'68 to Feb'69 were quite

Table-1.—Results of the fecal examination

Variety	Severity of infection* 1st	2nd
Birds		
Grey Jungle fowl.	Coccidia-rare Tapeworm-rare	Ascarida++ Tapeworm+
Scimitar Babbler & Black-throated Jays.	Coccidia+	
Mynas	Coccidia++	Tapeworm++
Pigeons	Coccidia++++ Ascaridia++	Coccidia ++ Ascaridia+
Openbilled storcks.	Coccidia++	
Guinea Fowl	Coccidia ++++	
Silver-eared Mesias & Blue-winged Swas.	Ascaridia+ Coccidia+++	
Striated-Laughing Thrush	Coccidia ++++	
Doves	Ascaridia-rare	
Common Pea Fowl.	Ascaridia-rare	
Red & Painted spur Fowl.	Tapeworm-rare	
Pheasants a. Silver Pheasants. b. Ring-necked Pheasants. c. Kalif Pheasants		Ascaridia++
Animals		
Jaguar (1)	Hookworm+	Toxocara-rare
Tiger cub (1) Deepak.	Hookworm+++	Toxocara+
Tiger (1)	Hookworm++ Toxocara+	
Tigress (1)	Hookworm++ Toxocara+	Toxocara+
Tigress (Kanan)	Hookworm++ Tapeworm+++ Toxocara+	Toxocara+
Fishing cat (1)	Hookworm++	Toxocara+
Clouded Leopard (2)	Hookworm++	Toxocara++
African Lion (3)	Toxocara++	Toxocara+
Indian Lioness (1)	Hookworm++ Toxocara++	Toxocara+
Golden cat (2)	Toxocara++	Toxocara+

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Clinical Article

SURVEY OF INTESTINAL PARASITIC INFECTIONS IN ZOO ANIMALS & BIRDS

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There are several sporadic reports on parasitic infections of zoo animals and birds in this country, but are still far from complete. Coccidiosis in Indian camel (Dubey & Pandey, 1964), Indian mongoose (Patnaik & Ray, 1965), pigeons (Patnaik & Ray, 1966), guinea fowl (Bhatia and Pande, 1967) and pea hen (Bhatia & Pande, 1968) have been reported. Infections of Toxascaris species in puma cub (Patnaik, 1964) and Ascaris species in lion (Jehan & Sood, 1968), Fasciola in spotted deer (Rao & Acharjyo, 1969) and Giardia in a lioness (Das & Jha, 1967) have also been recorded.

It is generally considered that the incidence of parasitic infections is high in monsoon. The present study was undertaken with a view to study the presence of different intestinal parasitic infections in zoo animals and to reduce the worm load to the minium before monsoon through examination of feces and subsequent treatment.

MATERIALS AND METHODS

Focal samples of the following varieties of animals and birds belonging to State Biological Park (Zoo), Nandan Kanan, Orissa, were examined. Nandan Kanan was opened by the Government of Orissa in 1960. The animals and birds of the zoo are mostly of Indian origin.

Kind of animals	Varieties* 1st.	Varieties* 2nd	Kind of birds	Varieties* 1st	Varieties* 2nd
a. Monkey & Lemurs	7	11	a. Birds of Prey.	3	3
b. Cats	10	9	b. Horn bills.	2	2
c. Civets & Mongooses	6	6	c. Storks, Herons & Pelicans.	8	8
d. Hyenas & Foxes	2	2	d. Laughing Thrushes	4	4
e. Bears	1	1	e. Doves, Pigeons, Partridges & Quails	7	6
f. Elephant	1	1	f. Fowls & Pheasants	9	10
g. Weasel family	4	4	g. Maynas	4	4
h. Rodents	5	6	h. Cranes	3	3
i. Horses & Donkeys	2	2	i. Parakeets	4	4
j. Deer & Antelopes	8	8	i. Swans, ducks & Geese	8	5
k. Cattle & Buffaloes	2	2	k. Other birds	17	17
l. Pigs	1	1			
m. Camel	1	1			
n. Panda	—	1			
o. Pangolins.	—	1			
Total	50	56	Total	69	66

* *1st = Examination was conducted during December '68 to Feb '69*
2nd = Examination was conducted during March '69 to June '69

solitary lesion of the bowel without metastasis or if metastasis present, it should be clearly of a younger generation.

In the present report, the anaplastic changes in the crypts of Leiberkuhn and a similar histological picture of the secondary growths in the muscular coat enabled us to classify this tumour as adenocarcinoma of the crypts in the duodenum. The possibility of Argentaffin carcinoma was ruled out since the cytoplasm was negative for Argentaffin granules when stained with Masson's stain.

Feldman (1932) while describing a case of intestinal adenocarcinoma had demonstrated extensive lesions of tuberculosis in spleen and lungs. In the present case also, a focus of tuberculoid lesion associated with acid fast bacilli were encountered in the serosa. The authors would like to mention here that there was incidence of tuberculosis in a lesser whistling teal, a duck and two pigeons from the same zoo. The Sarus crane must have contacted the infection from these birds.

The inflammatory changes described in the mucosa and perivascular tissue was ascribed to the irritation produced by the flukes present in the intestinal lumen. With this limited literature, it is difficult to conclude at this stage, the role of the intestinal flukes in tumorigenesis.

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ADINOCARCINOMA IN SARUS CRANE

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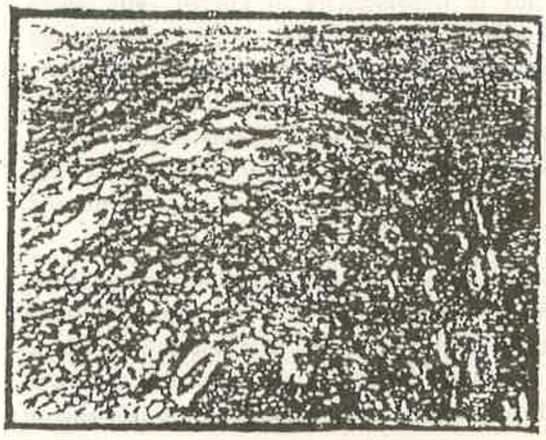

Legends :

Fig 1 : Section of intestine showing secondary neoplastic growths in the inner circular smooth muscles. Note the arrangement of columnar cells in an alveolar fashion.
H & E × 84.

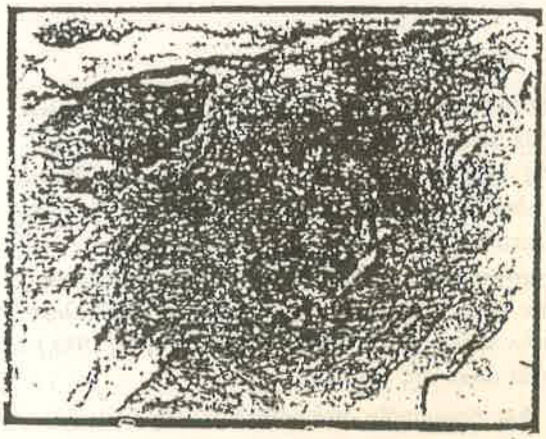

Fig 2 : Section of intestines showing tuberculoid lesions in the serosa.
H & E × 84.

crypts of Leiberkuhn manifested anaplastic changes characteried by hyperchromatism and enlargement of nuclei, enlargement of nucleoli and basophilia of cytoplasm. The mitotic figures were, however, scanty. There was perivascular infiltration of lymphocytes, plasma cells and macrophages in the submucosa.

The infiltrative propensities of the neoplastic growth was evinced in the inner circular, smooth muscle layer where the columnar cells along with Goblet cells in single or multilayers were arranged in an alveolar pattern supported by stromal tissue (Fig. 1). The lumina of such alveoli contained mucin due to hyperactivity of Goblet cells which was demonstrated in mucicarmine stained sections. In the centre of the secondary growth in the muscular coat, the cells were arranged in the form of solid blocks, the cytoplasm of which had numerous fuchsinophilic P.A.S. negative bodies. The inner circular and outer longitudinal muscles manifested severe retrogressive changes characterised by increased granularity and/or hyalinisation of sarcoplasm together with karyorrhectic and kareolytic changes of the nuclei.

The serosa was thickened due to an isolated granulomatous reaction consisting of a central caseonecrotic tissue surrounded by a large number of macrophages, lymphocytes and foreign body giant cells and a thick connective tissue capsule (Fig. 2). With Z. N. Carbol fuchsin staining, acid fast organisms morphologically indistinguishable from *Mycobacterium tuberculosis* were noticed.

DISCUSSION

The true incidence of neoplasms among zoo birds is not known because of paucity of reports in the literature. In two years study of pathological changes encountered among birds in captivity at State Biological Park, Orissa only this single case of adenocarcinoma could be observed. At the first instance on gross examination, the nodular growth has given the impression that the flukes (*Petasiger antigonus*) encountered in the lumen had a predelictory site in the muscular coat akin to the nodular lesions caused by *Chaunocephalus ferox* in open billed storks (Patnaik *et al.* 1970) but on incision, homogenous oval mass was observed.

Willis (1967) described that Argentaffin carcinomas arising from specialised granular epithelial cells of crypts of Leiberkuhn were the common tumours in human beings. Jubb and Kennedy (1963) described that Argentaffin carcinomas in cat do not attain a large size but infiltrated into the muscularis. Jackson (1936) while describing the carcinoma of intestines in chicken, emphasised that the tumour should essentially affect the mucosa with an extension into the muscularis and there should be a

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A CASE OF ADENOCARCINOMA OF CRYPTS OF LEIBERKUHN IN DUODENUM OF A SARUS CRANE (*GRUS ANTIGONE*)

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SUMMARY

A case of adenocarcinoma of the crypts of Leiberkuhn of post-duodenal end of intestines has been described for the first time in a Sarus crane. Concommitant lesions of tuberculosis and inflammatory and degenerative changes due to *Petasiger antigonus* has also been described.

INTRODUCTION

It is known that wild fowls in captivity are susceptible to carcinomatous growths and it is assumed that intestines and ovaries are the potential sites for neoplastic transformation as in common fowl (Feldman, 1932). The purpose of this communication is to place on record a case of adenocarcinoma of crypts of Leiberkuhn in a Sarus crane as the literature of this tumor is lacking.

MATERIALS AND METHODS

Out of 95 necropsies of captive birds conducted at State Biological Park, Orissa during 1967—69, the post duodenal end of a Sarus crane revealed three isolated oval growths measuring 1 × 0.5 × 0.5 cms protruding through the serosal surface.

Representative portions from these nodules were fixed in 10% buffered formol saline and processed by routine histopathological procedures and paraffin sections were stained by H & E method, P. A. S. Technique, Z. N. Carbol fuchsin technique, Mucicarmine technique, Ponchae fuchsin adrenal stain and Masson's stain for Argentaffin granules (Manual of histologic and special staining technic, 1949), where ever appropriate.

OBSERVATION

Macroscopically, the intestinal wall was much thickened and there was extensive catarrhal and fibrinous enteritis together with a number of flukes identified to be *Petasiger antigonus* Nigam, 1944.

Microscopically, the mucosa revealed catarrhal inflammation and fibrinoid degeneration with intermingled leucocytes in the fibrin network. The

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Histopathology :

Sections of lungs revealed numerous tubercles together with daughter tubercles distributed throughout the parenchyma. The tubercles consisted of massive calcification in caseonecrotic area with karryorrhectic nuclei surrounded by epitheloid and lymphocytic infiltration. The discrete nodules were encapsulated while there was extensive fibrosis around coalesced nodules. Giant cells were rare. Most of the lung parenchyma was obliterated by the tubercles. Pleura was markedly thickened due to fibrinous pleuritis, induration and monocytic cell infiltration.

Sections of liver revealed similar numerous discerete nodules of varying sizes along with formation of daughter tubercles as a result, large areas of hepatic tissue were replaced. The hepatic cells adjoining the tubercles revealed severe retrogressive changes. Sections of spleen revealed similar calcified and encapsulated nodules. In addition, there was severe reticuloendothelial cell hyperplasia, congestion, haemosiderosis, haemorrhages and fibrosis. The latter was often hyalinised.

The mediastinal and bronchial lymph nodes were enlarged due to multiple tubercle lesions and reticuloendothelial cell hyperplasia. Sections of kidney revealed focal encapsulated tubercle nodules in the cortex while the medulla revealed focal accumulation of epitheloid cells and lymphocytes in the interstitial tissue. Impression smears from the tubercle nodules and tissue sections revealed acid fast organisms morphologically akin to *Mycobacterium tuberculosis* on Ziehl-Neelsen's carbol fuchsin staining.

The pathology of tuberculous lesions in wild boar is comparable to those described in cattle and domestic pig. However, in the domestic pig, lung lesions were less common but in the present case, of all the organs studied, lung lesions were most extensive. Jubb and Kennedy (1972) stated that bovine type is more capable of producing generalised disease than the avian type in pigs. Again the former type produces encapsulated caseocalcified tubercles while the latter produces proliferative types of lesions. Bacteriological studies for typing of bacteria could not be undertaken in the present case because of lack of facilities.

SUMMARY

A case of generalised tuberculosis involving lungs, liver, spleen kidneys and mediastinal and bronchial lymph nodes have been described in a wild boar.

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SHORT COMMUNICATIONS

GENERALISED TUBERCULOSIS IN A WILD BOAR (*SUS SCROFA*)

Tuberculosis (TB), a chronic infectious disease caused by *Mycobacterium tuberculosis* is known to have a wide host range including wild animals. Iyer (1937) indicated that TB was common in elephants as early as 2000 B. C. Among Indian animals in captivity, Bombay Zoological Gardens experienced in 1908, a prolonged outbreak of TB which eventually infected many species including Ilamas, deer, sheep, antelopes, tapirs, coatis, binturongs and Lesser pandas (Liston ond Soparkar, 1924). Apart from monkeys of different types (Liston and Soparkar, 1924 ; Iyer, 1940; Nair and Murthy, 1951, and Chatterji, 1958), TB has also been reported in nilgai (Fox, 1923), bear and deer (Nair and Murthy, 1951), spotted and hog deer, gazelle, and binturong (Mukherji and Chatterji, 1958) and giraffe (Rai and Nair. 1958). Rao and Acharjyo (1969) reported TB among stump-tailed macaque, lesser whistling teal, duck and pigeon from Nandan Kanan Zoo. This note reports a case of generalised TB in a wild boar.

Gross pathology :

An emaciated male wild boar had a spontaneous death on 17.8.1976. At necropsy, the pleura was found to be markedly thickened due to fibrin strands and induration as a result, the lungs had adhered to thoracic wall. The lungs were yellowish green in colour and consolidated due to replacement of extensive areas of parenchyma by caseonecrotic mass. The surface and substance of the organ also revealed multiple, discrete encapsulated nodules of different sizes. The smaller nodules had coalesced to form bigger nodules. While cutting, there was a gritty feeling. The mediastinal and bronchial lymph nodes, spleen, liver and kidneys revealed similar nodular lesions.

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From the Table II it is seen that spotted deer belonging to all age groups were affected, the youngest affected was 5 months old. The wild pigs and monkeys affected were in the age group of 3 to 12 years and 8 to 20 years, respectively. The microscopic lesions in spotted deer and wild pigs were essentially similar in that the lungs were primarily affected in all cases indicating the possible infection through respiratory tract. Chatterji [5[reported that 22 out of 44 tuberculous affected captive animals had primary involvement of lungs. The younger lesions in spotted deer and wild pigs in this study were characterised by diffuse proliferation of reticuloendothelial cells and giant cells followed by extensive areas of caseation necrosis with calcified centres surrounded by fibrous tissue in the form of nodules. Langhan's giant cells were invariably seen. Interestingly in one spotted deer, numerous cavities in lungs akin to vomicae in man and dog were seen. Exudative pleuropneumonia and fibrosis were more pronounced in spotted deer than in wild pigs. In spotted deer and wild pigs, the lungs and associated lymph nodes and less frequently liver were involved whereas in wild pigs, apart from lungs and associated lympn nodal involvement, generalisation was more frequent which was indicated by the involvement of kidneys, liver, spleen and occasionally skeletal muscles and udder. The pathology of tuberculosis in spotted deer and wild pigs were akin to those seen in domestic cattle. Similar opinion was also expressed by Liston and Soparkar [2] and Fox [7]. According to Davies et al [12], wild ungulates were considered to be relatively resistant to infection but the disease was not uncommon in these animals particularly in the zoo. They further stated that fibrosis and calcification were considered as signs of host's resistance. The lesions in monkeys were, however, different from spotted deer and wild pigs in that they were more spreading in nature with extensive areas of caseation necrosis without calcification and encapsulation. Giant cell response was less frequent and generalisation was more with involvement of other visceral organs like kidneys, spleen and liver. Similar description was also given by Davies et al., [12] who indicated extreme susceptibility of primates to tuberculosis.

Since the inception of the zoo in 1960, was not considered as a problem until 1978. Only sporadic cases in a monkey, teal, pigeon[10] and a wild pig [11] were earlier encountered during the routine histopathological and necropsy examination. It is only during the past 2 years the disease has assumed serious proportions particularly in spotted deer, wild pigs and monkeys posing a serious threat to the health of other zoo animals and birds.

peritoneum pleura and occasionally muscles and udder with or without lesions were collected in 10 percent formol saline. Formalin fixed tissues were processed by routine histological technique and staited by haemaoxylin and eosin method. Smears prepared from suspected tuberculous lesions and paraffin sections were stained by Ziehl Neelson's carbol fuchsin method for demonstration of acid-fast organism.

Results and Discussion

Epidemiological data pertaining to proportionate mortality rate for tuberculosis, age, sex and organ involvement in some ungulates and primates are given in Table 1 and 2.

Table I : Proportionate mortality rate for TB in some ungulates and primates at Nandankanan from 1976 to 1980.

Sl. No	Kind of animal	Total population	Mortality due to various causes	Mortality rate in percent	Mortality due to TB	Proportionate mortality rate for TB
1.	Spotted deer	57	39	68. 3	12	30 77
2.	Wild pigs	64	30	65.55	12	40.00
3.	Barking deer	37	28	75 70	1	0.36
4.	Four horned antelope	13	10	77.00	1	10.00
5.	Assamese monkey	3	1	33.33	1	100.00
6.	Stump tailed macaque	4	2	50.00	2	100.00

Table II : Age. Sex and organ involvement of TB in the Zoo Animals

Kind of animal	No died M	No died F	Age group affected	Organs involved: Lungs	Liver	Med/astinel/Bronchial Lymph-node	Kidney	Spleen	udder	muscle	Pleura	Pericardium	Peritoneum
Spotted deer	8	4	5 months to 10 years	12	6	6/0		—	—	—	2	—	1
Wild pigs	10	2	3 to 12 years	12	—	8/3	2	4	1	1	—	1	—
Monkeys	1	2	10-20 years	3	2	1/1	—	1	—	—	—	1	1
Barking deer	—	1	8 years	1	—	1/0	—	—	—	—	1	—	—
Four horned antelope	1	—	8 years	1	—	—	—	—	—	—	—	—	—

M=Male
F=Female

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Tuberculosis in some Ungulates and Primates at Nandankanan Biological Park

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Twenty nine cases of tuberculosis affecting 12 spotted deer, 12 wild pigs, 3 monkeys, a four horned antelope and a barking deer were recorded during 1976 to 1980. The disease had assumed serious proportions during the past 2 years. It was found that spotted deers of all ages were affected, the youngest being 5-months-old, while wild pigs and monkeys affected were in the age groups of 3 to 12 years and 8 to 20 years, respectively. Lungs were primarily involved in these animals. In addition, tuberculous mastitis and myositis were also reported in wild pigs. The microscopic lesions in spotted deer and wild pigs were akin to those seen in cattle. In monkeys, the lesions were progressive in nature with extensive areas of caseation necrosis without calcification and encapsulation.

Introduction

Tuberculosis, a chronic infectious disease caused by *Mycobacterium tuberculosis* has a wide host range including wild animals and birds in captivity. Iyer[1] indicated that tuberculosis was common in elephants as early as 2000 B. C. Among Indian animals in captivity, Bombay Zoological Gardens experienced in 1908 a prolonged outbreak of tuberculosis which eventually infected many species including llamas, deer, sheep, antelopes, tapirs, coatis, binturongs and lesser pandas[2]. Apart from monkeys of different types[2, 3, 4, 5, 6]. Tuberculosis has also been reported in nilgai[7], bear and deer[4], spotted and hog deer, gazelle and binturang[8] and giraffe[9]. Rao and Acharjyo[10] reported in a stump-tailed macaque, a lesser whistling teal and a pigeon from Nandankanan Zoo. They[11] have also reported a case of generalised tuberculosis in a wild bear. The purpose of this communication is to report the prevalence of TB in the zoo particularly among spotted deer, wild pigs and monkeys since the disease has assumed serious proportions during the past 2 years resulting in heavy losses.

Material and Methods

The materials for the study were made available from the local zoo during the period from 1976 to 1980. Some of the vital organs like pieces of lungs, liver, spleen, bronchial, mediastinal and mesenteric lymph nodes, heart, kidneys, *Renal abscess:* In a hog deer massive aggregates of intact and degenerated neutrophils were seen in the necrotic areas of cortex and medulla. Primary abscess was however seen in both testes.

Tubercular nephritis: The lesions were characterised by central caseation necrosis with calcification surrounded by epithelioid cells, lympocytes and langhan's giant cells in the renal cortex formed a part of generalised tuberculosis involving lungs, liver, lymph nodes, spleen, peritoneum and pleura of gaur and pulmonary tuberculosis of sambar.

Lymphosarcoma involving the kidney as a part of metastatic lesions was detected in another gaur. A hog-deer which died suddenly of undetermined etiology exhibited generalised venous congestion including kidney.

In this study microscopical lesions in kidneys constituted 24.4 per cent of the total cases indicating high frequency of involvement of this organ to disease

Summary

Of the 127 captive wild ruminants belonging to 9 species examined, 31 samples (24.4 per cent) revealed 9 types of renal lesions. Nephrosis was the most common lesion in these animals.

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Table 1. Renal lesions in wild ruminants

Sl. No.	Pathological condition	Kind of animals								
		Spotted deer	Hog deer	Sambar	Barking deer	Mouse deer	Nilgai	Black buck	Gaur	Four horned antelope
1	Nephrosis	2	1	2	9	1	—	5	—	—
2	Chronic glomerulonephritis	—	—	1	—	—	—	—	—	—
3	Chronic interstitial nephritis	—	—	—	—	1	—	1	—	—
4	Pyelonephritis	—	—	—	—	—	—	1	—	—
5	Renal abscess	—	1	—	—	—	—	—	—	—
6	Tubercular nephritis	—	—	1	—	—	—	—	1	—
7	Microcalculi	--	—	—	—	—	—	3		
8	Lymphosarcoma	—	—	—	—	—	—	—	1	—
9	Venous congestion	—	1	—	—	—	—	—	—	—

of tufts with the presence of eosinophilic granular materials in the dilated capsular spaces. Similar lesion seen in 5 black bucks are perhaps due to some unknown blood borne toxins causing damage to the glomerular tuft and a consequent nephrosis.

Microcalculi: In three black bucks, the lumens of the convoluted tubules and interstitial tissue revealed irregular differently sized structureless PAS positive basophilic materials with slight eosinophilic tinge. The basophilic materials were found positive for calcium salts. The incidence of microcalculi has been found to be very high in goat kidneys (Tomar, 1968) and sheep and goat kidneys (Khanna, 1980; Sahoo and Rao, 1972 a). According to Cornelius and Moulton (1960) and Sastry (1970), there is a direct relationship between excretion of mucopolysaccharides and calcigerous stone formation.

Chronic glomerulonephritis: In a Sambar, the capsules of both the kidneys were markedly thickened and adhered to the parenchyma. Majority of glomeruli showed ischaemia, distortion and disruption of the tuft as a result the capsular spaces were widened. Some of the glomeruli were adhered to parietal layer. The Bowman's capsules were invariably thickened due to proliferation of periglomerular collagen fibres. The tubules showed necrobiotic changes of the lining epithelial cells associated with the presence of hyaline casts in the lumens. This condition has also been found to be uncommon in Indian sheep and goats (Tomar, 1968; Khanna. 1980; Sahoo, 1971 and Babu and Paliwal, (1988). The microscopic lesions are similar to those described by Jubb and Kennedy (1970) and Jones and Hunt (1983) but it's cause and mechanism remain unknown.

Chronic interstitial nephritis: In a mouse deer and black buck the kidneys showed focal wedge shaped greyish white areas extending from the cortex into the medulla. The capsules were thickened and firmly adhered to the parenchyma. Histologically majority of the glomeruli in the wedge shaped area were distorted, degenerated and shrunken. The interstitial tissue was infiltrated with large number of lymphocytes, plasma cells and monocytes as a result the tubules were widely separated. Some of the adjoining tubules were dilated due to presence of hyaline casts. The sections were negative for leptospires in Levatidi's staining. This form of nephritis associated with or without leptospires was found to be the most common type among sheep and goats (Kharole and Rao, 1963; Khanna, 1980 and Sahoo and Rao, 1972 b).

Pyelonephritis: The medullary region of the right kidney of a black buck revealed an elongated pyemic focus 2.3 x 1.0 mm. in size surrounded by a zone of hyperaemia. Histologically, the pyemic focus comprised of caseonecrotic tissue amidst dead and/or intact neutrophils. The dilated tubular lumens and interstitial tissue contained large number of neutrophils. Gram positive coccobacillary bodies were demonstrated in the necrotic area. Though pyelonephritis is one of the frequent forms of nephritis in domestic cattle, it is comparatively rare in sheep and goats.

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SPONTANEOUSLY OCCURRING RENAL LESIONS IN SOME INDIAN WILD RUMINANTS*

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Though literature on spontaneously occurring renal lesions in domestic ruminants through mostly abattoir survey is available from different parts of this country published information in their counterparts both in free-living state and captivity is lacking. Therefore, this paper reports such information.

Materials and Methods

The materials formed for this study were based on gross and histopathological examination conducted on 127 Indian captive wild ruminants of nine species belonging to three families which succumbed at Nandankanan Biological Park during 1967-84. Pieces of tissues from both the kidney with or without gross lesions from 34 spotted deer *(Axis axis,)* 9 hog-deer *(Axis porcinus)*, 18 sambar *(Cervus unicolor)*, 14 barking deer *(Mantiacus muntjak)*, 3 mouse deer *(Tragulus meminna)*, 3 gaur *(Bos gaurus)*, 8 Nilgai *(Bosephalus tragocamelus)*, 31 black bucks *(Antilope cervicapara)* and 7 for-horned antelopes *(Tetracerus guadricornis* were collected in 10 per cent formal saline solution. The formalin fixed tissues were processed by haematoxyline and eosin. Special staining methods such as Ziehl-Neelsen's, Gram's, Periodic acid schiff's (PAS) and Van Kossa's techniques were employed, whereever appropriate.

Results and Discussion

Renal lesions encountered in different kinds of animals have been tabulated (Table I) and a brief description of each condition has been given hereunder.

Nephrosis: This was the most common lesion encountered in the kidney (17.2 per cent) the incidence of which is much higher than those reported in goats (Tomar, 1968) and in sheep and goats (Sahoo, 1971; Babu and Paliwal, 1988) but in close agreement with the investigation of Khanna (1980). Grossly, the kidneys were pale in colour and soft in consistency. Histologically the cortical tubules revealed coagulation necrosis of the lining epithelial cells, the nuclei of which showed pyknosis, karyorrhexis and karyolysis and the cells were swollen due to cellular swelling and hydropic degeneration. In the 3 barking deer, these lesions were attributed to vascular damage resulting from bluetongue infection (Acharjyo and Rao, 1986) in which the glomerular tuft and interstitial capillaries showed marked congestion and haemorrhages. Majority of glomeruli showed degeneration and disintegration

* Part of the M. V. Sc. thesis submitted by the senior author

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Summary

Bluetongue like disease was reported in Nilgai antelope and barking deer at the Nandankanan Zoo, Orissa. The pathological features have been described.

സംഗ്രഹം

ഒറിസ്സായിലെ നന്ദൻ കാനൻ മൃഗശാലയിൽ ബ്ലൂടങ്ങ് മാതിരിയുള്ള ഒരു രോഗം ചില മൃഗങ്ങളിൽ ഉണ്ടായതിനെപ്പററി പ്രതിപാദിച്ചിരിക്കുന്നു.

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Table 1

Details of a bluetongue-like disease in some captive Indian wild ruminants

Sl. No.	Name of the wild ruminants	No. available			No. affected			Mortality rate in percent	No. died	Case fatality rate
		Female	Male	Total	Female	Male	Total			
1	Nilgai	2	2	4	2	2	4	100	3	75%
2	Four-horned antelope	1	3	4	1	3	4	100	4	100%
3	Barking deer	8	7	15	3	—	3	20	3	100%
4	Sambar	11	15	26	—	—	—	—	—	—
5	Spotted deer	19	20	39	—	—	—	—	—	—
6	Hog-deer	3	5	8	—	—	—	—	—	—
7	Blackbuck	20	25	45	—	—	—	—	—	—
8	Mithun	1	1	2	—		—	—	—	—
9	Mouse-deer		1	2	—	—	—	—	—	—
10	Ladakhi goat	1	—	1	—	—	—	—	—	—

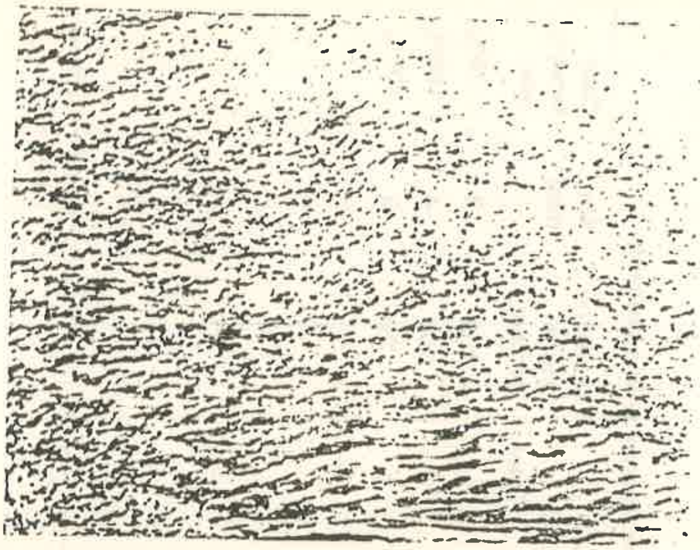

Fig. 3
Section of heart of a barking deer showing nonsuppurative myocarditis H & E x 25

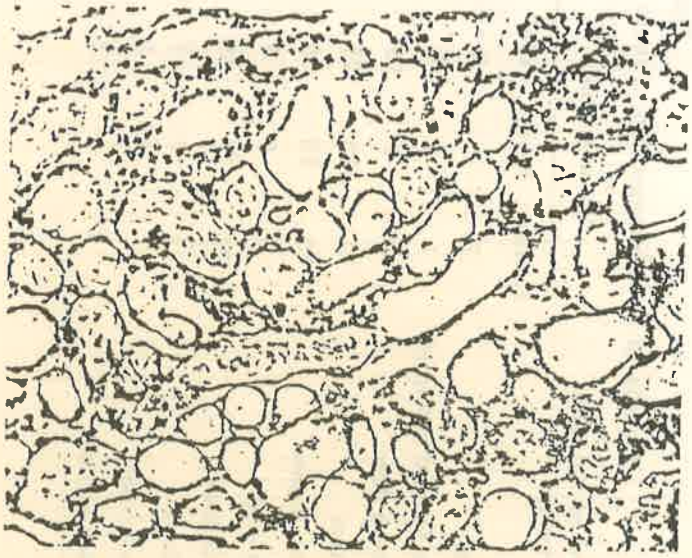

Fig. 4
Section of kidney of a barking deer showing blood casts in the dilated tubules. H & E x 25

Fig. 1
Tongue of a barking deer showing erosions on the dorsum of tongue

Fig. 2
Section of tongue of barking deer showing necrotic ulcers and hyperkeratosis H & E x 25

either surface of the swollen and cyanosed tongue (Fig. 1) and on the muscle. Hyperaemia and ulcerations were seen on the periople and interdigital tissue.

Histopathology :

Sections of tongue showed surface ulceration (Fig. 2) associated with the presence of diptheretic membrane. The epithelium which was free from ulcers showed acanthosis, hyperkeratosis and parakeratosis. The muscle fibres revealed fragmentation and hyalinisation associated with sarcolemmal cell hyperplasia. The intermuscular tissue and corium were oedematous and congested. Sections of heart showed nonsuppurative myocarditis characterised by massive infiltration of mononuclear cells and oedema replacing a number of myocardial fibres (Fig. 3) which often showed fragmentation.myolysis atrophy and or hyalinisation associated with sarcolemmal cell proliferation in all cases while the intermyseal tissue was oedematous and congested in two cases. In some areas, there was also replacement fibrosis. Sections of lungs, liver, spleen and abomasum showed hyperaemia. The peyer's patches in the small intestines and white pulp of the spleen showed depletion of lymphocytes. The kidney lesions consisted of congestion and haemorrhages in the glomerular tuft and interstitial tissue. Majority of glomeruli showed degeneration and disintegration of the tuft with the presence of eosinophilic granular material in the dilated capsular space. The lining epithelial cells of the tubules revealed severe retrogressive changes while the dilated lumens contained blood casts (Fig. 4).

Discussion

Though the occurrence of bluetongue among domestic ruminants was known in India (Negi, 1982), its prevalence in Indian wild ruminants was unrecognised. In this study, the disease was diagnosed on the basis of clinical signs, gross and histopathology and failure to identify foot and mouth disease virus from heart and tongue epithelium and rinderpest virus from mesenteric lymph node. The clinical signs and gross and histopathological lesions observed here were akin to those reported for bluetongue in deer (Trainer, 1970) and in sheep (Jubb and Kennedy, 1970). Of the 10 susceptible species available at the time of outbreak, clinical signs and mortality occurred in nilgai, fore-horned antelope and barking deer. It is possible that in other animals, the disease must have remained in an inapparent form. Confirmation of the disease by serology could not be made because of inherent difficulties in collection of sera samples from the affected animals.

Kerala Journal of Veterinary Science Vol. 17, No. 2, December 1986, P. 121—127

Research note:

BLUETONGUE LIKE DISEASE IN SOME CAPTIVE INDIAN WILD RUMINANTS

Bluetongue is an infectious arthropode borne viral disease of domestic and wild ruminants which was first recorded in South Africa in 1876 (Trainer, 1970). Since then, the disease was found to be world wide in distribution. From India, the disease was first reported in sheep from Maharashtra in 1964 and subsequently from Himachal Pradesh, Haryana, Karnataka, Gujarat, Andhra Pradesh and Rajasthan (Negi, 1982). Among wild ruminants, blesbok, bighorn sheep and white tailed deer are susceptible to bluetongue virus. Serological evidence of bluetongue was reported in gazelle (Barzillai *et al.* 1971), white tailed deer (Hoff *et al.* 1974), Wiltshire horn sheep (Bida *et al.* 1975), impala, leckwe, kudu, blue wild beast, gemsbok, spring bok and tessebe (Shimpson, 1979) and wild deer (Kammen and Cybinsky, 1981). The disease was reproduced experimentally in pronghorn antelope (Hoff, 1972), gazzelle (Barzillai and Tadmor, 1972) and Muntzak and Kudu (Hoff *et al.* 1973). Bluetongue has not been reported in Indian wild ruminants and therefore, the purpose of the communication.

Of the 146 animals belonging to 10 species of captive Indian wild ruminants at Nandankanan zoo available during January-February, 1983, 11 animals belonging to 3 species were affected with a disease simulating bluetongue resulting in the death of 10 animals (Table 1). Animals of all ages belonging to either sex were affected. Sudden death in 3 animals, death within 1-4 days of illness in 6 and within 20 days in one were recorded. The clinical signs observed prior to death were dullness, depression, restlessness, anorexia, lameness, copious salivation and lacrymation.

The blood was thick dark and unclotted. The skeletal muscles were dark in colour suggesting dehydration. Lungs, kidneys, liver, spleen and abomasal, intestinal and buccal mucosa were congested. The hypertrophied left ventricle showed numerous pale streaks which were well demarcated from the adjoining apparently healthy tissue. Numerous erosions of varying sizes with irregular raised borders were seen on

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Sl. No.	Name of bird	Sex	Age	Date of death	Gross lesions	Histopathology
8.	Rosy Pelican	F	Adult	11-8-71	Similar to hill mynah with additional involvement of thoracic muscles	Similar to hill mynah with additional involvement of thoracic muscles
9.	Domestic goose	F	Adult	13-7-77	Same as in Striated laughing thrush	Same as in Striated laughing thrush
10.	Peacock	M	Adult	6-1-70	Same as in Spur winged plover	Same as in Spur winged plover
11.	Graylag goose	F	Adult	26-5-73	Greenish plaques in thoraco-abdominal air sacs and extensive peritonitis	Same as in wild ducks

M = Male F = Female

observation on the pattern of mortality in this zoo during the past 15 years. However, indicated that the disease had not assumed serious proportions as the epidemic form had not been encountered. Only sporadic cases in individual adult birds occurring mostly in nodular form of the disease were detected. The gross and histopathological lesions observed herein were akin to those described by earlier workers (Ainsworth and Rewell, 1949 ; Neff, 1955 and O'Meara and Witter, 1971). The diagnosis in all the cases was based on demonstration of characteristic branched and septate hyphae morphologically indistinguishable from aspergillus species in affected tissues. Cultural examination, however, was not carried out for identification at species level.

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Table : Data on aspergillosis in different types of captive birds

Sl. No.	Name of bird	Sex	Age	Date of death	Gross lesions	Histopathology
1.	Racket tailed drongo	F	Adult	13-3-78	Both lungs were markedly congested Right lung revealed two yellow white pea-sized hard nodules	The nodules revealed epithelioid granulomas without any caseation necrosis Branched septate hyphae with conidia were seen in bronchial passages in Gridley stained sections
2.	Hill mynah	M	One month	30-1-78	Numerous greyish white pin-head to pea-sized nodules all over both the lungs replacing major portion of parenchyma. The lungs were adhered to the chest wall. Thoraco-abdominal air sacs revealed numerous greyish white plaques measuring upto 2 mm in diameter	Pulmonary nodules revealed caseous encapsulated granulomas with peripheral foreign body giant cells, epithelioid cells and lymphocytes. Secondary nodules were seen adjacent to the primary ones. Air sacs also revealed similar lesions
3.	Paddy bird	M	Adult	1-12-78	Blackish coloured mouldy growths with pin-head sized nodules uniformly distributed in both lungs	The nodules revealed focal aggregation of epithelioid cells and lymphocytes
4.	Spur winged plover	F	Adult	1-7-77	Both the lungs were markedly congested and oedematous	Septate hyphae with conidia were seen in the congested lung parenchyma
5.	Striated laughing thrush	F	Adult	24-8-69	Solitary caseous nodules 1.5 cm in diameter occupied a major portion of left lung. Only thin rim of parenchyma was left	Same as hill mynah
6.	White eyed buzzard	M	Adult	30-4-69	Same as hill mynah but the air sacs were not involved	Large number of tangled septate mycelia with spores were seen in epithelioid granulomatous nodules
7.	Wild duck (2 cases)	M F	Adult Adult	17-5-76 21-7-81	Congested lunge. Thoracoabdominal air sacs revealed greyish white plaques 3-4 mm in diameter apart from peritonitis	Plaques in the air sac revealed epithelioid granulomas

Indian J. Poult. Sci. Vol. 23 (3) 1988 : 254-257

Aspergillosis in Some Captive Birds at Nandankanan Zoo

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Aspergillosis is one of the commonest of all bird diseases. Natural infections have been diagnosed in variety of captive and free-living species of birds. It is characteristically a disease of captivity and close confinment particularly when the birds are kept under unhygienic conditions (Ainsworth, 1957). Neumann (1908) reviewed aspergillosis in water birds in which jay, turkey, pheasant, pigeon, duck, goose and swan apart from domestic fowls suffered from *Aspergillus fumigatus* infection. The first case of aspergillosis reported was in a jay by Meyer in 1815. Since then, the disease has been reported in penguins (Conti, 1938), Wood ducks (Bellrose *et al.*, 1945), in a variety of captive birds (Ainsworth and Rewell, 1949), pheasants (Agrimi, 1954), mallards (Neff, 1955), geese (Chwalibog, 1961), mynah (Jakowski 1966 and Tribonlin, 1981), emu (Saez *et al.*, 1979) and crane (Strond and Duncan, 1983). McDiarmid (1969) and O'Meara and Witter (1971) gave a detailed account of aspergillosis in wild birds. Saez (1971) analysed the postmortem data of 620 birds at Paris Zoological gardens over a period of 10 years in which he mentioned that penguins were more susceptible followed by red flamingos and pin flamingos to aspergillus infection. Sporadic case reports of the disease have been reported from India by Chakrovorty (1976) in an emu, Khan (1977) in a penguin, Rao and Acharjyo (1978) in a striated laughing thrush and Rao and Choudary (1980) in a flamingo. The purpose of this communication is to report aspergillosis in 11 species of captive birds at Nandankanan encountered during the past 15 years.

A systematic necropsy and histopathological examination of vital organs including lungs and air sacs collected from birds died at Nandankanan zoo from 1967 to 1982 was carried out. Out of 1500 necropsies, detailed histopathological studies were performed on 300 individual cases at the Department of Pathology, Orissa Veterinary College. Tissue samples fixed in 10 per cent formol saline were processed by standard histopathological techniques. Paraffin sections of six micron thickness were stained with routine haematoxylin and eosin method and Gridley's stain for demonstration of fungus in tissue sections.

Information regarding age, sex, date of death and gross and histopathology has been given in the Table.

Aspergillosis is a fatal disease in young chicks causing heavy mortality and morbidity particularly in peracute form of the disease. Close

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Table showing the number of birds affected with different diseases

Sl. No.	Cause of death	Number of birds affected				Per cent	Remarks
		Common geese	Greylag geese	Barheaded geese	Total		
1.	Gout	5	1	5	11	23.91	Gouty infiltration was seen on serosa of heart, lung, liver spleen, intestine, mesentery and kidney
2.	No specific pneumonia	2	1	1	4	8.70	—
3.	Pulmonary aspergillosis	3	1	—	4	8.70	In two cases there was involvement thoracoabdominal air sacs
4.	Heat stroke	3	—	1	4	8.70	Deaths occurred during the month of May
5.	Tumours						
	a. Myxosarcoma of liver Associated with cirrhosis and uraemic nephritis	1	—	—			
	b. Fibromyxoma wing	1	—	—	3	6.52	—
	c. Lymphoid leucosis (Liver and spleen)	1	—	—			
7.	Amyloidosis of spleen and kidney	1	—	—	1	2.47	Associated with uraemic nephritis
8.	Egg peritonitis/egg bound condition	1	—	—	1	2.47	The whole of abdomen was distended with impacted yolk materials. Liver showed numerous pin head sized necrotic foci.
9.	Pericarditis	1	—	—	1	2.47	—
10.	Cirrhosis with fatty changes	1	—	—	1	2.47	Associated with uraemic nephritis
11.	Oesophageal chocking	1	—	—	1	2.47	Seen in 3 week old goosling with dilated oesophagus due to impacted pulses and grain.
12.	Bumble foot	1	—	—	1	2.47	Associatedwith gram positive cocci.
13.	Yolk sac infection	1	—	—	1	2.47	—
14.	Killed by predator	2	2	1	5	10.87	—
15.	Undertermined	2	1	2	5	10.87	—

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Causes of Mortality in Geese at Nandankanan Zoo

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The incidence and distribution of diseases and causes of mortality in geese, particularly in captivity under Indian conditions are poorly understood. Few records of diseases concern mainly individual cases.

According to Fox (1923), geese were more often affected with mycoses than tuberculosis. Out of 83 geese autopsied, 15.6 per cent revealed endoparasitic infestation. Brassard (1965) stated that the percentage of deaths due to amyloidosis in geese and swans at Philadelphia zoo increased significantly during 1945-62. The number of deaths due to tuberculosis, moulds, renal diseases, hepatitis and infection accompanied by amyloidosis also increased during the second half of study period. Rao (1969) recorded a case of metastatic ossification in cirrhotic liver associated with fatty changes. Reynold and Gavutis (1973) observed that when 60 Canada geese were captured and moved to an enclosure containing abundant food and water, they began to weaken and die. Necropsy revealed emaciation and empty digestive tracts suggesting starvation. Henderson and Winterfield (1974) reported acute copper toxicosis following ingestion of copper sulphate at the rate of 600 mg per kilogram body weight. Necropsy lesions consisted of necrosis and sloughing of proventriculus and gizzard and greenish discolouration of lung. Wight (1976) described the histopathology of cerebral lipidosis in a Hawaiin goose. According to Hodgson (1978) violent tornidos and abrupt changes in the wind direction resulted in sudden death of 150 geese at Norfold country side. At postmortem, 4 birds revealed traumatic injuries, rupture of liver and haemorrhagic lungs. Among tumours in geese, fibroma (Fox, 1923; Chang *et al.* 1969), myxosarcoma (Fox, 1923 and Rao and Acharjyo, 1980) and chondrosarcoma (Eber and Malke, 1932) have been reported.

The objective of this communication is to throw some light on the causes of mortality in geese at Nandankanan zoo. For the purpose of exhibition at the zoo, 3 types of geese namely common geese, greylag geese and barheaded geese procured from the local bird dealers were maintained. The materials for this study were based on detailed necropsy and histopathological examination attempted on 46 geese which died at the zoo since its inception in 1960. The common causes of death and diseases have been given in the table. This study revealed that gouty infiltration in adults is a frequent malady. Similarly, pulmonary aspergillosis and neoplasms also occurred in adults.

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Fig. 1. Gizzard of Adjutant stork showing one 17.m long foreign body of plant origin.

cock aged about 12 years (Fig.2). The gizzard was distended and was almost empty containing a few grits only. Impaired functioning of the gizzard might have been the cause of death.

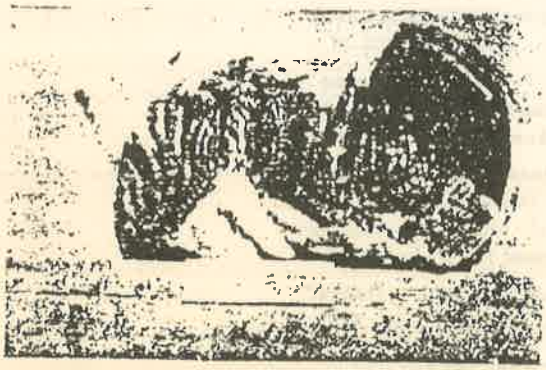

Fig. 2. Gizzard of a white peacock showing one 4.5 cm long foreign body of plant origin

PIGEON (*Columba livia*)

Sudden death in a female pigeon had been noticed. On postmortem examination the gizzard was seen adhered to the peritoneum with serofibrinous exudate. On seperating the gizzard "L" shaped staple wire (2.3 cm) was seen piercing

Fig. 3 Gizzard of a pigeon showing 'L' shaped staple wire foregn bodies (Arrow)

through the gizzard (Fig. 3). About 20ml of straw coloured fluid in the peritoneal cavity was present. Traumatic peritonitis was cause of death.

Hediger (1964) stated that birds of ten fall victims to dangerous bits of metal. Surgical interference may save their lives as has been shown by Bhattacharjee (1964) and Minsky and Petrak (1969). They removed nail by surgical intervention from captive cuckoo and pet peacock respectively.

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Short Communication

Traumatic Ventriculoperitonitis in Zoo Birds

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There are several reports on deaths of poultry birds associated with foreign bodies viz. nail, wire, stick, pin, bits of metal etc. piercing different parts of digestive traits, heart and liver (Blount, 1949; Nayak and Das, 1963; Peckhan, 1965; Christopher and Sastry, 1967; Ansari *et.al.*, 1970 and Singh and Christopher, 1975).

Perusal of available literature did not reveal much information on the traumatic ventriculoperitonitis of plant origin, in the zoo birds. During the routine postmortem examination at Nandankanan Biological Park, Orissa, foreign bodies were detected in the digestive tract resulting in ventriculoperitinitis in four species of zoo birds. These are being reported here in view of the dearth of such reports specially from India.

COMMON GREEN PIGEON (*Treron Pheonicoptera*) :

The postmortem examination of a five to six years old female bird of this species revealed adhesions between peritoneum and intestines with interspersed caseated mass. On close examination a thorn of plant origin measuring 2cm. was seen piercing through the intestinal wal. into the caseated mass. About 10 mll of straw coloured fluid was recovered from the peritoneal cavity. Death was attributed to traumatic peritonitis.

ADJUTANT STORK (*Leptoptilos dubius*)

The necropsy of a five to six years old Adjutant stork exhibited a slender stick of plant origin (8 cm x 0.2 cm) piercing through the wall of gizzard (Ventriculus) into the peritoneal cavity. On opening the gizzard it was found that greater part of the stick (17Cms.) was projecting into the lumen in a semi-coiled condition (Fig. 1). About 200 ml of turbid fluid was present n the peritoneal cavity. Death was attributed due to atony of the ventriculus and traumatic ventriculoperitonitis.

WHITE PEACOCK (*Pavo cristatus*) :

One 4.3 cm x 0.3 c.m long stick of plant origin was seen firmly emdbeded in one of the side walls of the gizzard, touching the opposite side in a white pea-

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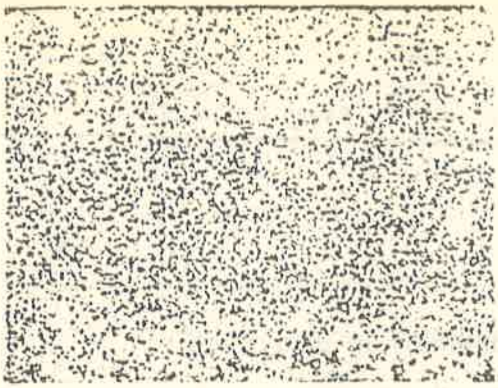
Publication No. 1 of 1977-78, Orissa College of Vetrinary Science & Animal Husbandry, Bhuvaneswar-3.



Spleen—Coalescing foci of necrosis with degenerated cellular debris, H & E, X 100.

Liver—Hepatic cell degeneration and vacuolations with small necrotic focus infiltrated by mononuclear cells, H & E, X 400.

Intestine—Showing congestion, focal areas of necrosis of mucosa and submucosa, and infiltration of lymphocytes, H & E, X 100.

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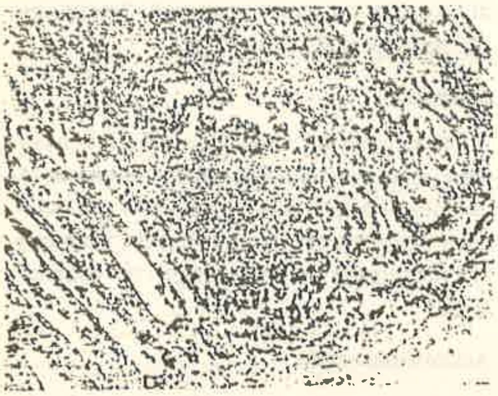
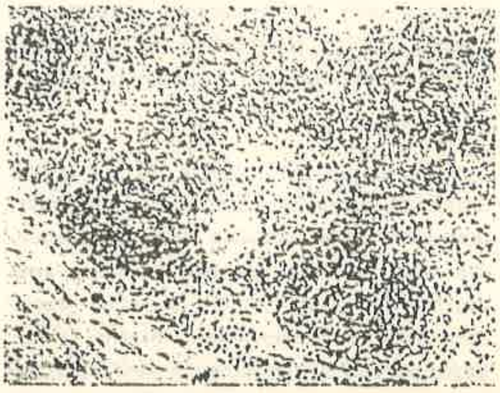


Intestine—Small necrotic focus in the mucosa; the adjoining area showing mild infiltration of mononuclear cells, H & E. X 100



Intestine—Ulcers penetrating into the muscular layer with mononuclear cell infiltration, H & E. X 100.

Intestine—Showing Lymphocytic infiltration and oedema of muscular layer, H & E, X 100

Intestine—Showing Gram positive rods, MacCallum Good p. sture, X 1000.

tion of sinusoids and blood vessels, degeneration of hepatic cells and focal areas of necrosis infiltrated by lymphocytic cells, were the main features in liver sections. No micro-organism could be detected in section by MGP and Giemsa staining methods. Except for hyperplasia of reticular of cells in the adenoid sheaths, no specific change attributable to ulcerative enteritis was observed in section of spleen.

Discussion

The nature and extent of the gross lesions of ulcerative enteritis in quail have been seen to be variable depending upon the time elapsing between infection and death. (Peckham, 1965). In acute cases there may be haemorrhagic enteritis in the upper portion of the intestine with punctate haemorrhages in the wall. The chronic cases manifest themselves by the presence of ulcers in the mucosa of intestine and caeca. The early gross picture may be complicated with a concurrent infection of coccidia which has been shown to be usually preceded or accompanied by ulcerative enteritis (Packham, 1959). In the present study, the gross lesion seen in the intestine of parakeet comprised severe enteritis of duodenal portion, however, punctuate haemorrhages on the intestinal wall, if any, in the fresh specimen, were not observed in the formalin fixed material. Only upon microscopic examination necrotic foci on the mucosa were seen alongwith severe congestion of blood vessels and mild lymphocytic infiltration into the lamina propria and submucosa. In the case of stork the gross and microscopic lesions were charcteristic simulating to those observed in quail (Durant and Doll, 1941) and in chicken (Peckham, 1941). The finding of gram positive sporulating rods in the intestinal sections in these cases might substantiate the reports on the isolation of similar organisms from liver and intestine of infected quail by Peckham (1960). However, they may not be taken for granted as the incriminating etiologic factor without attempting on isolation and determiing the pathogenicity of isolates.

Summary

Two cases of ulcerative enteritis have been reported with particular reference to pathologic alterations in a 3 years old male open billed stork and a female 7 months old rose ringed parakeet kept in confinement.

Acknowledgements

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were characteristic and consisted of small ulcers with circular outline, about 1 to 2 mm in diameter, on the intestinal mucosa. The larger ulcers, (3 to 4 mm in diameter) were roughly circular or sometimes oval in outline, and had slightly raised edges with greenish necrotic debris covering the lesions. They could not be seen through the serosa as the ulcers had not penetrated through the thick muscular coat. The cut surface of the ulcer was greyish-white in appearance and sharply demarcated. Ulcers were mainly confined to the upper middle portion of the small intestine, but the caeca was free from ulcerations. In the spleen greyish white confluent necrotic foci were noticed on the surface as well as on the cut surfaces. Liver lesions were comprised of small and discrate greyish foci of necrosis (rose ringed parakeet).

In case II, the duodenal mucosa was reported to be markedly congested due to severe enteritis. The spleen was slightly enlarged and congested. Liver had greyish mottling on the surface and patches of greyish discolouration in the cut surfaces.

Histopathology :

In case I, the early ulcers were small haemorrhagic necrotic areas involving the mucosa, submucosa and muscularis mucosa (Fig. 1). Cells adjacent to these areas exhibited coagulation necrosis with karyolysis and karyorrhexis. The blood vessels around the ulcers were severely congested. Lymphocytic and heterophilic cells infiltrated the adjacent area. Large older ulcers appeared as thick masses of granular acidophilic material mixed with cellular debris involving larger areas of the mucous membrane and penetrated upto the middle of the muscular layer (Fig, 2). The muscle fibres being disrupted due to oedema and infiltration by lymphocytes and heterophils (Fig. 3). Gram positive rods were seen in and around the necrotic area in sections stained by MGP staining (Fig. 4). In the centre of the lesion the micro-organisms appeared as Gram negative sporulating rods. Sections stained by PAS revealed absence of PAS positive material, mainly mucin, in the affected area. In the spleen, sections were found focal and large coalescing foci of necrosis (Fig. 5). The lymphoidal element was completely replaced except for a few left over cells exhibiting karyorrhexis and karyolysis. In liver section diffuse hepatic cell degeneration and vacuolations were the most prominent features throughout interspersed with small necrotic foci infiltrated by mononuclear cells (Fig. 6). Sections stained by MGP and Giemsa staining methods did not reveal any micro-organisms as observed in intestinal sections.

In case II, section of intestine showed severe congestion of blood vessels and capillaries in the submucosa and lamina propria and desquamation of mucosal epithelium. There were small focal areas of necrosis of the mucosa involving the villi and glands, disrupting the muscularis (Fig. 7). The adjacent tissue was infiltrated by lymphocytes. Giemsa stained sections of intestine revealed bluish rod shaped organisms. In MGP stained sections Gram positive bacilli were seen around the lesion but in the central necrotic area they appeared as Gram negative. A reduced PAS activity was noticeable in the necrotic zone as compared with the adjacent unaffected areas. Severe conges-

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Ulcerative Enteritis (Quails Disease) Like Lesions in Zoo Birds

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Ulcerative enteritis, primarily an enteric disease of quail, has been reported with increasing incidence of mortality and morbidity in domestic chickens (Peckham, 1965, Shukla and Rajya, 1968; Parihar and Rao, 1969). Various avian species including quail, the sharptail grouseh, European partridges, chukar partridges and wild turkeys have been reported to be susceptible to natural infection (Durant and Doll. 1941). Bullis and van Roekel (1944) reported the disease in domestic turkeys. Glover (1951) observed ulcerative enteritis in pigeons. Buss *et al* (1958) reported the disease in pheasents, blue grouse and wild quails. Rao *et al* (1971) have described a case of ulcerative enteritis resemembling quails disease in a large Indian parakeet. To what extent the infection from ulcerative enteritis in wild and captive zoo birds may account for losses is not known, although sporadic reports in game birds indicate the presence of disease in captivity causing serious losses to aviaries in the face of outbreak.

In the present study two cases of ulcerative enteritis like condition in a stork and in a parakeet have been reported.

Materials and methods

Case I

A 3 years old male open billed stork was found dead on 29-4-71 at Nandan Kanan Zoo in Orissa. Tissue pieces collected at necropsy in 10% formol-saline were presented to the Pathology Division of the Institute for histopathologic diagnosis.

Case II

A 7 months old rose ringed parakeet died on 6-12-71 was necropsied and the tissues and organs, exhibiting gross lesions were obtained in 10% formol-saline from the same Zoo.

The formalin fixed specimens were processed for histopathologic diagnosis. Besides the routine haematoxylin and eosin staining procedure, sections of intestine and liver were stained for micro-organisms by MocCallum Goodpasture's (MGP) and Giemsa staining techniques. Periodic acid schiff's (PAS) staining technique was employed on few intestinal sections.

Results and discussion

Gross lesions were variable in the two cases. In case I (open billed stork) these

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33.	Rosy Pelican	2	1 (50%)
34.	Necklaced Laughing Thrush	2	2 (100%)
35.	Rose-breasted Paraket	2	1 (50%)
36.	Emarald Dove	1	Nil
37.	Spotted Dove	2	Nil
38.	Himalayan Red-Crowned Jay	1	Nil
39.	Double barred sand grouse	1	Nil
40.	Red spurfowl	2	Nil
41.	Large Green Barbet	1	Nil
42.	House crow	1	Nil
43.	Crow pheasant	1	1 (100%)
44.	Barn owl	1	Nil
45.	Crested serpent eagle	2	Nil
46.	Short toed eagle	1	Nil
47.	Tawny eagle	2	Nil
48.	Pigeon	21	Nil
49.	Red billed blue magpie	2	Nil
50.	Green pigeon	5	1 (20%)
51.	Spotted munia	4	Nil

From table I, it will be seen that spotbill, wigeon, shoveller, red-crested pochard, Malabar pied hornbill, great Indian hornbill. black stork, white stork, necklaced laughing thrush and crow pheasant showed 100% positive reaction. In other 19 varieties of birds the serological evidence varied from 20 to 66.6%. Remaining 22 varieties of birds did not show any reactors. These findings indicated that 29 varieties, out of 51 varieties of birds tested in this trial are susceptible to *Mycoplasma* infection suggesting that these birds could serve as reservoir host for maintenance of *Mycoplasma* infection in nature.

Summary

A survey was conducted to detect the presence of *M. gallisepticum* antibody in birds of State Biological Park, Orissa. Rapid whole blood slide agglutination test with the help of Avian PPLO diagnostic antigen was employed in this study. Fortynine birds of 29 varieties, out of 138 birds of 51 varieties, tested in this trial showed serological evidence of *M gallisepticum* antibody, suggesting that these birds are susceptible to *Mycoplasma* infection.

MARCH, 1972

TABLE I

Details of the Serological Test

Sl. No.	Birds	No. of birds tested	No. and percentage of birds showing evidence of *M. gallisepticum* antibody.
1.	Hill Myna	4	2 (50%)
2.	Black Swan	1	Nil
3.	Lesser Whistlig Teal	2	Nil
4.	Common Goose	4	1 (25)%
5.	Barheaded Goose	2	1 (50%)
6.	Pintail	6	3 (50%)
7.	Spotbill	1	1 (100%)
8.	Wigeon	2	2 (100%)
9.	Shoveller	2	2 (100%)
10.	Redcrested Pochard	2	2 (100%)
11.	Dabchick	2	Nil
12.	Malabar Pied Hornbill	3	3 (100%)
13.	Great Indian Hornbill	1	1 (100%)
14.	Brahminy Duck	8	3 (37.5%)
15.	Whitenecked Stork	2	1 (50%)
16.	Black Stork	1	1 (100%)
17.	Black Ibis	1	Nil
18.	White Ibis	2	Nil
19.	White Stork	1	1 (100%)
20.	Openbilled stork	1	Nil
21.	Painted Stork	3	1 (33.3%)
22.	Grey Heron	4	Nil
23.	Guinea Fowl	9	3 (33.3%)
24.	Lilford Crane	1	Nil
25.	Demoiselle Crane	3	1 (33.3%)
26.	Common Peafowl	5	2 (40%)
27.	White Peafowl	1	Nil
28.	Silver Pheasant	1	Nil
29.	Grey Junglefowl	2	1 (50%)
30.	Sarus Crane ...	3	2 (66.6%)
31.	Blacknecked stork	2	1 (50%)
32.	Adjutant stork	2	1 (50%)

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Serological Evidence of Mycoplasma Gallisepticum Antibody Among Zoo Birds

By

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Introduction

Infectious sinusitis of turkeys and chronic respiratory disease of chickens, caused by *Mycoplasma gallisepticum*, are widespread and are of great economic importance to the poultry industry. Besides, chicken and turkeys, guinea fowls and pheasants are also susceptible to *M. gallisepticum* infection (Van Roekel and Olesiuk, 1953). Osborn and Pomeroy (1958) isolated the agent from naturally infected pheasants. Jungherr *et. al.* (1953) and Winterfield (1953) have indicated pigeons as susceptible hosts. Wichmann (.957) reported natural *Mycoplasma* infection in chukar partridges (*Alectoris graeca*). Wills (1955) isolated the agent from infected peacock (Pavocristatus). The present study was conducted to detect the presence of *M. gallisepticum* antibody in various species of zoo birds kept in captivity by serological means (rapid plate agglutination test).

Materials and Methods

Birds maintained in NANDAN KANAN, Biological Park, Orissa have been used for present study. Avian PPLO diagnostic antigen (Australian) was used for the detection of *Mycoplasma* antibody. A drop of blood from wing vein of each bird was taken on a clean glass slide by puncturing the vein with sterilized needle. A drop of stained diagnostic antigen was added to it. Uniform mixing was done by stirring with a clean stick. Reaction (appearance of clumps) was read within 2 minutes of adding the antigen.

Results and Disscussions

Blood of 138 birds of 51 varieties were tested in this trial. All these birds were quite healthy at the time of testing. The detailed report of study are given in table I.

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HISTOPATHOLOGY OF THE PARASITIC NODULE ASSOCIATED WITH *ANTHROCEPHALUS LONGESPICULUM* MAPLESTONE, 1931 (SYN.—*UNCINARIA PHILIPPINENSIS*, CHITWOOD, 1932, *UNCINARIA LOGESPICULA*, SANDGROUND, 1933) IN THE PANCREAS OF A HOG-BADGER (*ARCTONYX COLLARIS*)

During the routine necropsy examination of captive animals that are having natural death at Nandan Kanan-Zoo, a hog-badger that died on 1-8-1971 revealed a firm fibromatous growth having the size of an arecanut, adjacent to the tapering end of pancreas. Incision of the growth yielded a number of nematodes intertwined in tortuous tunnels of different sizes. The number of parasites recovered depended on the size of the tunnels. As many as 10 parasites were recovered from a large tunnel. The parasites were identified to be *Uncinaria longespicula*.

Haematoxylin and eosin stained sections of the parasitic nodule revealed sections of parasites cut in various planes embedded in structureless necrotic tissue of the tunnels. The tunnels were lined by a thin fibrous connective tissue. Major portion of the nodule comprised of dense fibrovascular granulation tissue together with diffuse infiltration of eosinophils, plasma cells and lymphocytes. Perivascular accumulation of these cells was also not infrequent. Sections of small intestines revealed extensive catarrhal enteritis associated with marked thickening of the submucosa due to infiltration of number of eosinophils.

The present observations indicate that the adult parasites lead an erratic life in the abdominal viscera adjacent to pancreas instead of their normal predilectory site which is small intestines. The localisation of parasites in an abnormal site had apparently incited a chronic inflammatory reaction. Further, the pathogenic behaviour of the parasites was reflected by the presence of necrotic tissue around them.

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of the epithelium and subepithelium resulting in ulceration. Further, the parasitic invasion had resulted in marked thickening of submucosa due to oedema and excessive infiltration of granulocytes and lymphocytes. The immature fluke, while remaining in the crypts, had also produced deleterious affects by drawing a plug of tissue into its acetabulum (Fig. 3).

Zajicek[6] described the condition, caused by *Tetrameres fissipina*, as chronic catarrhal and later proliferating proventriculitis. Nearly identical pathology has been described by Soulsby[3], in proventiculus as also for *Echinoparyphium* leading to catarrhal enteritis. A precise account of gross and histopathologic observations are herein briefly recorded in a sarus crane.

Orissa Veterinary College, Bhubaneswar-3,
March 20, 1972.

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A NOTE ON HISTOPATHOLOGY OF LESIONS DUE TO A CONCURRENT INFECTION BY A SPIRUROID NEMATODE AND AN ECHINOSTOME FLUKE IN A SARUS CRANE

INFORMATION on the pathogenic effects produced by spiruroid nematodes and echinostome flukes in intestines of different anatid hosts is meagre[1-6]. Soulsby[3] has compiled the available information. This communication reports some observations on proventricular lesions due to *Tetrameres* infection and intestinal lesions due to *Echinoparyphium* infection in a sarus crane.

Grossly, the proventricular lesions due to *Tetrameres* sp. consisted of multiple dark coloured uniformly sized nodular elevations measuring about 2 mm projecting into the luminal side. On incision of these nodules, blood red coloured fusiform or spherical female spiruroid nematodes indentified as *Tetrameres* sp. were recovered along with pools of exudate. These worms had transverse striations in its middle region and a well-developed uterus which was distended with eggs. Histological study of the proventricular nodules revealed that the pronounced changes were confined to the gland lobules which were characterised by their distention due to presence of adult females as a result of which there was marked atrophy of the tubular glands (Fig. 1).

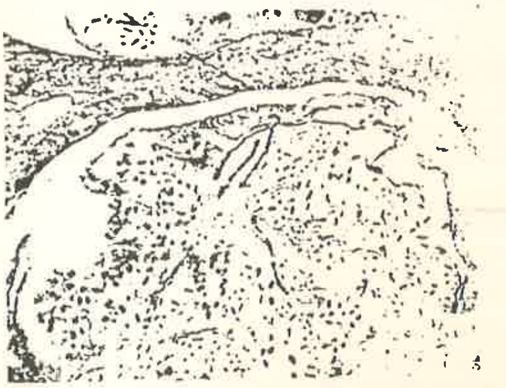

FIG. 1. Section of proventriculus showing distention of gland lobule due to presence of adult *Tetramere* Sp. H & E, × 85.

At some places a fibrous connective tissue capsule was seen around the parasite. The gland lobules, which were free from parasitic invasion, were also distended due to accumulation of inflammatory exudates. The hyperplastic cells lining the free ends of tubular glands appeared in the form of finger-like projections. The intertubular and interlobular structures were widely separated due to marked proliferation of fibrous connective tissue and infiltration of mononuclear cells. The superficial surface of tubular glands manifested disruption and/or hyperplasia of goblet cells whereas the tunica propria was markedly thickened due to proliferation of fibrous connective tissue and infiltration of mononuclear leucocytes.

Grossly, the small intestines were distended with a cheesy pàste-like material admixed with a number of flukes identified as *Echinoparyphium* sp. Microscopical sections revealed that the flukes made their way into mucosa and submucosa and their head collar was seen deeply embedded into the wall (Fig. 2). At the site of fluke penetration through

FIG. 2. Section of small intestines showing the head collar of *Echinoparyphium* sp. deeply embedded into mucosa and Submucosa H & E, × 85.

FIG. 3. Intestines showing section of an immature fluke drawing a plug of tissue into its acetabulum. H & E, × 85.

mucosa and submucosa, there was traumatic destruction of the tissue characterised by denudation

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HAEMOSIDEROSIS IN A MOSCOVY DUCK (*CAIRINA MOSCHATA*)

A female Moscovy duck dead at Nandan Kanan Zoo on June 22, 1970 revealed diffuse chocolate-brown areas of discoloration and multiple white circumscribed pinhead sized foci over the surface and substance of both the liver lobes. In addition, two non-parasitic cysts measuring 4·5 cm × 4·0 cm and 2 cm × 1·5 cm were noticed in the mediolateral aspect of the enlarged right lobe.

The haematoxylin and eosin stained sections of liver revealed that most of the hepatic cells particularly around the central vein and Von Kupffer cells in majority of lobules were over-loaded with an amorphous yellow granular pigment masking the morphology of the cells. Perl's prussian blue stained sections confirmed that they were haemosiderin pigments. The hepatic cells which were free from the pigment revealed necrobiotic changes. In the peri-portal areas, there was extensive hyperplasia of bile ducts associated with proliferation of fibroblasts and infiltration of lymphocytes, plasma cells and macrophages. The capsule of the liver was markedly thickened and pig-mented. Haemosiderin pigments were also noticed in the cytoplasm of epithelial cells lining the proximal convoluted tubules of the kidney.

Extensive biliary hyperplasia and hepatitis noticed in the present case indicate the possi-bility of some toxins circulating in liver originating from feed, like fungus contaminated nut meal which might be responsible for haemolysis of erythrocytes and consequent haemosiderosis in various organs.

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March 20, 1972.

Table 1. Cause-specific mortality in lions

Cause of mortality	Juveniles		Subadults	Adults	Total	Per cent
	Neonatal period	2 month-1 year				
Still birth	12	-	-	-	12	10.81
Cannibalism	3	-	-	-	3	2.70
Maternal rejection	58	-	-	-	58	52.25
Rabies	-	-	1	2	3	2.70
Senility	-	-	-	5	5	4.50
Intestinal impaction	-	1	-	-	1	0.90
Pulmonary abscess	-	-	-	1	1	0.90
Drowning	-	-	-	1	1	0.90
Gastritis/enteritis/ gastroenteritis	-	4	2	4	10	9.00
Pneumonia	-	3	1	1	5	4.50
Traumatic injuries	-	3	3	-	6	5.40
Debility	-	2	-	-	2	1.80
Septicaemia/toxaemia	-	-	2	-	2	1.80
Putrefied	-	-	-	2	2	0.90
Total	73	13	9	16	111	

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Causes of mortality in lions at Nandankanan

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The purpose of this communication is to high-light the causes of death including some pathological conditions in captive lions.

Data in relation to mortality of 111 lions (102 born at Nandankanan Biological Park, Orissa) were collected including information pertaining to date of arrival/birth/death, sex/age and month-wise mortality from January 1964 up to March 1992. The animals were broadly divided into 3 different age groups, viz. 0 - 1 year (juveniles including neonatal period from 0 day - 1 month of age), 2 - 3 years (subadults); and above 3 years (adults). The specific cause of mortality was determined on the basis of history, pathoanatomical changes observed at necropsy and histopathological examination wherever found necessary.

Maximum deaths (77.47%) occurred in juvenile stage, particularly during neonatal period (65.76%), the mortality rate was lowest in subadults (8.18%). Of the 16 deaths in adults, 5 died of senility (>15 years), 2 between 10 and 15 years and rest between 3 and 10 years. Such information is not available from zoos and sanctuaries of this country, but the results closely tallied with the mortality figures (Rao and Acharyo 1993) on tigers (which also belong to large cat family) of this zoo for these age groups. Though mortality was more or less uniform throughout the year, maximum deaths were noticed in August followed by those in April, but there was no difference as far as the sex was concerned. The major causes of mortality (Table 1) in juveniles were maternal rejection and still-birth. These figures were in close agreement with those of Fowler (1986). He observed that no specific effort was made as in San Diego zoo to bottle feed and raise neonatal lion cubs as in this zoo. The important causes of death in subadults and adults were gastritis/enteritis/gastroenteritis, traumatic injuries, pneumonia and senility. Out of 33 deaths in lions of unspecified age, Rathore and Khera (1981) recorded similar pattern of mortality in most of the Indian zoos and Sanctuaries.

Of the 5 died due to senility, 4 had lesions associated with chronic glomerulonephritis and 1 had 4 balls of piloconcretions in intestinal lumen. Another 2 lions (1 aged 3 years and another 9½ years) also had lesions of nephrosis and degenerative lesions of kidneys suggesting that renal disease is an important disorder of lions which confirmed the statement of Fowler (1986) in nondomestic felines.

Six adults and subadults had numerous firm nodules of 2 -3 cm diameter protruding through serosa and/or mucosa. Incision of these nodules yielded numerous parasites (*Galonchus perniciosus*) admixed with cellular debris. Histologically dead/degenerating/calcified/intact parasites were found in tunnel-like spaces in fibrous tissue which was infiltrated with lymphocytes, monocytes and plasma cells. Apart from this, during routine clinical examination *Eimeria felis*, *Eimeria felina*, *Isospora leonina*, *Isospora felis*, *Spirometra erinaceae* from faeces; *Toxocara mystax*, *Toxascaris leonina* from intestines; and *Dirofilaria immitis* from right ventricle of heart, were recovered.

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gesting encephalitis. Impression smears from brain were negative for rabies in fluorescent staining. Similar syndrome was reported in Bristol zoo (Kely *et al.* 1986) in white tiger which was considered to be a slow virus infection or hepatic encephalopathy. Acording to Tilson and Seal (1987) tigers are prone to a wide variety of nervous disorders. From India, Parkinson's syndrome (Rathore and Khera 1981) and meningoencephalitis (Sengupta 1974) of possible viral aetiology affecting white tigers were reported.

Generally, parasites do not pose any problem as far as the mortality of tigers is concerned (Tilson and Seal 1987). During this investigaion 2-3 coiled parasites of *Dirofilaria immitis* were detected in the right ventricle of 5 adult tigers aged >8 years of which 2 had concommitant *Paragonimus westermani* infestation.The incidental finding of these prarasites is because this is a known endemic region for heart worms. During routine clinical examination *Eimeria harmani, Eimeria novowanyen* from faeces, *Toxocara cati, Taenia pisiformis* and *Spirometra erinnacae* from intestine and *Haemaphysalis intermedia* from skin of ear were also recovered.

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Table 1. Cause specific mortality

S.No.	Cause of mortality	Juvenile				Subadults		Adults		Total	Per cent
		Neonatal period		2 months - 1 year							
		Normal coloured	White	Normal coloured	White	Normal coloured	White	Normal coloured	White		
1.	Still-birth	11	5	-	-	-	-	-	-	16	15.70
2.	Canibalism	5	-	4	1	-	-	-	-	10	9.80
3.	Debility and anaemia	16	4	-	2	-	-	-	-	22	21.57
4.	Maternal rejection	9	4	2	-	-	-	-	-	15	14.70
5.	Pneumonia	6	4	1	1	-	-	-	-	12	11.76
6.	Tetanus	-	1	-	-	-	-	-	-	1	0.98
7.	Septicemia	-	-	-	1	-	-	-	-	1	0.98
8.	Rabies	-	-	-	-	-	-	1	-	1	0.98
9.	Nonsuppurative meningoencephalitis	-	-	-	-	-	1	-	1	2	1.96
10.	Haemorrhagic gastroenteritis	-	-	3	1	-	-	1	1	6	5.88
11.	Senility	-	-	-	-	-	-	3	-	3	2.94
12.	Traumatic injuries	-	-	-	-	1	-	3	-	4	3.92
13.	Neoplasms	-	-	-	-	-	-	1	1	2	1.96
14.	Pulmonary abscess	-	-	-	-	2	-	-	-	2	1.96
15.	Snake bite	-	-	-	-	-	1	-	-	1	0.98
16.	Hepatitis	-	-	1	-	1	-	-	-	2	1.96
17.	Undertermined	-	-	-	-	1	-	1	-	2	1.96
	Total	47	18	11	6	5	2	10	3	102	

Short Communications

Indian Journal of Animal Sciences 63(1): 17-19, January 1993

Aetiopathology of tiger mortality at Nandankanan*

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This communication highlights the causes of death including some pathological conditions in Indian tigers, as very little information is available in India (Saharia 1979, Rathore and Khera 1979, 1981).

Data in relation to mortality of 4 102 tigers (73 normal coloured Bengal tigers and 29 white tigers) of which 97 (68 normal colured and rest white) were born at Nandankanan Biological Park, Orissa, were collected including information pertaining to data of arrival/birth/death and sex/age and month-wise mortality from January 1962 to January 1991. The animals were divided into age groups viz 0-1 year (juveniles including neonatal period from 0 day to 1 month of age), 2-3 years (subadults) and above 3 years (adults). The specific cause of mortality was determined on the basis of history, patho-anatomical changes observed at necropsy and histopathological examination, wherever found necessary.

Deaths (81.37%) occurred in juvenile stage particularly during neonatal period (63.7%) which was much higher than those reported by Saharia (1979) and Pant and Dhariyal (1979). Maximum mortality occurred during May to June and November to December due to extreme heat and cold respectively. The mortality rate was lowest in subadults (5.88%) at this zoo. It was much lower than those reported (12.35%) by Saharia (1979). Of the 13 deaths in adults 6 died of senility (>15 years old), 4 were <8 years old and rest were 3 years old, the figures of which were much lower than the reported mortality of 58.5% for this age group (Saharia 1979). However, the mortality figures due to senility were in close agreement with that of Kurup (1978). All dead animals aged >10 years at this zoo had common lesions of chronic nephritis and pneumonia.

The major causes of mortality (Table 1) in juveniles were still-birth, debility, canibalism and anaemia commonly due to accompanying maternal rejection and pneumonia. Similar observations were made by Pant and Dhariyal (1979), Fowler (1986) and Tilson and Seal (1987) on still-births and maternal rejection. Much higher incidence of pneumonia was recorded in nursing tigers (23%) in Tierpark, Berlin and 26% in San Diego zoo (Fowler 1986). Though the higher incidence of still-birth in tigers is ascribed to inbreeding (Roychoudhury and Sankhala 1979, Roychoudbury 1980), Roychoudhury and Acharjyo (1988) established that the inbreeding had no role in early mortality at Nandankanan.

Nonsuppurative meningoencephalitis with typical nervous signs like epileptiform fits, ataxia, tendency to cramp during teething, head turning etc. were recorded in 2 white tigers. Histological sections of brain revealed marded oedema, congestion and mononuclear cell infiltration in meninges, marked gliosis and perivascular cuffing with mononuclear cells and neuronal degeneration sug-

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Traumatic injuries resulting from capture operations for management/disposal/transfer from one to another enclosure/inter- and intra-species fighting/fighting during rutting season/treatment caused mortality up to 18.59% of the total deaths in these species of animals (Table 2). This is comparatively lower to those reported by Rathore and Khera (1981, 1982) in deer and bovines and by Khan *et al.* (1983) in deers and antelopes. Improved management practices and capture operations will considerably lessen the losses due to traumatic injuries.

The percentage of deaths due to important conditions like pneumonia, debility, tuberculosis and fascioliasis reported herein were more or less in accordance with the observations made by Rathore and Khera (1981, 1982) in a country-wide survey of mortality data in deer and wild bovines.

Rinderpest was not encountered during the study period in this park in spite of the fact that it is an important disease earlier recorded in Indian captive ruminants of other parks of the country (Gupta and Verma, 1949; Ray and Samanta, 1974; Rathore and Khera, 1982; Khan *et al.*, 1983). Foot-and-mouth disease was, however, responsible for 1.09% of deaths. One gaur and 2 spotted-deers of Hyderabad Zoo (Khan *et al.*, 1983) and 3 sambars of Guwahati Zoo (Baruah, 1983) died of foot-and-mouth disease. Though the occurrence of blue tongue among wild ruminants was known (Trainer, 1970), its prevalence in Indian wild ruminants was unrecognized. During the course of this study an outbreak of blue-tongue-like disease causing mortality in barking-deer, nilgai and four-horned antelope was encountered.

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were recorded in 9 species of Indian wild ruminants, viz. spotted-deer (*Axis axis*), 117; hog-deer (*Axis porcinus*), 19; sambar-deer (*Cervus unicolor*), 73; barking-deer (*Muntiacus muntjak*), 81; mouse-deer, (*Tragulus meminna*), 16; gaur *Bos gaurus*), 7; nilgai, (*Bosephalus tragocamelus*), 17; black-buck, (*Antilope cervicapra*), 93; and four-horned antelope (*Tetracerus quadricornis*), 34, belong to the families of Cervidae, Tragulidae and Bovidae.

The animals were broadly divided into 5 different age groups, viz. 0—4 weeks (neonatal period), 2—12 months, 2—5 years, 6—10 years and over 10 years. The seasons were divided into summer (March-June), rainy (July-October) and winter (November-February). Analysis of variance technique (Snedecor and Cochran, 1967) was employed to detect the statistical significance.

The cause-specific mortality was determined on the basis of history, pathoanatomical changes observed at necropsy and histopathological examination, wherever found necessary.

The results of age-specific mortality and recorded causes of death are given in Tables 1, 2.

The highest mortality (39.17%) was recorded during the first year of life. However, as the age advanced, the percentage of mortality tended to decrease. The mortality rate during the neonatal period was more than 21% in all the species except in four-horned antelope (14.71%). The results of a separate analysis of 113 neonatal deaths (Table 3) indicated that maximum mortality (41.59%) was recorded in the first week of life. There was a highly significant difference ($P < 0.05$) between different species and between age-groups with respect to mortality. The difference between the sexes and seasons was statistically nonsignificant. Schaller (1967) made similar observations with respect to mortality in free-living sambar, gaur and spotted-deer at Kanha National Park. He pointed out that 50% of the young sambar and gaur died before reaching the age of 1 year and the total spotted deer fawn mortality was 48% of the annual fawn crop.

Table 3. Period specific neonatal mortality

Period	Spotted-deer	Hog-deer	Sambar	Barking-deer	Mouse-deer	Gaur	Nilgai	Balckbuck	Four-horned antelope	Total
Still-birth	8 (30.77)	6 (85.71)	4 (15.39)	3 (16.67)	—	—	3 (60.00)	5 (25.00)	1 (20.00)	30 (26.55)
Immediate habdomadal period	5 (19.23)	—	6 (23.08)	2 (11.11)	3 (75.00)	—	2 (40.00)	2 (10.00)	1 (20.00)	21 (18.58)
Habdomadal period	6 (23.08)	—	7 (26.92)	3 (16.67)	—	—	—	9 (45.00)	1 (20.00)	26 (23.01)
Post-habdomadal period	7 (26.92)	1 (14 19)	9 (34.61)	10 (55 55)	1 (25.00)	2 (100.00)	—	4 (20.00)	2 (40.00)	36 (31.36)

Numbers in parentheses indicate percentage.

Table 2. *(Concluded)*

Causue of death	Spotted-deer	Hog-deer	Sam-bar	Bark-ing deer	Mouse deer	Gaur	Nilgai	Black-buck	Four-horned antelope	Total	Percentage
Complications of tranquillisation	—	—	1	—	—	—	—	1	—	2	0.44
Debility	9	—	10	8	1	—	1	6	2	37	8.10
Traumatic injuries	27	1	19	12	1	1	—	20	4	85	18.59
Senility	—	—	—	—	1	—	1	1	—	3	0.66
Killed by predator	3	—	1	4	—	—	—	5	—	13	2.84
Intussusception of intestine	—	—	—	1	—	—	—	—	—	1	0.22
Impaction of abomasum	—	—	—	1	—	—	—	—	—	1	0.22
Tympanites	—	—	—	2	1	—	—	—	—	3	0.66
Rejection by mother after birth	1	—	1	—	1	—	—	—	1	4	0.87
Hydrocephalus	—	—	1	—	—	—	—	—	—	1	0.22
Still-birth	8	6	4	3	—	—	3	5	1	30	6.57
Undetermined causes	5	1	4	4	—	—	1	7	2	24	5.25
Total	117	19	73	81	16	7	17	93	34	457	100.00

Table 2. Recorded causes of death in 9 species of captive wild ruminants

Cause of death	Spotted-deer	Hog-deer	Sambar	Barking-deer	Mouse-deer	Gaur	Nilgai	Black-buck	Four-horned antelope	Total	Percentage
Foot-and-mouth disease	2	—	1	—	—	—	—	2	—	5	1.09
Blue-tongue-like disease	—	—	—	3	—	—	2	—	4	9	1.97
Tuberculosis	14	—	5	7	—	1	—	1	1	29	6.35
Pasteurellosis	—	—	—	—	—	2	—	—	—	2	0.44
Nocardiosis and zygomycosis	—	2	—	—	—	—	—	—	—	2	0.44
Theileriasis	—	—	—	—	—	—	—	1	—	1	4.22
Fascioliasis	4	—	—	—	—	—	—	10	—	14	3.06
Tapeworm infestation	—	—	—	1	—	—	—	—	—	1	0.22
Neoplasms	—	—	—	—	—	1	2	—	—	3	0.66
Pneumonia	18	1	11	18	7	—	1	14	6	76	16.63
Gastroenteritis	2	—	2	1	2	2	—	5	1	15	3.28
Hepatitis	6	—	2	4	—	—	3	3	1	19	4.16
Traumatic reticuloperitonitis	—	—	—	—	—	—	1	—	—	1	0.22
Peritonitis	—	1	1	—	—	—	—	—	—	2	0.44
Pericarditis	2	1	—	2	1	—	—	—	1	7	1.53
Dystokia	—	—	—	—	—	—	—	1	—	1	0.22
Septicaemia	—	3	—	1	—	—	—	3	6	13	2.84
Toxaemia	3	2	—	—	—	—	—	1	3	9	1.97
Pyaemia	—	—	—	1	—	—	—	—	—	1	0.22
Heat stroke	3	—	—	1	—	—	—	3	1	8	1.75
Stress	7	—	6	5	1	—	—	3	—	22	4.81
Drowning	3	1	4	2	—	—	2	1	—	13	2.84

Table 1. Age-specific mortality in 9 species of captive wild ruminants

Age group	Spotted-deer (*Axis-axis*)	Hog-deer (*Axis porcinus*)	Sambar (*Cerves unicolor*)	Barking-deer *Muntiacus muntjak*	Mouse-deer *Tragulus memmina*	Gaur (*Bos gaurus*)	Nilgai *Bose-phalus trago-camelus*	Blackbuck (*Antilope cervicapra*)	Four-horned antelope (*Tetra-cerus quadri-cornis*)	Total	Remarks
0-1 Month (Neonatal period)	26 (22.22)	7 (36.84)	26 (35.62)	18 (22.22)	4 (25.00)	2 (28.57)	5 (29.41)	20 (21.51)	5 (14.71)	113 (24.73)	Mortality 39.17% in the first year
2-12 Months	17 (14.53)	4 (21.05)	8 (10.96)	9 (11.11)	3 (18.75)	1 (14.29)	3 (17.65)	11 (11.83)	10 (29.41)	66 (14.44)	
2-5 Years	30 (25.64)	5 (26.32)	17 (23.29)	26 (32.10)	3 (18.75)	1 (14.29)	3 (17.65)	39 (35.48)	13 (38.23)	131 (28.67)	
6-10 Years	38 (32.48)	3 (15.79)	15 (20.55)	26 (32.10)	6 (37.50)	2 (28.57)	5 (29.41)	22 (23.65)	6 (17.65)	123 (26.91)	
Over 10 years	6 (5.13)	—	7 (9.58)	2 (2.47)	—	1 (14.29)	1 (5.88)	7 (7.53)	—	24 (05.25)	

Numbers in parentheses indicate percentage.

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Mortality pattern in some Indian captive wild ruminants*

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Wild ruminants form an important and interesting group among the mammalian collection of any zoological park. Information on causes of mortality in captive Indian wild ruminants are scanty (Liston and Soparkar, 1924; Gupta and Verma, 1949; Ray and Samanta, 1974; Rathore and Khera, 1981, 1982; Khan *et al.*, 1983). This paper presents the epidemiological data in relation to mortality in 9 species of Indian wild ruminants recorded at Nandankanan Biological Park, Orissa.

Epidemiological data pertaining to the date of arrival birth death, sex, age and history from July 1967 to October 1984 were collected from Nandankanan Biological Park, Orissa. A total of 457 deaths

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of the neoplastic growth. The tumour tissue was separated from normal liver parenchyma by a fine band of connective tissue and atrophied hepatic cells.

Concomitant neoplasia was of rare occurrence in zoo birds. The neoplasm in sarus crane was an uncommon type comprising mesothelioma in peritoneum and hepatoma in liver, simultaneously occurring in the same bird. Jubb and Kennedy (1970) mentioned that transplantation growths in peritoneum and mesothelioma having adenocarcinomatous appearance are difficult to differentiate. A definite conclusion on the possible origin of the tumour from peritoneum, and not a transplantation growth, was arrived at in the present case after detailed necropsy examination coupled with histopathological study of vital organs. The morphological pattern of the cells, both in the primary growth in peritoneum and secondary growths in lung parenchyma, were very much similar to mesothelioma described in other animals (Jubb and Kennedy, 1970) and birds (Patnaik and Mohanty, 1970). The multicentric origin of the tumour was traced out by the examination of different areas of peritoneal growths. The patho-anatomy of hepatoma reported herein is akin to the one described earlier (Rao and Acharjyo, 1971) but for more malignant features. The multiplicity of growths noticed in liver is due to multicentric origin of the tumour.

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1971). A concomitant neoplasia composed of mesothelioma in peritoneum with metastatic growths in lungs and a hepatoma in liver is described herein in a 5-year-old female sarus crane. This is the first report of the kind in this species in India.

Out of the 16 sarus cranes necropsied during the period under report, diffuse peritoneal growths, liver, lungs, ovary, heart, spleen and intestines were collected during post-mortem examination of a 5-year-old female sarus crane, which died suddenly without showing any prior symptoms. The tissues collected in 10% formol saline were later embedded in paraffin and sectioned at 5-6 μ thickness. Routine haematoxylin and eosin staining method and Von-Gieson's method were used.

Gross pathology

The peritoneum was markedly thickened and opaque. Multiple, firm, cream-coloured, nodular/tuft-like growths of irregular size were seen diffusely disseminated over extensive areas of peritoneum. The size of nodular lesions varied from 1 mm to 2 cm in diameter. While the smaller nodules were sessile, the larger ones had well-defined peduncles. The abdominal cavity contained about 300 ml of straw-coloured fluid. The cut surface of the right lung manifested 3 well-defined circumscribed cream-coloured lesions, 0.5 to 1 cm in diameter. Liver lesions were characterized by multiple, circumscribed greyish-white, soft encapsulated growths of 2 mm to 1 cm in diameter. These lesions were sharply demarcated from the adjacent liver tissue. The ovary was non-functional. No lesions were detected in other organs, except marked catarrhal enteritis in small intestine.

Histopathology

Histologically, the nodular growths of neoplastic tissue was composed of mesothelial cells—the arrangement of which was in the form of papillary, acinar or solid forms—and appeared like an adenocarcinoma. The neoplastic cells—polygonal, cuboidal or columnar in type—were arranged in single or multiple layers, frequently supported by scant amount of collagen fibres. The morphology of neoplastic cells was characterized by round to oval, centrally placed vesicular nuclei of fairly uniform appearance with single centrally placed, intensely stained nucleoli and a pale acidophilic cytoplasm. Mitotic figures were infrequent. At some places the cells had an epithelioid appearance and were grouped into islands separated by fibrous stroma carrying blood vessels. Extensive degenerative changes were observed in the centre of the solid blocks of neoplastic tissue.

Distinct papillary growths, continuous with serosal lining of peritoneum, were composed of malignant cells of epithelial character and were supported by vascular connective tissue core. The exfoliated cells had vacuolated cytoplasm.

The metastatic lesions in lungs were composed of cuboidal or columnar cells arranged in papillary pattern supported by scant amount of collagen fibres.

The ovary was non-functional and the intestines revealed extensive catarrhal enteritis. Reticulo-endothelial cell hyperplasia was noticed in spleen, whereas the heart revealed mild retrogressive changes in myocardial fibres.

The liver lesions were one of malignant hepatoma. The neoplastic cells were indistinguishable from normal hepatic cells; they were arranged in the form of cords or with distinct alveolar arrangement adjacent to vascular spaces. The tumour cells generally round or polygonal had vesicular variable-sized nuclei with single or double nucleoli. The cytoplasm was variable in amount and less acidophilic than the adjacent normal hepatic cells. Giant hepatocytes with hyperchromatic nuclei and occasional multi-nucleated large cells were frequently encountered at the periphery

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A note on concomitant neoplasia in a sarus crane (*CRUS ANTIGONE*)

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A systematic necropsy examination of captive birds dead at Nandan Kanan Zoo, Orissa, and histopathological examination of vital organs hitherto collected from such birds is being carried out for the last 6 years to gain information on the incidence of avian neoplasms in the zoo birds. Out of the 850 birds examined during the period, a case of hepatoma was recorded in a sarus crane (Rao and Acharjyo,

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Tuberculosis at Nandankanan Biological Park - An Overview

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Tuberculosis (TB) - an ubiquitous and cosmopolitan chronic infectious disease caused by *Mycobacterium tuberculosis* is known to have a wide host range including wildlife species particularly in Zoological Gardens. The disease is worldwide in distribution though most predominant in temperate regions. Iyer (1937) while reporting the common occurrence of the disease in Indian elephants indicated that the disease is known since 2000 B.C. in India. Among Indian animals in captivity, Bombay Zoological Gardens in 1908 experienced a prolonged outbreak of TB which eventually infected many species including lamas, deer, sheep, antelopes, tapirs, coatis, binturongs and lesser pandas (Liston and Soparkar, 1924). Apart from monkeys of different types (Liston and Soparkar, 1924; Iyer, 1940; Nair and Murty, 1951; Chatterji, 1960; Basak *et. al.* 1976), TB has been reported in Nilgai (Fox, 1923), bear and deer (Nair and Murty, 1951), spotted and hog-deer, gazelle and binturong (Mukherji and Chatterjee, 1958), Giraffe (Rai and Nair, 1958) and Rhinoceros (Mann *et. al.* 1981). The disease among animals and birds has been found to be the most common in majority of Indian zoos (Sengupta, 1974; Basak *et. al.* 1975; Rathore and Khera, 1982; Rao *et. al.* 1982; Baruah, 1983 Singh *et. al.*, 1986).

Materials and methods

Systematic necropsy examination of all the mammals, avains and reptiles which died at Nandankanan Biological Park and histopathological examination of tissues hitherto collected from suspected cases of TB have been carried out from 1967-1990 to gain information on the incidence and prevalence of tuberculosis at the zoo. About 1200 mammals, 2500 avians and 200 reptiles were screened for the purpose during this period. Formalin fixed tissues were processed by routine histological methods and stained by haematoxylin and eosin and Zeihi-Nielson's methods.

Results and discussion

The yearwise recorded cases, age, sex and organ involvement of TB in different zoo species have been appended (Table 1 & 2). The gross lesions in diffirent species of ruminants and wild pigs which were more or less identical were characterised by multiple discrete encapsulated nodules of varying sizes in different organs. The smaller nodules had coalesced to form bigger ones, the incision f which often gave gritty sound. In 3 sambars and 2 spotted deer numerous ragged irregular cavities in lungs simulating vomicae in man and dog were seen. The pleura in some ruminants were markedly thickened due to fibrin strands/fibrosis as a result the lungs were frequently adhered to the chest wall. In a sambar and wild pig the udders were found to be firm and easy to cut with exeggeration of lobular architecture. Typical grape-like clusters were found on the peritoneum of a gaur.

In primates, the affected organs showed numerous soft creamy-white nodules of varying sizes. In the avian species the livers were affected in all the cases. In the wallaby, liver, lungs and spleen were affected in which the greyish white tubercles could be enucleated easily simulating lesions in avians. Histological lesions in general were characterised by focal aggregation of reticuloendothelial cells with or without giant cells followed by caseation necrosis. The commonest nodular form particularly in ruminants consisted of caseation necrosis with central calcification surrounded by epithelioid cells, macrophages, lymphocytes and langhans type of giant cells. The discrete nodules were encapsulated whereas there was extensive fibrosis around coalesced nodules. In avian species calcification was not observed. In wallaby, there was only epithelioid granulomas without caseation, calcification, encapsulation and giant cell formation. In 20 ruminants, there was exudative fibrinous pleuropneumonia. The udder of a sambar was affected with chronic organ tuberculosis while a wild pig has extensive area of caseation necrosis. The diagnosis of the disease was made on the basis of demonstration of acid-fast organisms morphologically akin to *Mycobacterium tuberculosis* in the affected tissues. Isolation and typing of the bacteria was not done.

Table 2 shows that spotted deer belonging to all ages were affected the youngest being 5 months old. In the mammalian species, the lungs were always involved suggesting repiratory route of infection while in the avian species, the liver was affected in all cases indicating possible alimentary route of the infection. Generalisation of infection was found to be frequent in wild pigs and primates perhaps due to their extreme susceptibillity to the disease. In the primates the lesions were found to be spreading in nature because of extensive areas of caseation necrosis, less fibrosis and infrequent giant cell response. Calcification and fibrosis were found to be common in wild ruminants and pigs indicating the signs of hosts resistance and the pathology resembles that seen in domestic cattle. This study showed that so far the carnivores and reptiles were free from the disease and the incidence of the disease in avian species considerably low.

Conclusions

Previous reports revealed that TB is widely distributed in animals and birds in different zoos of this country and this study confirms the earlier reports. The wide spread occurrence of the disease in zoo species has become an increased concern to Veterinarians, Zoo Directors and Scientists in related disciplines. Since there is neither any national programme to erradicate TB nor any mandatory reporting system accurate data is not available on the type(s) of Mycobacteria causing the disease in wildlife species. The inability to control the disease in valuable non domesticated animals has resulted in dramatic economic losses and failure to replace certain endangered species. The importance of Mycobacterial infections is further emphasised by public health hazard.

The diagnosis of the disease is often difficult in certain species because of slow progression and failure to recognise the clinical signs early in course of infection. Though tuberculin skin test procedures are somewhat useful in establishing a presumptive diagnosis of the disease, this test is not always reliable in some species. Moreover because of lack of facilities for capture operations in wildlife, this test is not routinely practised in Indian zoos. Confirmatory diagnosis has to be made only on the basis of necropsy and histopathological examination as has been done in this study and cultural examination and typing of bacteria wherever it is feasible.

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Table 1: Yearwise recorded cases of TB at Nandankanan

Year	Spotted deer	Barking deer	Sambar	Black buck	Four horned antelope	Hog deer	Gaur	Wild pigs	Primates	Avian	Marsupials (Wallaby)	Total
1967	—	—	—	—	—	—	—	—	1	—	—	1
1968	—	—	—	—	—	—	—	—	—	1	—	1
1969	—	—	—	—	—	—	—	—	—	2	—	2
1970 -1974	—	—	—	—	—	—	—	—	—	—	—	NIL
1975	—	1	—	—	—	—	—	—	—	1	—	2
1976	—	1	—	—	—	—	—	1	—	—	—	2
1977	—	—	—	—	—	—	—	—	—	1	—	1
1978	7	—	—	—	—	—	—	6	1	—	—	14
1979	4	—	—	—	—	—	—	1	—	—	—	5
1980	1	—	—	—	—	—	—	4	3	—	—	8
1981	—	3	—	—	—	—	1	2	—	—	—	6
1982	—	—	1	—	—	—	—	—	—	—	—	1
1983	1	1	1	—	—	—	—	—	—	—	—	3
1984	1	—	2	—	—	—	—	—	1	—	—	4
1985	2	2	1	3	1	—	—	—	—	—	—	9
1986	—	—	1	2	—	1	1	1	1	—	—	6
1987	1	1	—	—	—	—	—	—	—	—	—	2
1988	—	—	—	—	—	—	—	—	—	—	—	NIL
1989	—	—	—	—	—	—	—	—	—	—	1	1
1990	—	—	—	—	—	—	—	—	—	—	—	NIL
Total	17	9	6	5	1	1	1	15	7	5	1	68

Table 2 : Age, sex and organ involvement of TB in zoo species

Kind of zoo species	Number died M	Number died F	Age group affected	Lung	Mediastinal/ Bronchial L.N.	Liver	Kidney	Spleen	Udder	Muslce	Pleura	Pricar-dium	Peritoneum
1. Spotted deer	11	6	5m-10 yrs	17	6/3	4	—	—	—	—	11	—	1
2. Barking deer	4	5	1-9 yrs	9	4/0	1	—	1	—	—	—	—	—
3. Sambar	3	3	5-12 yrs	6	3/1	—	1	—	1	—	6	—	—
4. Black buck	—	5	5-10 yrs	5	2/0	—	—	—	—	—	2	—	—
5. Gaur	1	—	12-13 yrs	1	1/1	1	1	1	—	—	1	1	1
6. Hog deer	—	1	1 yr	1	—	—	—	—	—	—	—	—	—
7. Four-horned antelope	1	—	8 yrs	1	—	—	—	—	—	—	—	—	—
8. Wild pigs	11	4	3-12 yrs	15	7/5	—	2	4	1	1	—	—	1
9. Primates	3	4	10-20 yrs	7	0/3	1	—	3	—	—	1	1	—
10. Wallaby	—	1	Adult	1	—	1	—	1	—	—	—	—	—
11. Lesser whistling teal	—	1	Adult	1	—	1	—	1	—	—	—	—	—
12. Pigeon	1	1	Adult	—	—	2	—	—	—	—	—	—	—
13. White Cockatoo	—	1	15 yrs	—	—	1	—	—	—	—	—	1	—
14. Grey Java sparrow	1	—	6 yrs	—	—	1	—	—	—	—	—	—	—

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INCIDENCE OF HEART WORMS IN CAPTIVE WILD CARNIVORES

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Though the occurrence of *Dirofilaria immitis* in domestic and wild carnivores is known throughout the world (Fowler, 1986), it is particularly common in red foxes, lions, wolves and coyotes besides pet dogs of United States of America (Stunt and Youatt, 1972; Forrester *et al.* 1973; Kazacos and Edberg, 1973; White, 1975; Williams and Dade, 1976; Pratt *et al.* 1981, Carlson and Niclosn, 1983; King and Bohning, 1984). Information on the incidence of this parasite in wild carnivores from other parts of the world including India is meagre. The purpose of this paper is to place on record the occurrence of this parasite in different wild carnivores.

The material formed for this study is based on routine necropsy and histopathological examination of different varieties of wild carnivores maintained at Nandankanan Biological park during 1962-1991. Most of the carnivorous species (numbering 20) except African lions are widely distributed throughout India in general and Orissa state in particular. Information pertaining to age and sex of the animal and date and cause of death were recorded.

Of the 20 species maintained at the zoo, 17 cases involving 8 species (Table 1)

Table1. Details of heart worm infestation in wild carnivores

Sl. No.	Animal	No. necropsed	No. positive Male	No. positive Female	Percent	Cause of death
1.	Lion (*Panihera Leo*)	50	2	1	6.0	Haemorrhagic gastroenteritis
2.	Bengal tiger & White tiger (*Panthera tigris*)	102	2	3	4.9	Two died of senility, one due to intrahepatic bile duct carcinoma, another to non-suppo-rative meningoencephalitis and fifth to intestinal perforation due to bone splinter
3.	Leopard and black panther (*Panthera pardus*)	65	3	1	6.06	Two leopards died of senility and one due to empyema and black panther died from haemorrhagic cystitis
4.	Golden cat (*Felis temmincki*)	15	1	—	6.6	Squamous cell careinoma of lungs associated with uraemia
5.	Jackal (*Canis aurius*)	20	1	—	5.0	Senility
6.	Fox (*Valpes bengalensis*)	20	1	—	5.0	Dirofilariasis
7.	Wild dog (*Cuon alpinus*)	5	—	1	20.0	Senility
8.	Wolf (*Canis lupus*)	4	1	—	25.0	Septicaemia

had *Dirofilaria immitis* in the right ventricle of heart. The number of parasites in coiled position ranged from 2-8. It was observed that all these animals were aged more than 5 years. Histopathological examination conducted on vital organs of these animals indicated that the primary cause of death in most of the animals was other than dirofilariasis (Table 1) except for four where there were atheromatous lesions in pulmonary artery, pulmonary infarction and embolic glomerulonephritis associated with generalised venous congestion caused by these parasites (Rao and Acharjyo, 1991).

This study indicated that about 5-6% of the major groups of carnivorous animals particularly adults necropsied had incidental finding of these worms suggesting that this region is endemic for heart worm infestation.

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KERALA JOURNAL OF VETERINARY SCIENCE. VOL. 9. NO.2. DECEMBER 1988. P 71-76

PREVALENCE AND PATHOLOGYOF FATTY LIVER IN CAPTIVE BIRDS

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Fatty liver is not uncommon in non-domasticated captive brids. Occurrence of this condition in liver has been reported in a variety of species which include parakeets, parrots, cockatoos cockatiels and love birds (Beach, 1962; Arnall and Keymer, 1975; Baker, 1980) merlins (Cooper and Forbes, 1983) and humming birds (Ingram, 1978). The fatty liver diseases, fatty liver kidney syndrome (FLKS) and fatty liver haemorrhagic syndrome (FLHS) may cause mortality in young chicks and laying hens respectively (Randall *et al.*1977). The pathogenesis of fatty liver is diverse and causes include starvation, wasting disease, chronic anaemia, metabolic disorders, obesity, chemical and bacterial toxins (Goudie, 1980). Recently it is found that phosphorus and aflatoxin poisoning are also significant cause of fatty liver (Wadsworth *et. al.* 1984). The present study was carried out to assess the susceptibility of various nondomesticated captive birds to fatty liver and to describe some of the pathomorphological features in different species of birds.

Materials and Methods

During the period May'87 to April'88, 407 dead birds were necropsied. The majority of birds examined were collected from Zoological Garden, Calcutta and small portion from external sources. All the carcasses were examined for macroscopical lesions and routine bacteriological, mycological and parasitological examinations were carried out as necessary. Tissue pieces of the major organs showing any macroscopic abnormalities, were fixed in 10% formal saline, routinely processed for paraffin sectioning to have a 4-5μ thickness and stained with haematoxylin and eosin. Additional sections of liver were stained with Van Gieson's stain, Gordon and Sweet's stain, MacCallum Good pasture and Gridley stain.

Results and Discussion

A total of 407 birds from 14 different orders were examined histologically (Table 1). Of these 12 cases showed marked fatty infiltration of the liver and 6 cases (5%) were from the order psittaciformes indicating that some species of this area are particularly susceptible to fatty changes. Beach (1962) and Baker, (1980) also recorded the prevalence of fatty liver in a budged (psittaciformes) to be 4.3% and 8.2% respectively and thus corroborate the present finding.

Isolation and identification studies revealed that bacterial infection was only intercurrent infectious condition in quail infected with *P. multocida*. Another condition lymphoid leukosis was found to be associated with fatty changes Association of concurrent neoplastic disease with fatty changes was also noted previously by Minsky and Petrak (1982) in cage bird but no intercurrent bacterial infection recorded earlier.

In most of the cases the carcasses were obese. This obesity associated with fatty liver was also noted by Beach (1962) and Minsky and Petrak (1982). Grossly, the liver of the affected birds were swollen or enlarged, pale white or yellow in colour and frible or fatty. Similar findings were also seen by Wadsworth *et al.* (1984). Histologically the livers showed moderate to extensive fatty changes characterised by the presence of intracytoplasmic fat droplets in the form of vacuoles within the hepatocytes with no lobular demarcation (Fig.1). Infiltration of fat droplets often being responsible for distension of hepatocytes and displacement of the nuclei to the cell membrane. Reticulolysis of the hepatic parenchyma (Fig.2) and regular areasof fibrosis were noticed in majority cases under the order psittaciformes. The significant difference in pathologic features among different orders are given in Table-II. These findings are somewhat differing from the finding recorded in young chicks with FLKS and in laying hens with FLHS as reticulolysis and fibrosis of the liver are not a feature of the fatty changes in young chicks, though it is recorded in laying hens (Butler, 1976). Unlike FLHS in laying hens haemorrhages in liver was not conspicuous in the present study.

Summary

The livers of 407 non-domesticated captive birds were and examined histologically. Marked fatty changes of liver was found in 12 cases. Out of these 12 cases 6 cases were from the order psittaciformes, indicating that the species under this order are susceptible to fitty liver. Affected livers were commonly swollen or enlarged, pale white or yellow in colour and soft, friable or fatty at post mortem examination. Histologically, marked fatty infiltration of the liver was characterised by the presence of intracytoplasmic fat vacuoles within the hepatic parenchyma. Reticulolysis and librosis were seen with fatty changes. Bacterial infection and neoplastic disease were found in association with fatty changes.

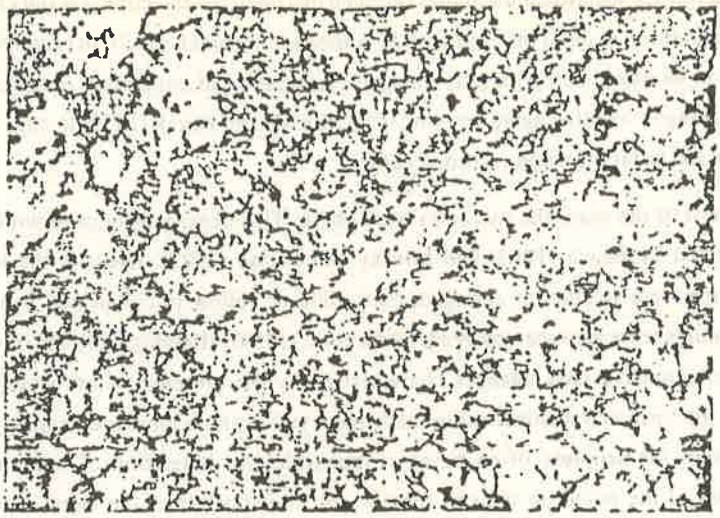

Fig. 1.
Intracytoplasmic infiltration of fat droplets in liver parenchyma of a budgerigar. H & E x 80.

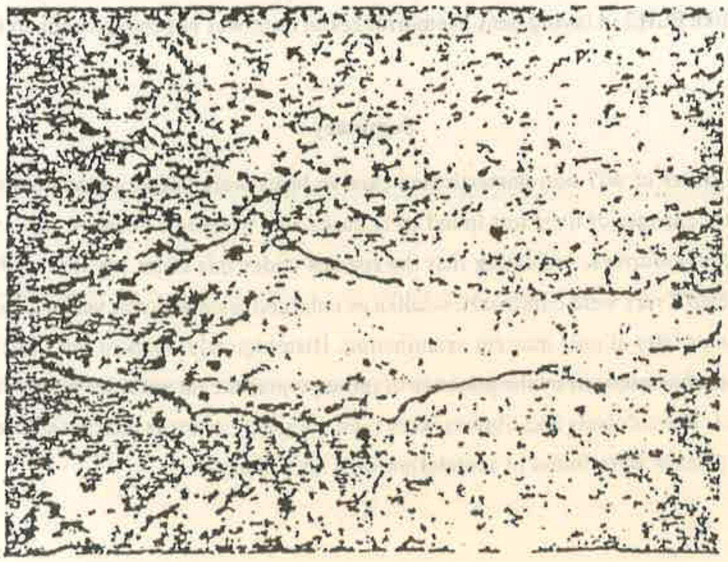

Fig. 2.
Liver parenchyma showing reticulolysis Gordon Sweet Silver impregnation method x 360.

Table I

The occurrence of fatty liver syndrome in individual orders of bird examined at necropsy

Order	No. of birds with fatty liver	No. of birds examined	Prevalence %
Apodiformes	0	11	0
Psittasiformes	6	120	5
Passeriformes	1	9	10
Piciformes	0	7	0
Rheiformes	0	3	0
Casuariiformes	0	27	0
Sphenisciformes	0	13	0
Pelecaniformes	0	14	0
Ciconiiformes	0	15	0
Anseriformes	1	14	7
Columbiformes	0	23	0
Cuculiformes	0	23	0
Gruiformes	0	26	0
Galliformes	4	102	4
	12	407	3

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Table II

Significant pathologic features observed in individual orders in fatty liver

Order/Species	Significant pathologic changes in liver	
	Macroscopic	Microscopic
Psittaciformes		
Budgerigar (*Melopsittacus undulatus*)	Pale whitish or yellowish friable and fatty	Minimal fibrosis, moderate to extensive reticulolysis
Rose ring parakeet (*Psittacula krameri*)		
Sulphur creasted cockatoo (*Kakatoo Sulphuree sulphurea*)		
Cockatoo (*Cacatua gymnopsis*)		
Love bird (*Agapornis roseicollis*)		
Passeriformes		
Java sparrow (*Padda oryzivora*)	Enlarged friable and fatty	
Anseriformes		
Lesser whistling toul (*Dendrocygna javanica*)	Hyperemic friable	Massive haemorrhage with inflammatory reaction, partial reticulolysis
Galliformes		
Silkie fowl (*Gallus sp.*)	Pale swollen	Moderate haemorrhage with cellular infiltration
Domestic bantom (*Gallus sp.*)		
Quail (*Cortunix cortunix*)		

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KERALA JOURNAL OF VETERINARY SCIENCE VOL.19 NO.1 JUNE, 1988, P.145-148

Research note

AFLATOXICOSIS IN PARROTS

Aflatoxicosis due to toxic factor in groundout was first reported in duck population byAsplin and Carnaghan (1961) and the disease is not well recognised among all domesticated asian species affecting the economy of the poultry farmers (Reddy *et al.* 1933 and Rao *et al.* 1985). The reports on the occurrence of the disease among birds in captivity are scanty (Petrak, 1982). In the present communication, an outbreak of aflatoxicosis has been recorded among parrots (*Psittacula krameri*) of Calcutta Zoological Garden.

High mortality was observed among the parrots maintained in four sheds of Calcutta Zoological Garden. Two hundred and twenty seven out of 440 parrots died showing symptoms of loss of appetite, diarrhoea, dullness and depression during July and August, 1987.

Initially, all the affected birds were treated with hostacycline powder and vitamins without any response. Later on furasol with vitamins was administered but no effect was observed and mortality continued.

The parasitologial and bacteriological investigations were conducted on materials sent to this laboratory but the results were negative. Subsequently 21 dead parrots and 3 ailing parrots were brought to this laboratory for further investigation. A thorough postmortem examination of all the birds were conducted and aflatoxicosis was suspected on the basis of clinicopathological changes. Organs showing gross abnormalities were preserved in 10% neutral formal-saline, processed for paraffin sectioning at 5" thickness and stained with haematoxylin and eosin.

Samples of feed were subjected for analysis to determine the aflatoxin content (TPI, 1972)

The affected birds showed poor appetite, weakness, stunted growth, anemia and incoordination followed by death.

Grossly, haemorrhages were observed in leg muscles, liver, lungs, kidneys and intestines. The liver was friable with presence of fatty changes and necrotic foci. Kidneys were swollen with presence of petechial haemorrhages. Intestines revealed haemorhagic exudation.

The most striking histopathologic lesions were observed in the liver, kidneys and intestines. The changes in the hepatic parenchyma

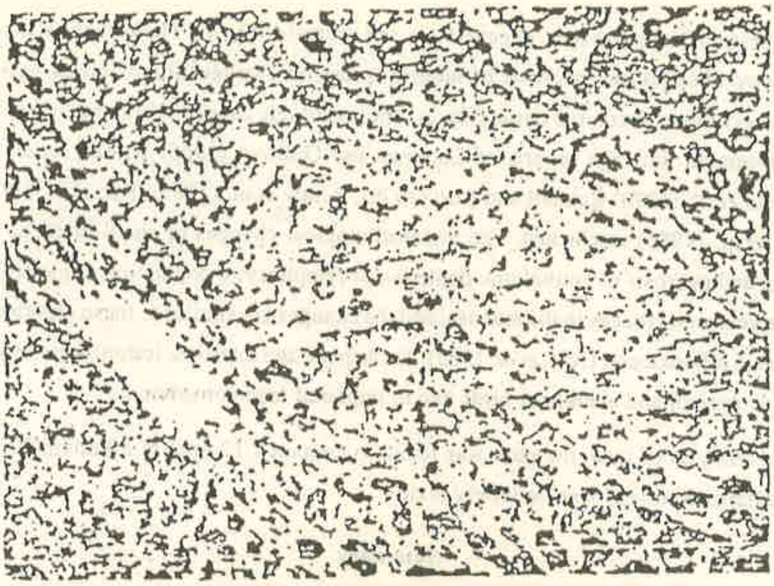

Fig. 1
Liver: Congestion, haemorrhages, degeneration and necrosis of hepatic cells. H & E x 100

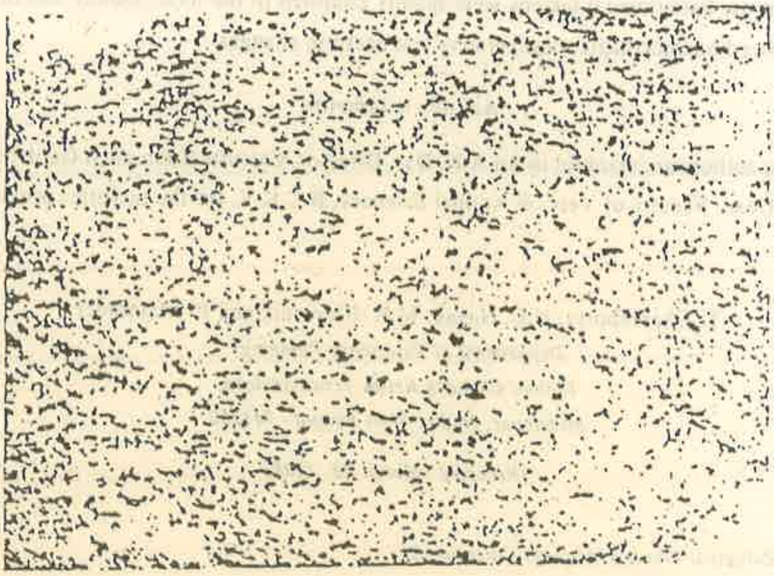

Fig. 2
Kidney: Degeneration and necrosis of tubular epithelium, congestion and haemorrhages in the interstitial tissue. H & E x 80

were congestion, haemorrhages, degeneration and necrosis. (Fig.1). The kidneys also revealed degenerative changes and necrosis of tubular epithelium, congestion of blood vessels and haemorrhages in the interstitial tissue (Fig.2). The pathologic changes observed in these organs are in agreement with the reports of Cardiner and Oldroyd (1965) Kratzer *et al.* (1969). Vanzytveld *et al.* (1970) Randall and Bird (1979). Reddy *et al.* (1983), Rao *et al.* (1985) and Moorthy *et al.* (1986) in chicken. The histopathological changes of small intestine showed solughing and necrosis of epithelium, depletion of lymphocytic population in payers patches and massive haemorrhages in the mucosa, and the changes are similar to these reported earlier in chicken in aflatoxicosis (Rao, *et al.* 1985). The hepatic and intestinal lesions were responsible for stunted growth and anemia of birds due to impaired feed conversion.

On analysis of feed, the ratio was found to contain 1.12 ppm of aflatoxin B_1 and this level of aflatoxin in feed was definitely toxic.

Summary

The prevalence of aflatoxicosis in parrots was reported on the basis of feed analysis and clinico-pathologocal observations. The feed contained 1.12 ppm of aflatoxin. There was poor appetite, diarrhoea, dullness, depression, stunted growth anemia and mortality in the affected birds. Pathological lesions were mainly confined to the liver, kidney and intestine which showed haemorrhagic, degenerative and necrotic changes.

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ISOLATION OF *P MULTOCIDA* F-3, 4 FROM A STILLBORN SNOW LEOPARD

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Veterinary Record (1992) 130. 36

A STILLBORN snow leopard (*Panthera uncia*) was sent from Padmaja Naidu Himalayan Zoological Park, Darjeeling. India to the Institute of Animal Health and Veterinary Biologicals, Calcutta for laboratory examination on May, 16. 1989. Its dam had a history of abortion and stillbirth in the two preceeding gestations before this, but no material was made available to this institute for investigation.

Post mortem examination of the stillborn cub revealed septicemic changes in all the visceral organs. Heart-blook smears revealed the presence of large numbers of Gram-negative cocobacilli.

The heart-blood was cultured in 10 per cent ox blood agar and MacConkey's agar plate and incubated for 48 hours. The stomach contents were also cultured in brucella agar with crystal violet 1:500,000 and brilliant green 1:250.000 under 10 per cent carbon dioxide tension. and fluid thioglycolate medium for 96 hours.

Bacterial growth was noticed in the blood agar plates only where dewdrop-like colonies were oberved. From biochemical reactions the organisms were identified as *Pasteurella multocida*. In 1990, the isolate was identified as *P multocida* capsule group F somatic type 3. 4 at the US Department of Agriculture, National Animal Disease Centre, Ames, Iowa.

P multocida scrogroup F has only recently been identified (Rimler and Rhoades 1987) and has been isolated only from turkeys in the USA. Isolation of *P multocida* F-3, 4 from a calf in the UK appears to be the first from a mammalian source (Jones and others 1988).

The association of *P multocida* with bovine abortion has received attention (Roberts 1971, Sastry 1983, Ward and others 1985). The role of this organism as the primary cause of stillbirth in this case could not be ascertained as virological investigation could not be undertaken. However, from the available literature this appears to have been the first report of isolation of such an organism from a wild carnivore associated with abnormal termination of pregnancy and the second mammalian isolate that the authors are aware of (R.B. Rimler. personal communication).

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ISOLATION OF *MICROSPORUM GYPSEUM* FROM SKIN LESIONS OF GREAT GREY KANGAROO (*MACROPUS GIGANTEUS* SHAW, 1790)

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Microsporum gypseum was isolated in culture from skin lesions of a Great Grey Kangaro (*Macropus giganteus*) maintained at the Zoological Garden, Calcutta. This a new host record.

Although many of the zoo animals are hosts of different dermatophytes, report of such infection in Kangaroo is rare.

Four out of 8 Great Grey Kangaroos (*Macropus giganteus*) of the Zoological Garden, Calcutta manifested skin lesions on the tail, abdomen, chest, ears and face ; lesions on the tail, abdomen and chest were circumscribed while in other areas the margin of the lesion was irregular. There as alopecia over the part. Pruritus was moderate to intense.

Two of the infected animals were investigated. Representative areas showing active lesions were selected, thoroughly washed with soap and water, dried, swabbed with 70% alcohol and dried again ; with the help of a blunt scalpel, margin of the lesion was scraped and the scrapings were collected between two sterile slides, pressed together and wrapped in sterile paperpack.

In the laboratory, bits of scales and hairs were examined under a KOH-mount ; irrespective of the result, scrapings were washed in 0.1% crystal violet solution for 1 minute and was inoculated into slants of Sabourau d-cycloheximide-chloramphenicol media containning cycloheximide (Actidione, SAS) @ 0.5 mg/ml and chloramphenicol (chloromycetin, Parke Davis) @ 0.05 mg/ml ; the slants were incubated at room temperature (27$\pm$1°C) for a period of 14 days. Macro and micromorphological study of the colony were made on the 10th and 14th day respectively as per Ajello *et al.* (1973).

The results of laboratory studies are presented below :—

KOH-mount revealed presence of fungal elements ; ectothrix invasion of hairs with spores, 6-8 μm in diameter, were noticed singly as well as in short chains.

Macromorphology :—

Growth — rapid
Colony diameter — 8-10 mm
Ground plan — irregular
Texture — coarsely powdery
Surface colour — light ochre
Reverse colour — dull yellow.

* CRS Project Gangarampur (24 Parganas). ** Zoological Garden, Calcutta-27

Micromorphology :—

Numerous macroconidia were noticed ; these were ellipsoid with thin and echinulate walls ; there were six cells ; the macroconidia measured on an average 43.2×8.1 μm. No microconidia could be seen (Fig.) :

Identification :

In consideration of the characteristic macroconidia, the dermatophyte was identified as *Microsporum gypseum*. Subculture of the isolate was identified by Commonwealth Mycological Institute, England as "*Microsporum gypseum* group. Agrees closely with the anamorph of *Nannizia gypsea* (Nann.) Stock." (H 946/14/Y 12).

List of dermatophytes infecting different animals with their host and distribution has been documented by Ainsworth and Austwick (1973) ; it appears that the only dermatophyte recorded so far from a Kangaroo is *Trichophyton mentagrophytes*. As such the present report is a new host record for *M. gypseum*.

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MICROSPORUM GYPSEUM FROM KANGAROO

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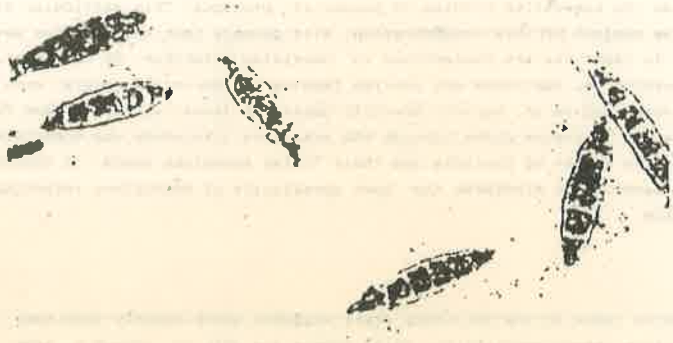

Legends:

Six-celled macroconidia with thin and echinulate walls. Lactophenol cotton blue × 360.

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AKADEMIE - VERLAG

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STUDIES ON HOST-SPECIFICITY OF COCCIDIAN PARASITES IN CAPTIVE AND WILD MAMMALS OF INDIA

By S. K. Chaudhuri[1] and S. K. Das[2]

Introduction

Coccidians are of widespread occurrence, with representatives attacking members of all major groups of the animal kingdom, especially birds and mammals. Since a large number of coccidia have so far been reported in the context of domestic, paradomestic, feral as well as wild birds and mammals, these parasites represent a focal point of attraction to veterinarians. Protozoologists, too, feel attraction to this group of protozoa, as they present a diverse morphology and biology, hinting on their inter-relationship.

These parasites provide an important tool to study host-parasite inter-relations and, thereby, assess the speciation problem of parasitic protozoa. This particular problem has been choosen as subject of this communication. Wild mammals that enjoy a free movement and those living in captivity are susceptible to coccidian infection. To be exact, various herbivores, carnivores, omnivores and species feeding on specialised diets, such as frugivores, insectivores and so on, harbour specific coccidian fauna, as may be seen from plenty of literature. An intensive probe through the available literature was undertaken by the authors to compile a list of coccidia and their Indian mammalian hosts, of course, excluding domestic mammals, to elucidate the host specificity of coccidians infecting captive and wild mammals.

Discussion

The host-parasite index on the following pages suggests quite clearly that some parasites exhibit a rather narrow specificity, while others are able to infect a wide range of hosts. For a parasite, the host body, especially its internal milieu, constitutes a special 'ecological niche'. It is at present well established that the phenotype is a multidimensional attribute of the genotype. It is the phenotypic structure that comes in relation to ecological factors, and for a parasite it is the physiological constituent of the host body. At a first glance, it may appear that coccidians of narrow specificity, such as *Eimeria ailuri*, *E. aurei*, *E. cati*, *Isospora ursi*, *I. pardusi*, are less pliable and adaptable in comparison to those of wider host specificity, such as *Eimeria arloingi*, *Eimeria crandallis*, *Eimeria parva*, *Isospora felis*. Nevertheless, there is no conclusive picture.

Present-day parasitologists feel that parasites with narrow specificity, in terms of evolution, should not be considered as a primitive group. Parasites, sometimes, are intimately connected with the speciation problem of the host species. Hence, hosts that have maintaining a status quo over a considerable length of time may be considered to have preserved their internal milieu and, thereby, provide very little chance for the parasitic group to diverge and to speciate. This situtation has been recognized for endemic host species with a more consistent coccidian fauna. For example, spotted deer *Axis axis*, endemic in the oriental region, is reported to harbour only four species of *Eimeria*. Such a situation might be taken as an old intimate association. This conjecture is additionally

This paper is dedicated to the 65th birthday of Prof. Dr. habil. R. I p p e n.

Host - Parasite index :

(Recorded from captive and wild mammals of India)

Host	Parasite
ORDER : PRIMATES	
Bonnet Monkey *Macaca radiata*	*Isospora* sp. BHATIA et al., 1972
Slow loris *Nycticebus coucang*	*Eimeria coucangi* PATNAIK and ACHARJYO, 1970 *Eimeria nycticebi* PATNAIK and ACHARJYO, 1970
ORDER : RODENTIA	
Common giant flying squirrel *Petaurista petaurista*	*Eimeria petauristae* RAY and SINGH, 1950
Indian palm squirrel *Funambulus palmarum*	*Eimeria bandipurensis* RAY et al., 1965
ORDER : CARNIVORA	
African lion *Panthera leo leo*	*Eimeria felina* NIESCHULZ, 1924 *Isospora leonina* MANDAL and RAY, 1960 *Isospora mohini* AGRAWAL et al., 1981 *Isospora pantheri* AGRAWAL et al., 1981
Corsac fox *Vulpes corsac*	*Isospora buriatica* YAKIMOFF and MATSCHOULSKY, 1940

Host	Parasite
Clouded leopard *Neofelis nebulosa*	*Isospora leopardi*, AGRAWAL et al., 1981
Indian fox *Vulpes bengalensis*	*Eimeria lomarii* DUBEY, 1963b
	Isospora buriatica YAKIMOFF and MATSCHOULSKY, 1940
Indian grey mongoose *Herpestes edwardsi*	*Eimeria pandei* (PATNAIK and RAY, 1965) PATNAIK and RAY, 1966
	Eimeria nawalai DUBEY and PANDE, 1963
	Isospora dubeyi PATNAIK and RAY, 1965
	Isospora garnhami BRAY, 1954
	Isospora hoarei BRAY, 1954
Jackal *Canis aureus*	*Eimeria aurei* BHATIA et al., 1979
	Isospora tropicalis MUKHERJEE and KRESSNER, 1965
Jungle cat *Felis chaus*	*Eimeria cati* YAKIMOFF, 1933
	Eimeria felina NIESCHULZ, 1924
	Eimeria hammondi DUBEY and PANDE, 1963
	Eimeria mathurai DUBEY and PANDE, 1963
	Isospora rivolta (GRASSI,1879) WENYON, 1923

Host	Parasite
Leopard *Panthera pardus*	*Isospora felis* (WASIELEWSKI, 1904) WENYON, 1923
	Isospora pardusi PATNAIK and ACHARJYO, 1971
Leopard cat *Felis bengalensis*	*Isospora felina* PATNAIK and ACHARJYO, 1971
	Isospora nandankanani PATNAIK and ACHARJYO, 1976
Indian lion *Panthera leo persica*	*Isospora sp.* CHAUHAN et al., 1973
Red panda *Ailurus fulgens*	*Eimeria ailuri* AGRAWAL et al., 1981
Sloth bear *Melursus ursinus*	*Isospora ursi* AGRAWAL et al., 1981
Striped hyena *Hyaena hyaena hyaena*	*Isospora levinei* DUBEY, 1963a
Tigon (hybrid between tiger and lioness)	*Isospora felis* (WASIELEWSKI, 1904) WENYON, 1923
White tiger *Panthera tigris tigris*	*Isospora felis* (WASIESLEWSKI , 1904) WENYON, 1923
ORDER : ARTIODACTYLA	
Argali *Ovis ammon*	*Eimeria arloingi* (MAROTEL, 1905) MARTIN, 1909
	Eimeria crandallis HONESS, 1942
	Eimeria faurei (MOUSSU and MAROTEL, 1902) MARTIN, 1909
	Eimeria parva KOTLAN et al., 1929

Host	Parasite
Barking deer *Muntiacus muntjak*	*Eimeria dawri* BHATIA et al., 1973
	Eimeria sardari BHATIA et al., 1973
	Eimeria sp. BHATIA, 1968
Blackbuck *Antilope cervicapra*	*Eimeria antilocervi* RAY and MANDAL, 1960
	Eimeria cheetali BHATIA, 1968
	Eimeria arigai PANDE et al., 1972
Chinkara *Gazella gazella*	*Eimeria cheetali* BHATIA, 1968
	Eimeria chinkari PANDE et al., 1970
Fallow deer *Dama dama*	*Eimeria intricata* SPIEGEL, 1925
Four-horned antelope *Tetracerus quadricornis*	*Eimeria chausinghi* PANDE et al., 1970
Hippopotamus *Hippopotamus amphibius*	*Isospora hippopotami* AGRAWAL et al., 1981
Hog deer *Axis porcinus*	*Eimeria parahi* PANDE et al., 1970
Indian bison *Bos gaurus*	*Eimeria gaurusi* PATNAIK and ACHARJYO, 1971
Ladhak goat *Capra ibex*	*Eimeria arloingi* (MAROTEL, 1905) MARTIN, 1909
	Eimeria crandallis HONESS, 1942
	Eimeria ninakohlyakimovnae YAKIMOFF and RASTEGAIEFF, 1930

Host	Parasite
Moufflon *Ovis musimon*	*Eimeria arloingi* (MAROTEL, 1905) MARTIN ,1909
	Eimeria crandallis HONESS, 1942
	Eimeria faurei (MOUSSU and MAROTEL, 1902)
	Eimeria parva KOTLAN et al., 1929
House deer *Tragulus meminna*	*Eimeria ramgai* PANDE et al., 1970
Nilgai *Boselaphus tragocamelus*	*Eimeria nilgai* PANDE et al., 1970
	Eimeria tragocamelis BHATIA, 1968
	Eimeria yakimovi RASTEGAIEFF, 1930
One-humped camel *Camelus dromedarius*	*Eimeria cameli* (HENRY and MASSON, 1932) REICHENOW, 1953
	Eimeria dromedarii YAKIMOFF and MATSCHOULSKY, 1939
	Eimeria rajasthani DUBEY and PANDE, 1963
Rocky mountain bighorn sheep *Ovis canadensis*	*Eimeria arloingi* (MAROTEL, 1905) MARTIN, 1909
	Eimeria faurei (MOUSSU and MAROTEL, 1920) MARTIN, 1909
	Eimeria ninakohlyakimovae YAKIMOFF and RASTEGAIEFF, 1930
	Eimeria parva KOTLAN et al., 1929

Host	Parasite
Siberian wild goat *Capra sibirica*	*Eimeria crandallis* HONESS, 1942
	Eimeria faurei (MOUSSU and MAROTEL, 1902) MARTIN 1909
	Eimeria ninakohlyakimovae YAKIMOFF and RASTEGAIEFF, 1930
	Eimeria parva KOTLAN et al., 1929
Spotted deer *Axis axis*	*Eimeria cervis* MANDAL and CHOUDHURY, 1986
	Eimeria cheetali BHATIA, 1968
	Eimeria sp. BHATIA, 1968
	Eimeria wassilewskyi RASTEGAIEFF, 1930
Two humped camel *Camelus bactrianus*	*Eimeria cameli* (HENRY and MASSON, 1932) REICHENOW, 1952
	Eimeria dromedarii YAKIMOFF and MATSCHOULSKY, 1939
Wild boar *Sus scrofa scrofa*	*Eimeria neudebliecki* VETTERLING, 1965
	Isospora suis BIESTER and MURRAY, 1934
Wild goat *Capra aegagrus*	*Eimeria ninakohlyakimovae* YAKIMOFF and RASTEGAIEFF, 1930
	Eimeria crandallis HONESS, 1942

supported by the simple fact that these parasites do not produce any pathogenic symptom that might concern a veterinarian. In other words, it may be envisaged that the parasite has attained some sort of teleological evolutionary paradox turning towards mutualism.

This situation may as well be interpreted in a slightly different fashion. A parasite of narrow specificity might have been introduced to the body of suitable host species. It was established in the course of time, and since the host species were smoothly adjusted to local environment, they did not speciate. The parasite, too, had no innate impetus for diversification and speciation.

Parasites exhibiting a wider range of specificity might give an apparent impression of their advanced evolutionary status. Critical examination of the situation may lead to the conclusion that such parasites have a wider range of adaptability, since they are able to thrive within the body of more than one host species. However, these host species, taxonomically, in most cases, are not too different from each other but are closely related. It may be safely concluded that related host species have more or less identical genomes, although the gap between them is sufficient to prevent inter-breeding. Obviously, their internal physiological environments may be considered as quite identical. It is interesting to note that in such cases, parasites exhibit certain morphometric diversion, as depicted by morphometric measurements of their oocystic structure. It would be premature to difine them as separate species or sub-species either, because such determination would certainly demand experiments on cross-transmission and their successful establishment.

Since the inception of taxonomic studies into coccidia, DOFLEIN (1916), PINTO (1928) and HOARE (1933) laid emphasis on the morphological parameters of sporulated oocysts for species determination. The second school of thought represented by REICHENOW (1921) and WENYON (1926) hold that determination of species should encompass the biological phenomena exhibited by parasites at their life-cycle stages.

Leaving aside the existing dispute on taxonomy of coccidia and taking the determined species as valid ones, we may use the host-parasite index as a tool for determination of taxonomic locus standi of parasites and their hosts, as well. KENNEDY (1975) suggested that specificity and distribution of related parasites are very often restricted to related genera and species of the hosts. The evolution of parasites, as believed by SPRENT (1962) proceeds to an ultimate stage, when it becomes immunologically recognised as the 'self'. This condition might have been achieved by the coccidia recorded from captive and wild mammals. It is also evident from the work of various authors that a recently introduced parasite leads to manifestation of various recognizable symptoms in a host. Therefore, suitable prophylactic measures should be sought for, in order to prevent dispersion of coccidian parasites from one group of hosts to another.

This investigation is primarily intended to provide a comprehensive account of coccidian parasites of the captive and wild mammals in India. Although the present study is fairly theoretical, the index may be used as a convenient tool for reconnaissance, and the same would be of much help in adopting suitable prophylactic measures for eradication of coccidian infestation. This index, also, may be treated as the initiating study upon which future investigations may be untertaken, with the view to clearing up inter-relations between parasites and their hosts, undertaken.

Summary

Studies on host-specificity of coccidian parasites in captive and wild mammals of India

A large number of coccidian parasites has so far been reported in the context of wild and captive mammals of India. This paper reviews the coccidian fauna of said hosts with diverse feeding habits and tries to establish host-specificities of the parasites concerned. The coccidian species so far recorded fall into two categories, those of a restricted specificity and those of a wider range. A critical survey tends to indicate that narrow

specificity very often involves closely related host species. These parasites are less important from the stand-point of zoo management, but the second category deserves more careful concern.
The host-parasite index included in this paper can be used by personnel engaged in zoo and wildlife management, especially in tropical countries, for eradication of parasites.

Zusammenfassung
Untersuchungen zur Wirtsspezifität von Kokzidien bei Zoo- und Wildtieren in Indien
Im Zusammenhang mit Zoo- und Wildtieren in Indien gibt es Berichte über eine große Anzahl von parasitären Kokzidien. In der vorliegenden Arbeit wird die Kokzidienfauna bei den erwähnten Tierarten unter Bezugnahme auf unterschiedliche Fütterungsrégimes und die Wirtsspezifität der Parasiten zusammenfassend im Überblick dargestellt. Die bisher beschriebenen Kokzidienarten sind zunächst zwei Hauptkategorien zuzuordnen, nämlich Parasiten mit begrenzter und Parasiten mit breitgefächerter Wirtsspezifität. Eine kritische Betrachtung weist darauf hin, daß die Parasiten mit begrenzter Spezifität häufig bei miteinander verwandten Wirtsarten zu finden sind. Diese Kategorie von Parasiten ist aus tiergärtnerischer Sicht von geringerer Bedeutung. Die andere Kategorie dagegen verdient größere Beachtung. Der in der Arbeit enthaltene Wirts-Parasiten-Index kann besonders in tropischen Ländern sowohl von Mitarbeitern zoologischer Gärten als auch von Wildhütern zur Parasitenbekämpfung genutzt werden.

Résumé
Etudes sur le caractère spécifique de l'hôte des coccidies chez les animaux gardés au zoo et chez les animaux sauvages en Inde
Plusieurs rapports mentionnent la présence d'un grand nombre de coccidies parasitaires en rapport avec les animaux gardés et les animaux sauvages en Inde. La communication donne un aperçu de la faune des coccidies chez les différentes espèces en se référant aux divers régimes alimentaires et au caractère spécifique de l'animal hôte. Les espèces de coccidies décrites jusqu'ici sont tout d'abord à classer en deux catégories principales, à savoir les parasites à spécificité limitée et les parasites à large spécificité de l'hôte. Une étude critique révèle que les parasites à spécificité limitée sont souvent à observer chez des espèces hôtes semblables. Cette catégorie de parasites n'est pas d'une très grande importance pour les jardins zoologiques alors que l'autre catégorie nécessite toute notre attention.
L'index sur les parasites et leurs hôtes contenu que renferme cet exposé peut être utilisé pour combattre les parasites, notamment dans les pays tropicaux aussi bien par le personnel de jardins zoologiques que par les gardiens des réserves d'animaux sauvages.

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RELATIONSHIP BETWEEN SPORULATION AND EFFECTS OF TEMPERATURE AND CHEMICAL EXPOSURES ON ISOSPOROID COCCIDIUM IN A WHITE TIGER (PANTHERA TIGRIS TIGRIS LINN.) IN ZOOLOGICAL GARDEN OF CALCUTTA

By S.K. Chaudhuri and A. Choudhury

Introduction

Reported in this paper is the relationship between sporulation and the effect of exposure to various temperatures and chemicals on oocysts of Isospora felis (Wasielewski, 1904, and Wenyon, 1923) in a male white tiger, an albino variety of Panthera tigris tigris Linn., kept in the Zoological Garden of Calcutta. This record of Isospora felis infection is believed to be reported for the first time. White tiger is of majestic appearance, with icy blue-green eyes and grey-brown stripes on off-white ground. Oocysts of Isospora felis were collected from faecal samples of the animal and are described in detail in this paper. Reference is made also to clinical symptoms, prophylaxis, and steps taken for anticoccidial therapy.

Material and methods

Faecal samples were collected immediately after defaecation and moved in a vial to a laboratory on the same compound. The vial had been half-filled with 2.5 per cent solution of potassium dichromate ($K_2Cr_2O_7$), with some air space being left on top of the surface. The material was passed through two layers of cheesecloth to remove coarse particles. Some of the samples were placed in Petri dishes with 2.5 per cent potassium dichromate solution for proper sporulation. Petri dish dimensions were 15 mm x 20 mm. The depth of fill was kept below 4 mm. Air bubbles were introduced intermittently at room temperature. Sporulated oocysts were microscopically examined by a method which had been proposed by Kenneth et al. (1977). They were treated at room temperature as control material. Immediately after defaecation, the oocysts, which had been cleared of coarse particles or debris were exposed to various chemicals at room temperature, namely to five, ten, and 15 per cent solution of sodium chloride, two, five, and ten per cent solution of copper sulphate, normal solution of sodium bicarbonate, and 40 per cent formalin solution. Fifty oocysts from each of the Petri dishes were checked in eight-hour intervals for three days.

The oocyst batches kept in the above solutions of varying concentrations then were exposed to different temperatures, 20°C, 25°C, 30°C, 35°C, and 40°C. Samples of each of the Petri dishes again were checked in eight-hour intervals, for two days.

A Zeiss ocular micrometer with oil-immersion lens (100x) was used for measurement, while microphotographs of oocysts, sporocysts, and sporozoites were taken by means of a Leica M-3 camera.

Results

Morphometric description of sporulated oocysts

The double-walled oocyst was found to be oval in shape and tapered towards its anterior end. The outer part of the wall was thinner than the inner part. Fifty sporulated normal oocysts were morphometrically measured. They were between 41.0 µm and 49.5 µm in length, the average being 46.0 µm, and between 29.0 µm and 34.2 µm in width, the mean value being 31.0 µm. Accommodated in each of the oocysts were two sporocysts of equal size. No micropyle was discernible in an oocyst. There were neither oocyst residuals nor polar granules. Elliptical sporocysts were between 20.5 µm and 24.0 µm in length, the average being 21.0 µm, and between 15.9 µm and 19.0 µm in width, the average coming to 16.9 µm. There was plenty of sporocyst residuum with granules (Fig. 1). Four sausage-shaped sporozoites which were slightly tapered towards their head ends were held by each of the sporocysts. Each of the sporozoites had a large refractile globule at its posterior end. Ten sporozoites were measured. They were between 11.9 µm and 15.3 µm in length, the average being 12.7 µm, and between 2.55 µm and 4.25 µm in width, the average being 3.9 µm.

Table 1

Morphometric assessment of Isospora felis oocysts by different authors (first established by W a s i e l e w s k i, 1904, and W e n y o n, 1923)

Authors	Host	Length µm	Width µm	Average µm
Reichenow (1921)	Domestic cat	33 - 45	23 - 35	-
Kotlán (1961)	Domestic cat	30 - 45	26 - 36	-
Levine (1961)	Lion, dog, domestic cat	32 - 53	26 - 43	43 x 33
Shah (1970)	Domestic cat	38 - 51	27 - 39	41.6 x 30.5
Pande, Bhatia, Chauhan, and Grag (1970)	Indian lion	23 - 33	20 - 28	26 x 22
Chaudhuri and Choudhury (1980)	"Tigon" (hybrid carnivore)	40.8 - 49.3	28.9 - 34.0	45.97 x 31.05
Authors of this paper	Tiger (albino variety)	41 - 49.5	29 - 34.2	46 x 31

Sporulation time and percentage of successful sporulation in 2.5 per cent potassium dichromate solution at room temperature

The sporulation time required by Isospora felis in white tiger at room temperature was found to be between 64 and 72 hours. Room temperatures recorded during that period of time varied between 25°C minimum and 35°C maximum. Air bubbles were blown through the faecal samples for proper aeration of the oocysts. Approximately 85 per cent of all oocysts sporulated. C h a u d h u r i and C h o u d h u r y (1980) reported successful sporulation at room temperature in the same medium of 78 per cent of Isospora felis oocysts of "Tigon".

Table 2

Effects of exposure to chemicals on sporulation at room temperature

Exposure hr	Control 2.5 p.c. $K_2Cr_2O_7$ solution	Experimental material: Sodium chlor. sol. 5%	Sodium chlor. sol. 10%	Sodium chlor. sol. 15%	Copper sulph. sol. 2%	Copper sulph. sol. 5%	Copper sulph. sol. 10%	Normal sol. sod. bicarb.	Formalin sol. 40 %
8	NC	NC	NC	NC	NC	NC	NC	NC	NC
16	SS	SS	SS	SS	SS	SS	SS	NC	IS
24	NS	NS	NS	50%x	NS	NS	NS	IS	x (Fig. 2)
32	NS	NS	IS	x	NS	NS	x	50% CS	
40	25%	NS	50%CS		NS	NS		85% CS	
48	25%	NS	70%x		NS	NS		x	
56	60%	15%	90%x		1(.	4%			
64	85%	25%	SOD		12%	4%			
72	85%	30%	OD		12%	5%			

Key: NC no change, SS sporulation started, IS irregular sporogony, NS normal sporogony, x died, CS ceased sporogony, SOD sporulated oocysts deformed, OD oocysts deformed

Table 3

Effects of different temperatures and chemical exposures on sporulation of Isospora felis oocysts

Exposure hr	Control material 2.5% $K_2Cr_2O_7$ sol. Temperature, °C					Experimental material 5% sodium chloride solution Temperature, °C					10% sodium chloride solut. Temperature, °C				
	20	25	30	35	40	20	25	30	35	40	20	25	30	35	40
8	NC	SS	NS	NS	95%S	NC	NC	SS	NS	25%S	SS	IS	IS	IS	■
16	NS	NS	90%S	97%S	DS	NS	NS	20%S	15%S	OD	5%S	IS	IS	■	
24	NS	85%S	85%S	DS	30%■	NS	30%S	SOD	SOD	SOD	10%S	■	■		
32	NS	85%S	NS	90%S	SOD	25%S	33%S	SOD	SOD	■	CS				
40	90%S	90%S	SOD	SOD	SOD	35%S	SOD	SOD	SOD		SOD				
48	90%S	SOD	SOD	10%■	25%■	SOD	SOD	AD	AD		SOD				
	15% sodium chlor.sol.					2% copper sulphate solution					5% copper sulphate sol.				
	20	25	30	35	40	20	25	30	35	40	20	25	30	35	40
8	SS	IS	IS	■	■	NS	NS	NS	IS	IS	NS	NS	NS	IS	IS
16	CS	IS	■			NS	NS	NS	■		NS	13%S	20%S	SOD	SOD
24	10%S	■				8%S	10%S	15%S	20%S	SOD	NS	18%S	20%S	5%S	■
32	■					15%S	15%S	20%S	SOD	SOD	10%S	SOD	SOD	SOD	IS
40						20%S	SOD	SOD	SOD	SOD	15%S	SOD	SOD	SOD	SOD
48						SOD	SOD	SOD	SOD	SOD	SOD	■			
	10% copper sulph.sol.					normal sol.sodium bicarbon.					40% formalin solution				
	20	25	30	35	40	20	25	30	35	40	20	25	30	35	40
8	IS	IS	■			IS	IS	■			IS	■			
16	■					IS	■				■				
24						■									
32															
40															
48															

Key: NC no change, SS sporulation started, S sporulated oocysts, NS normal sporogony, IS irregular sporogony, ■ died, DS deformation of oocysts started, OD oocysts deformed, SOD sporulated oocysts deformed, CS ceased sporogony, AD all oocysts deformed

Clinical symptoms

The affected white tiger lost appetite and strength. Faeces turned liquid, almost watery, and were of extremely foul odour.

Control of coccidiosis in white tiger

Sulphamethazine (ICI) has proved to be highly effective in anticoccidial therapy of feline animals. It was found to be non-toxic to the host animal treated. It has been regularly used on anticoccidial treatment of feline animals in the authors' zoological garden. Approximate live weight of the affected white tiger was 150 kg. Coccidiosis in the animal was successfully controlled by administration of three tablets of 5 g of sulphamethazine in the feed ration, followed by half that dose on the following day.

Discussion

Studies into Isospora felis were first initiated by W a s i e l e w s k i (1904) and continued, more recently and in greater detail, by W e n y o n (1923). Sporulation time of Isospora felis was first recorded by W e t z e l (1925) and found to be somewhat between 48 and 60 hours. No reference was made by him to temperature. R a o and H i r e g a u d a r (1952) found Isospora felis oocysts to undergo complete sporulation in five per cent dichromate solution, after they had been allowed to stay "overnight". No temperature was mentioned by them either. The oocysts obtained from white tiger (albino variety) by the authors of this paper were kept in 2.5 per cent potassium dichromate solution at various temperatures, including room temperature. These were treated as control material.

Effects on sporulation of exposure of Isospora felis oocysts to various chemicals in different concentrations at room temperature were compared with results obtained from treatment in common culturing medium (Table 2). Some remarkable findings were recorded by the authors of this paper regarding viability of Isospora felis oocysts which had been exposed to 15 per cent sodium chloride culture at room temperature. These findings differed from those reported by B o n d e i s (1936) who found that oocysts of Eimeria pfeifferi died in 15 per cent solution of sodium chloride in 24 hours. However, D u n - c a n (1959a) reported about the same oocyst species to survive ten days in the same solution. The authors measured oocyst viability by the criterion of infectivity. K a r (1947) reported that oocysts of Eimeria stiedae and Eimeria perforans survived 24 hours in ten per cent solution of copper sulphate, while Isospora felis died in the same medium after 32 hours.

Effects of exposure to various chemicals at different temperature levels on both sporulation and viability of Isospora felis oocysts are given in Table 3. Sporogony was found to be highly irregular in different experimental media. Sporoblasts underwent distortion and turned elliptical in shape instead of staying spherical. Sporulated oocysts became wrinkled (Fig. 3).

Tolerance and viability values of Isospora felis oocysts in response to differentiated environmental conditions are given in Tables 2 and 3. Data on effects of chemical substances at different temperature levels, including room temperature, on sporulation and viability of oocysts of Isospora felis in white tiger may have significant bearings on practice, in that prophylaxis against feline coccidiosis can be designed with close adjustment to natural conditions. Chemical substances with lethality to Isospora felis oocysts, as shown in Tables 2 and 3, can be used for disinfection of enclosures in which feline animals are kept.

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Summary:

Relationship between Sporulation and Effects of Temperature and Chemical Exposures on Isosporoid Coccidium in a White Tiger (Panthera tigris tigris Linn.) in Zoological Garden of Calcutta

Oocysts of Isospora felis were studied and tested for sporulation and viability when exposed to various chemical at different temperature levels. Potassium dichromate solution, 2.5 per cent in concentration, was used for control. The oocysts had been obtained for investigation from a white tiger (albino variety) in the Zoological Garden of Calcutta, India. A morphometric assessment of Isospora felis oocysts is also given.

Zusammenfassung:

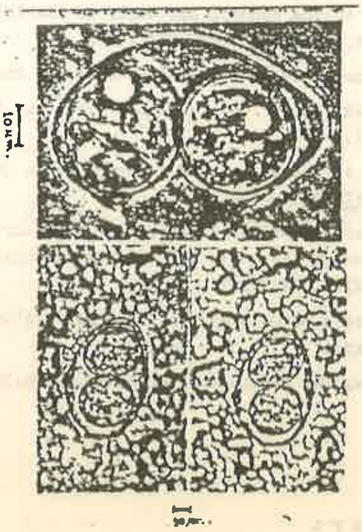
Auswirkungen verschiedenartiger chemischer Expositionen in unterschiedlichen Temperaturbereichen auf Sporenbildung und Lebensfähigkeit von Isospora-felis-Oocysten bei einem weißen Tiger im Zoo von Kalkutta

Sporenbildung und Lebensfähigkeit von Oocysten von Isospora felis wurden nach unterschiedlichen chemischen Expositionen in mehreren Temperaturbereichen untersucht. Als Kontrollsubstanz diente Kaliumdichromat in 2,5-prozentiger Konzentration. Die Oocysten waren zur Untersuchung aus Kotproben von einem weißen Tiger (Albino) im Zoo von Kalkutta gewonnen worden. Sie wurden auch morphometrisch beurteilt. Die Ergebnisse sind in Tabellen und Abbildungen dargestellt.

Резюме:

Влияние различных химических экспозиций в различных температурных областях на образование и жизнеспособность изоспора-фелис- ооцист у белого тигра в Калькуте.

Образование спор и жизнеспособность ооцист изоспоры фелис исследовались в зависимости от химических экспозиций и температурных областей. Контрольным веществом является калий-бихромат в 2,5% концентрации. Ооцисты выделялись из кала белого тигра в зоопарке Калькуты. Результаты морфометрических исследований отражены в таблицах и рисунках.



Figures

Fig. 1 Normal sporulated oocyst (magnification factor: 1,000)

Fig. 2 Oocyst died in 40 per cent formalin solution at room temperature in 24 hours (magnification factor: 400)

Fig. 3 Oocyst wall wrinkled in ten per cent sodium chloride solution at 30°C in 16 hours (magnification factor: 400)

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From Zoological Garden of Calcutta (Director: Dr. A. N. G u h a)

INVESTIGATION OF COCCIDIOSIS IN "TIGON", A HYBRID CARNIVORE KEPT IN THE ZOOLOGICAL GARDEN OF CALCUTTA, INDIA

By S. K. C h a u d h u r i and A. C h o u d h u r y

Introduction

It is the authors' privilege to report in this paper exogenous development of Isospora felis (W a s i e l e w s k i , 1904; W e n y o n , 1923), on "Tigon", a hybrid carnivore, together with the animal's response to anticoccidial therapy. The animal reviewed, a female aged four years at the time of investigation, had resulted from a cross between a Bengal tiger (Panthera tigris tigris) and an African lioness (Panthera leo persica). The individual had been born in Calcutta, on March 8th, 1974, with the mother's seventh litter. Isospora felis was collected from faecal samples of the "Tigon", on April 5th, 1978. Reported in this paper are details relating to sporogony of Isospora felis oocysts on the hybrid cat as well as sporulation periods required by the species under different temperature conditions, including room temperature. Sporocysts and sporozoites are also described in detail.

Material and methods

Faecal samples were collected, immediately after defecation, and mixed with potassium dichromate solution in a concentration of 2.5 per cent. The material was passed through two layers of cheesecloth to remove coarse particles and then poured into Petri dishes, 15 x 20 mm, the depth of fill being less than 4 mm. Sporulation was allowed to take place at room temperature, and incubation was undertaken at 20 °C, 30 °C, and 50 °C. Air bubbles were introduced intermittently to aerate the material for better sporulation at room temperature.

The oocysts were examined prior to incubation and then at regular intervals of eight hours for 20 °C culturing or four hours for 30 °C and 50 °C culturing, until sporulation was complete. The sporulation process was observed by concentrating the oocysts, which was achieved by centrifugal flotation, using supersaturated sugar solution. Hanging-drop oocyst cultures were prepared by a method described by M a h r t (1968) to facilitate high-continuity observation of sporogony. Fifty oocysts were checked in each of the time intervals.

Observation was concentrated largely on sporulated oocysts. A Zeiss ocular micrometer with oil-immersion objective (100 X) was used in the measurements. A Leica M-3 camera was used to obtain photomicrographs of the oocysts, sporocysts, and sporozoites, while a Lucida Leitz camera was used for the drawings.

Results

Sporogony

Reddish coloration of the fresh faeces appeared to indicate haemorrhage, which actually was confirmed by means of benzidine tests. Only unsporulated oocysts were passed in fresh stools. Fully formed spherical sporonts, measuring about 25 µm, were contained in the cysts. The cytoplasm of the sporonts was granular, with a single row of granules situated peripherally. No nucleus was noticed (Fig. 1). One single nucleus, about 7 µm in diameter, usually appeared at the periphery of the sporont (Fig. 2), within 90 and 120 minutes. The sporont turned ovoid in shape, along with growth, and was somewhat constricted at centerline. Constriction gradually resulted in division of the sporont into two sporocysts. The two sporoblasts were nearly spherical in shape, at the beginning, each of them with a distinct nucleus in its centre. Then, each of the sporoblasts underwent elongation, in the course of development, and transformation to an elliptical sporocyst. Each of the sporocysts then had a single nucleus at one pole (Fig. 3). Two nuclei appeared at either pole of each sporocyst, within half an hour

(Fig. 4). The residual granular material then formed the membrane of the sporocyst. The cytoplasm in each of the sporocysts began to undergo simultaneous differentiation into sporozoites (Fig. 5). No micropyle nor polar granule was noticeable. Completion of sporogeny was evident, when each of the sporocysts had undergone differentiation into four fully developed sporozoites, with clear sporocyst residuum being left (Fig. 6).

Sporulation time and percentage of successful sporulation at room temperature

Temperature, humidity, and unobstructed access to oxygen were found to be three fundamental factors underlying any oocyst sporulation. The sporulation time required by Isospora felis in "Tigon" at room temperature was found to be between 48 and 72 hours. The room temperatures recorded in that period of time were between 28 °C minimum and 35 °C maximum. Air bubbles were blown through the faecal samples for proper oocyst aeration. Some 78 per cent of all oocysts sporulated under such conditions.

Percentual sporulation at different temperatures

Sporulation time required by Isospora felis of "Tigon" was recorded for 20 °C, 30 °C, and 50 °C. The period required by 88 per cent of all oocysts to undergo sporulation at 20 °C was 40 hours, while 90 per cent of all oocysts completed sporulation at 30 °C in twelve hours and another 90 per cent at 50 °C in six hours. Comparable figures reported by S h a h (1970) in the context of domestic cat (Felis domestica) were 40 hours for 20 °C and twelve hours for 30 °C, and the percentages of oocyst sporulation were 96 and 95, respectively.

A comparison between oocyst sporulation percentages obtained by the authors of this paper, at different temperatures, on the one hand, and those reported by S h a h (1970), on the other, is given in Table 1.

Table 1

Findings obtained by Shah (1970) from domestic cat

Time needed for sporulation (hr)	Temperature °C	Percentage of sporulation
40	20	96
12	30	95
Findings obtained by authors of this paper from "Tigon"		
40	20	88
12	30	90
6	50	90

Oocyst morphology

The oocyst is oval in shape and tapered towards one end. It is double-walled, with the outer wall being thinner than the inner wall. Measurements were taken of 35 sporulated oocysts. Their lengths varied between 28.9 and 34.0 µm, the average being 31.05 µm. Accommodated in each of the oocysts were two sporocysts equal in size. No micropyle was established from an oocyst. Oocyst residuum or polar granules were not noticed either. The sporocysts were of elliptical shape and varied in length between 20.4 and 23.8 µm, giving an average length of 21.1 µm. Their widths varied between 15.3 and 18.7 µm, bringing the average to 16.3 µm. Sporocyst residuum was of remarkable size and contained granules. Each of the sporocysts had in it four sausage-shaped sporozoites which tapered slightly towards one end, each of them carrying a large refractile globule at the broader end. Measurements could be taken only of eight sporozoites. Their lengths varied between 11.9 and 13.3 µm, the average being 12.75 µm, while their widths varied between 2.55 and 4.25 µm, giving an average of 3.9 µm.

Clinical symptoms

The affected "Tigon" suffered inappetence and feebleness. Faeces turned liquid, almost watery, and haemorrhagic diarrhoea developed. Faecal odour was extremely foul.

Control of coccidiosis in "Tigon"

"Sulphamezathine" (Imperial Chemical Industries) is highly effective on coccidiosis in felines. It proved to be non-toxic to the host animals treated. It has been used regularly to control coccidiosis in groups of felines in the authors' zoological garden.

The approximate live weight of the "Tigon" affected was 105 kg. The disease was taken under control with good success by administration of two "Sulphamezathine" tablets of 5 g in the food ration, followed by half that dose the other day. Subcutaneous injection of "Sulphamezathine" sodium solution in a concentration of 33.3 per cent, under sterile conditions, and concomitant application of "Vesadin" (May & Baker Ltd.) failed to produce palpable therapeutic results on coccidiosis of carnivores in the authors' zoological garden.

Discussion

Studies into Isospora felis had been first initiated by W a s i e l e w s k i (1904) and continued more recently, in greater detail, by W e n y o n (1923). W e n y o n , in his report on Isospora felis sporulation, elaborated on the presporont phase. He referred to sporonts with two distinct nuclei as well as to sporoblasts with nuclear streak and sporozoites with a residual body each. Also included in his report were studies into the nuclear structure and nuclear division of sporonts and into the sporoblast phase which began, after oocysts had been crushed and their content stained with iron haematoxylin. While the authors, in the study under review, also followed up the presporont phase, they did not discover any sporont with two nuclei nor any sporoblast with four nuclei. An adequate account of Isospora felis sporulation in all phases was given by T o m i m u r a (1957). While a certain account of Isospora felis sporogony was given by L i c k f e l d (1959), as well, his description was quite incomplete. S h a h (1970) contributed to more elucidation of the Isospora felis sporulation process and its timing in domestic cat.

The authors of this paper noted some difference between their own findings regarding sporulation and its timing, on the one hand, and those reported by S h a h (1970) for Isospora felis in cat, on the other. Sporulation time of Isospora felis was first identified by W e t z e l (1925) and found to be somewhat between 48 and 60 hours. Yet, he failed to mention any temperature. R a o and H i r e g a u d a r (1952) found Isospora felis oocysts to undergo complete sporulation in five per cent dichromate solution, after they had been allowed to stay "overnight". They mentioned no temperature either. The authors of this paper studied oocyst material obtained from "Tigon". Their oocysts were kept in properly aerated 2.5-per-cent $K_2Cr_2O_7$ at various temperatures, including room temperature. Times required for sporulation at different temperatures together with the percentages of sporulation, recorded by S h a h (1970) from domestic cat and by the authors of this paper from "Tigon". a hybrid cat, are given for comparison in Table .

A morphometric account of Isospora felis oocysts is tentatively given by the authors of this paper in Table 2. Reference is made also to findings obtained by other workers from different host species. No significance needs to be attributed to some slight variation in measured variables of "Tigon", which seems to be attributable to some new kind of host interaction.

The "Tigon" infected with Isospora felis received "Sulphamezathine" (Imperial Chemical Industries) for anticoccidial therapy, on April 8th, 1978, and its faeces were cleared of Isospora felis as of April 10th, 1978.

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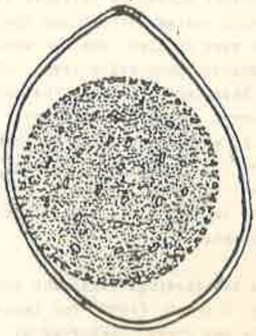
Unsporulated oocyst in fresh faeces; no nucleus visible in sporont

Oocyst with two sporocysts, each with two nuclei

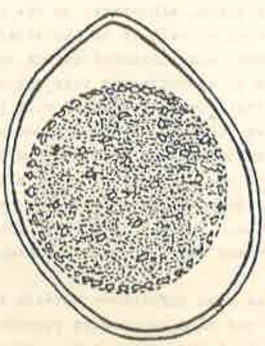
Oocyst with partially formed sporozoites

Sporulated oocyst



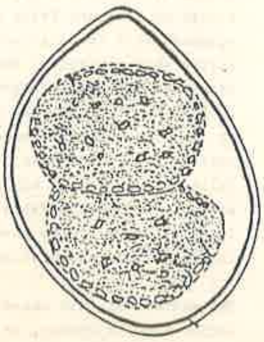
1

Unsporulated oocyst in fresh faeces; no nucleus visible in sporont



2

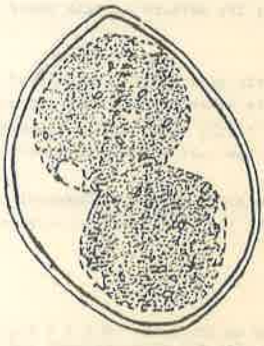
Oocyst with sporont nucleus visible



3

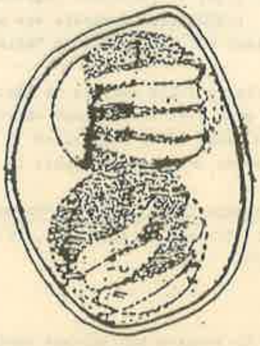
Transformation of oocyst to sporocysts

10µm



4

Oocyst with two sporocysts, each with two nuclei



5

Oocyst with partially formed sporozoites

6

Oocyst after sporulation with four fully developed sporozoites and residuum in each sporocyst

Table 2

Comparative measures of Isospora felis oocysts, as reported by different authors (first established by Wasielewski, 1904, and Wenyon, 1923)

Authors	Hosts	Length, µm	Width, µm	Average, µm
Reichenow (1921)	Domest. cat	33 - 45	23 - 35	-
Kotlán (1961)	Domest. cat	30 - 45	26 - 36	-
Levine (1961)	Lion, dog and domestic cat	32 - 53	26 - 43	43 x 33
Shah (1970)	Domest. cat	35 - 51	27 - 39	41.6 x 30.5
Authors of this paper	"Tigon"	40.8-49.3	28.9-34.0	45.97 x 31.05

Summary:

Investigation of Coccidiosis in "Tigon", a Hybrid Carnivore kept in the Zoological Garden of Calcutta

Sporogony and morphology of oocysts of Isospora felis are the subjects of this paper. They were studied in the context of a four-year old female "Tigon", an unusual hybrid animal which originated from a cross between a lioness and a tiger in the Zoological Garden of Calcutta.

Zusammenfassung:

Untersuchungen über die Kokzidiose bei einem "Tigon", einer Kreuzung zwischen Tiger und Löwe, im Zoologischen Garten von Kalkutta

Mit der vorliegenden Arbeit wird ein Beitrag zur Sporogonie und Morphologie der Oozysten von Isospora felis vorgelegt. Die Untersuchungen erfolgten an einem vier Jahre alten weiblichen "Tigon", einer ungewöhnlichen Kreuzung zwischen einer Löwin und einem Tiger des Zoologischen Gartens von Kalkutta.

Résumé:

Etudes sur la coccidie chez un "tigon", un croisement entre tigre et lion au Jardin zoologique de Calcutta

L'étude présente constitue une contribution à la sporogonie et à la morphologie des ookystes d'Isospora felis. Les examens ont été faits sur une "tigonne", femelle de quatre ans, croisement insolite entre une lionne et un tigre réalisé au Jardin zoologique de Calcutta.

Резюме:

Изучение кокцидиоза у "Тигона"-животного, полученного в результате скрещивания тигра и львицы в зоопарке города Калькутты.

В предложенной работе обсуждается спорогония и морфология ооцист от Isospora felis. Исследования проводились на четырехлетней самке "Тигон", полученной в результате редкого скрещивания тигра и львицы в зоопарке города Калькутты.

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Torulosis in Golden Pheasant *(Chrysolophus pictus)*: a case report

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J. Samaddar

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Darjeeling-734 101, India.

A mixed pair of golden pheasants *(Chrysolophus pictus)*, which are originally residents of the interior of China, were reared in the aviary of the Padmaja Naidu Himalayan Zoological Park, Darjeeling. In due course a cock-pullet was hatched, weaned and sheltered by an attendant; later the bird emaciated rapidly and died after a month.

Post-mortem of the pheasant showed small granulomatous swelling of the intestinal mucosa and inflammed, hyperaemic liver. Leishman's staining of the smears drawn from those organs revealed clusters of encapsulated light-stained spherlacal bodies. The diameters of such bodies were in average 4μ and 15μ in the smears from intestine (Fig. 1) and liver (Fig 2) respectively. The capsules were stained dark while the encircled bodies were reddish. There was no connecting filament.

The morphological study confirms the parasite to be *Cryptococcus* sp., the mycotic organism having zoonotic importance and the difference in dimension indicates that the infection introduced through digestive tract gained its maturity in hepatic tissues.

Discussion :

Bisbocci (1938) first described cryptococcal enterohepatitis in wild fowl. Earlier the organism was recorded from man and large animals.

Emmons (1955), Walter and Yee (1968), Thasmakom *et al* (1970), Boehm *et al* (1970) and Jacubicz (1974) observed the presence of this mycotic organism in the droppings of domestic pigeons in different parts of the world.

The present report is the first record of cryptococcosis or torulosis in two different stages in the intestine and liver of a golden pheasant.

Acknowledgement :

Authors are thankful to Dr. S. Roychowdhury, Dy. Director, P. N. Himalayan Zoological Park, Darjeeling and also to the Director of Veterinary Services, West Bengal.

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Fig.—1

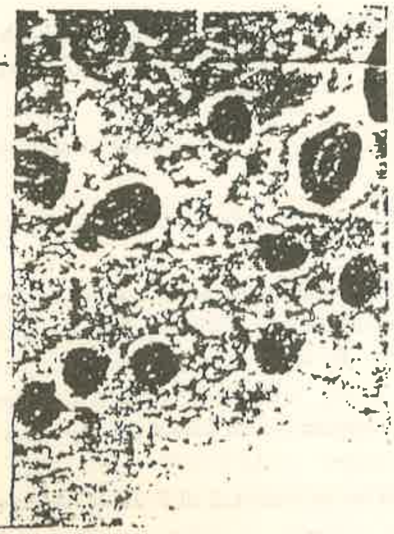

Fig.—2

Fig. 1. *Cryptococcus* in Intestinal smear. X 800

Fig. 2. *Cryptococcus* amongst hepatic cells. X 800

Indian vet. med. J. Vol. 14, September, 1990: 213—214

Short Communication

FOOT AND MOUTH DISEASE IN AN ELEPHANT IN CALCUTTA ZOOLOGICAL GARDEN : A CASE REPORT

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Foot and mouth disease is a well popular viral disease mainly of cloven footed animals. This disease in epizootic form in domestic animals causes serious economic loss in many parts of the world. In some countries strict eradication programme reduces the intensity of the disease to a very low extent, though the prevalence of disease in wild animals is not at all affected. Besides cloven footed animals other wild animals like elephant and wild antelopes are also affected (FAO/UNDP report, 1972 ; Hedger and Brooksby, 1976). Piragino (1970) reported an outbreak of FMD in African elephant, Pyakural and Singh (1976) reported another outbreak in Indian elephant in Nepal. But available literature cited no such occurence in elephant in captive condition. The present communication deals with a case of this disease in a zoo elephant.

A young (6 years) female Indian elephant of Zoological Garden, Calcutta first showed symptoms of being off-feed and listlessness, noticed on 21st Feb. 1988. After two days the animal further exhibited profuse salivation and high rise of temperature (105°F). On thorough examination, vesicular lesions were noticed on the mouth, snout and eruptions on the feet which later became ulcerated. Due to ulceration the animal became unable to take food and showed lameness. On the basis of clinical picture, gross lesions and course of the illness, the disease was suspected to be FMD. To confirm the diagnosis, epithelium of the tongue and tissue from feet were collected in screw capped vials containing 50% glycerine saline (W/V) for identification of the causative viral agent. A small piece of affected tissue was triturated and centrifused and in supernatent 100 I. U. of penicillin and 100 mg of streptomycin was added and inoculated in the foot pad of the guineapig.

On isolation, type '0' FMD virus was identified. Inoculation studies in guineapig showed formation of vesicles on the fifth day after inoculation. The indentified type '0' FMD virus in the present case is the common strain to be responsible for this disease in elephant as also described by Pyakural and Singh (*loc. cit.*). But Piragino (*loc. cit.*) isolated 'A-7' strain of FMD virus from an outbreak. 'SAT-2' strain of FMD virus may also cause this disease though natural infection is yet not recorded (Howell *et al.*, 1973). It has also shown that pathogenesis of this disease followed a more or less similar course to that which is usually

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noticed in other suspectible animals. The clinical picture attributed to this disease in this observation showed that the involvement of feet and buccal cavity was very severe in elephant which was also noted by Pyakura and Singh (*loc. cit.*). As the elephant was stall fed and kept in a separate accommodation distant from other animals, the source of infection could not be properly worked out.

Treatment with Resticline (Tetracycline hydrochloride) and washing of the feet, snout and mouth with Pot. permanganate solution alongwith application of Mercurochrome lotion, spirit Acriflavin and Nebasulph powder made the elephant recover after one month.

However, this observation again supports the previous workers and confirms that FMD is not a disease of cloven footed animals alone but also occurs in other animals. Furthermore, it may be concluded that due to lack of protectives measure, it raises the possibility that wild animals including elephant may harbour the infection and play an important role in dessimination of the disease.

Acknowledgements

The authors are grateful to Sri A. K. Das, Director, Zooloqical Garden, Calcutta for his active cooperation.

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INDIAN VET.J.71. OCTOBER. 1994 : 1047

XYLAZINE-KETAMINE ANAESTHESIA IN A TIBETAN WOLF *CANIS LUPU'S CHANCO*

Goutam Chakraborty and Arup Kr. Das[1]

A male adult (3 yrs old) wolf weighing about 10 kg showed symptoms of lameness swelling of the hock joint of the left hind limb. A combination of xylazine* and ketamine** anaesthesia was used for physical examination. The combined drug was taken into a plastic projectile syringe (3ml capacity) and administered in the neck region with a blowpipe. The wolf was injected 2 times in rapid succession. The approximate dose of xylazine and ketamine was 1.33 mg and 10 mg/kg body wt. respectively.

The induction time took about 10 minutes. Respiration was normal. Salivation was minimal and eyes remained open. There was excellent level of analgesia and anaesthesia. It took 15 minutes for examination of the joint and to do the necessary clinical procedures. Complete recovery occurred 1 hour after injection of xylazine and ketamine.

Wallach and BOever (1983) reported ketamine and xylazine combination as the most commonly used chemical agent in wild carnivores. The sedative analgesic and muscle relaxation properties of xylazine have also been found to be useful in combination with ketamine for Tibetan wolves without any ill effects.

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1. ADVO, PNHZ Park, Darjeeling

2. Vety Surgeon, Govt. of West Bengal, Parasite Control Unit. Howrah

* Xylazine Farvet Lab. Holland (20ms/ml)

** Ketaset Fort Dodge Lab. U.S.A. (100mg/ml)

INDIAN VET.J.68. JUNE. 1991 : 517 - 520

ISOLATION OF *CRYPTOCOCCUS NEOFORMANS* FROM CAPTIVE BIRDS

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Cryptococcosis, a disease of zoonotic importance is sporadic in occurrence in animals and man. Its causative agent, *Cryptococcus neoformans* has saprophytic existence and is not transmitted by direct contact between the hosts, but it appears in man, animals and birds sharing the same environment. There exist only a very few case records on the spontaneous disease in some species of captive birds based on clinical and necropsy findings (Clipsham and Britt, 1983; Fenwick *et al.*, 1985; Nayak *et al*, 1985). However, reports on pathologic features of the spontaneous disease and the prevalence of infection in the birds environment are scanty. The present study is an effort made in this direction.

Materials and Methods

A disease of prolonged course in certain species of captive birds was observed at the Calcutta zoo periodically over the past two years. The ailing birds were examined clinically and symptoms were recorded. Droppings from both ailing and incontact birds and also from clinically healthy pigeons of the same enterprise were cultured on modified Littman Oxgall agar to isolate the organisms (Botard and Kelley, 1968).

Dead birds were necropsied and gross pathologic lesions were recorded. Impression smears from heart blood and diseased organs were stained with Gram's Loeffaler's methylene blue, Ziehl-Neelsen's (Z-N) and lactophenol cotton blue stains for the demonstration of organisms. Aseptically collected tissue materials from the edges of lesions were cultured bacteriologically. The same materials were also utilized for mycological studies and isolation attempts were made on Sabouraud's dextrose agar medium at room temperature for 3-5 days.

Tissue pieces from diseased organs were immediately fixed in 10% neutral formalin, processed for paraffin sectioning at 5μm thickness and stained with haematoxylin and eosin (HE). Duplicate sections were further stained with Z-N for mycobacteria, modified periodic acid schiff's (PAS) for fungus (Iyer, 1981) and Mayer's mucicarmine stain to differentiate *C. neoformans* from other capsular fungal agents.

Results

Cryptococcal infection in different species of captive birds is shown in the table. Out of 69 (16.95%) culturally positive birds, only 11 (2.7%) manifested clinical signs, comprising of dullness and depression, progressive emaciation, thickening of the base of tongue, bilateral nasal exudation, laboured breathing and death.

---

1. Calcutta Zoological Garden, Alipore

Impression smears stained with lactophenol cotton blue showed clusters of encapuslatad light stained, spherical bodies of 4 to 13µm in diameters without any connecting filaments, morphologically suggestive of *Cryptococcus* sp. Cultures from droppings of 4 pheasants and 58 pigeons on Littman oxgall agar produced distinct brown coloured colonies on 4 days of incubation. Infected tissue materials on Sabouraud's dextrose agar exhibited soft, white to cream coloured yeast-like colonies on 3 days of incubation, which later became pale brown-coloured with mucoid appearance. Fermentation of sugars had negative reaction, but urease test was positive confirming the organisms as *C. neoformans*. Fungal isolates were also confirmed as *C. neoformans* at the School of Tropical Medicine, Calutta.

Cryptococcal Infection in the different species of captive birds

Species	No. of birds examined	No. of samples culturally positive			No of birds positive for Cryptococcal infection	No. and percentage of birds showing clinical signs and mortality
		Droppings	Infected tissues	Droppings and infected tissues		
Muscovy duck (*Cairina moschata*)	72	—	2	—	2	2 (1.44%)
Pheasant (*Argusianus argus*)	94	4	6	4	6	6 (5.64%)
Macaw (*Ara ararauna*)	55	—	2	—	2	2 (1.10%)
Parrot (*psittacula krameri*)	81	—	1	—	1	1 (0.81%)
Pigeon (*Columba livia*)	105	58	—	—	58(60.9%)	—
.	407	62	11	4	69(16.95%)	11(2.7%)

All the 11 birds on necropsy contained multiple nodules in the lungs and liver Intestines of 4 pheasants also had nodules and thickening of the mucosa. The nodules were white or cream-coloured, varying in sizes from a millet seed to a pea, glistening in appearance, slimy in consistency and firmly attached to the respective organs. Cut surfaces had multiple focal areas of caseation and necrosis scattered throughout the parenchyma. Liver further revealed enlargement and light grey in appearence and the glisson's capsule was excessively thickened. Lungs also contained firm rubbery areas of consolidation which showed a mucoid cut surface.

Histologically, HE stained sections revealed multiple granulomas which consisted of a central caseo-necrotic mass with the presence of large numbers of faintly stained fungal bodies, epithelioid and foreign body giant cells and the whole lesions were

Isolation of *Cryptococcus neoformans* from captive birds—T. Chakraborty *et al*

Fig. 1 Liver showing granulomatous lesions with giant cells engulfing the fungal bodies (H and E)

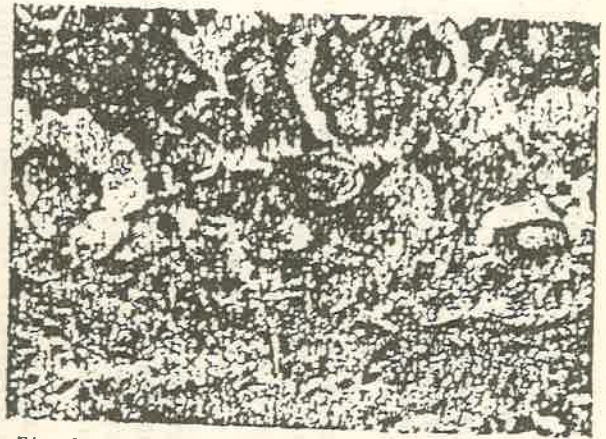

Fig. 2 cryptococcal organisms in the granuloma appearing as ovoid thick walled with wide capsule (PAS) encapsulated with connective tissue elements infiltrated with lymphocytes, macrophages and plasma cells (Fig. 1). Many giant cells were observed engulfing the fungal bodies Occasionally, the lesions coalesced involving a large area of lung and liver parenchyma.

In modified PAS technique, the organisms in the granulomas appeared as ovoid, thick-walled and surrounded by a wide capsule (Fig. 2). The capsule was distinctly pink to red in colour by mucicarmine stain, thus also confirming the organism as *C. neoformans* histologically.

Liver further revealed central lobular coagulation necrosis and inter and intra-lobular proliferation of reticuloendothelial cells, with varying numbers of lymphocytes and plasma cells.

Discussion

Captive birds at large enterprise live in an environment continuously occupied by them and contaminated with the pathogens from either infected or carrier host birds. *C. neoformans* is usually excreted in the droppings and nasal secretions of both infected and carrier hosts thus contaminating the soil and dust.

Cultures from the diseased organs of 11 birds and also droppings of 4 pheasants with clinical signs and mortality showed *C. neoformans*. Interestingly, the organisms were also recovered in 58(60.9%) of 105 dropping samples of clinically healthy pigeons in the same enterprise. Emmons (1955) also observed cryptococcal organism in 57.0% of 111 droppings samples of clinically normal pigeons culturally. He hypothesized that virulent strains are found abundantly in the nests and in accumulation of pigeon manure. The results of this study suggested that pigeons are also susceptible to cryptococcal infection without any clinical disease and acted as carrier birds. Infection to all susceptible birds is nearly acquired by inhalation of fungal spores along with terrestrial dust (Ajello, 1958).

Clinical signs of the spontaneous disease observed in this study were almost identical to the earlier reports in macaw (Clipsham and Britt, 1983), molucan cockatoo (Fenwick *et al.*, 1985) and golden pheasant (Nayak *et al.*, 1985). The formation of granulomatous lesions in the organs is the characteristic response and such lesions are possibly developed due to low grade of hypersensitivity of the virulent strains of *C. neoformans*. Hypersensitivity granulomas are T-cell dependent, representing a form of delayed hypersensitivity (Jones and Hunt, 1983). Earlier report (Barron, 1955) suggesting affinity of cryptococcal organisms to cerebrospinal meninges of animals and man, was not a feature in the birds of this study, possibly due to host specificity.

Summary

The prevalence of cryptococcosis in captive birds was reported based on the isolation and clinicopathological findings. of 69 (16.95%) positive cases, only 11 (2.7%) birds of 4 species showed clinical signs and mortality with characteristic granulomatous

lesions in the lungs, liver and occasionally in the intestine. Cryptococcal organisms were also identified in the granulomatous lesions. High numbers of dropping samples from clinically healthy pigeons of the same enterprise were culturally positive for cryptococcal infection. It is suggested that the pigeons act as a carrier host for the spontaneous disease to other birds.

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Indian vet. J. 66. December, 1989 : 1170 - 1171

SQUAMOUS CELL CARCINOMA IN A YAK

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Squamous cell carcinoma may affect any part of the boy. Incidence of this type of carcinoma is very common in bovines (Ingmire, 1947; Kulkarni, 1953; Takutake *et al*, (1976). Occurrence of this neoplasm in zoo animals seems to be low. Ensley *et al.* (1980) reported a case of squamous cell carcinoma in Indo-China sika deer. In the present communication a squamous cell carcinoma on the right cheek of a yak (*Bos mutus*) is reported.

A solitary nodular growth was observed in the lower right cheek of a 3 year old yak in Calcutta zoo. Initially the growth was soft and small in size (4cms) but gradually increased. The lesion later became irregular in shape with greyish-white in appearance and ulcerated Oozing out of sticky material from the lesion was observed and the animal was frequently scratching with foreleg. The lesion was regularly dressed with antiseptic lotion. Treatment with ampicillin was tried with no result. Biopsy material was taken from the growth The animal died two months after the first apprisal of the growth and the size of the growth measured 15cms at the time of death.

Affected tissues from the growth were collected during partial autopsy. Routine autopsy of the animal was beyond the scope. Materials were preserved in 10% neutral formal saline, processed through conventional technique for paraffin sectioning and stained with haematoxylin and eosin. On section, surface was granular and greyish-white in colour; histopathologically very regular concentric keratin layers were seen to form "pearls" (Fig. 1). This was the picture in one section, but the other showed extensive anaplasia with infiltrative chords of cells that invaded the dermis and subcutis. A good number of thin walled blood vessels were seen in these areas. Clumps of anaplastic carcinogenic cells were seen in a number of blood vessels which is a definite sign of metastasis In some places extensive necrosis evidenced by karyorrhexis and karyolysis were seen. The anaplasia of the cells were confirmed by the polyhydral cells with prickle borders and presence of large hyperchromatic nuclei and plenty of mitotic figures. The histopathological findings are identical to the description of Jubb and Kennedy (1970).

The present case bears an importance by the fact that the animal died within 2 months after the first appearance. Furthermore extensive search for literature revealed no such report of carcinoma in yak. Yak generally live in the region of Tibet and Upper Himalayas where sun rays are not so scorching as in Calcutta which is situated near the Tropic of Cancer. As the animal was kept in the zoo where prolonged scorching solar radiation is usual it might have produced the lesion.

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In the histological study carcinogenic cells were observed in the blood vessels which is a definite sign for metastasis, but due to the lack of facilities for detailed and complete autopsy examination the authors failed to find out metastasis in other organs of the animals.

Acknowledgements : The authors are indebted to the Director, Alipore zoo, Calcutta for his kind co-operation.

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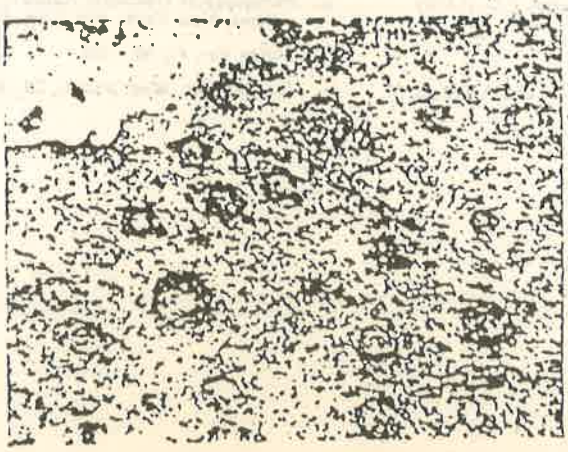
Squamous cell carcinoma in a yak

—T. Chakraborty *et al*



Squamous cell carcinoma with pearl in the centre and the carcinogenic cells around the "pearls" (H & E)

Indian Journal of Veterinary Pathology 19 (2) 136, December, 1995

Short Communication

TOXOCARIASIS IN HIMALAYAN WOLF *(CANIS LUPAS CHANCO)* PUPS

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Available literature did not reveal any record of neonatal mortality in Himalayan wolf pup due to toxocara sp. hence the present communication is an attempt in this direction.

Materials for the present study consisted of five pups which were born during February, 1993 and died by the age of 1.5 months. These pups were living with the adults in an outdoor enclosure attached to night shelter. These pups were showing the clinical signs of general weakness/emaciation/ retarded growth tacked up abdomen, diarrhoea, dehydration and inability to move.

Necropsy revealed emaciation, dehydration, focal patchy diffuse areas of pneumonia with blood tinged exudate in bronchi and trachea, congested liver, haemorrhagic gastroenteritis and thickening of intestinal wall. Stomach/intestinal contents were blood tinged and contained 10 to 50 adult parasites indistinguishable from *Toxocara canis*. Heart blood in cultural examination showed the presence of *Staph.* aureus and *Past. multocida*.

Histopathological study revealed characteristic changes of acute bronchopneumnonia. Acute inflammatory changes with necrotic foci and connective tissue proliferation were seen in liver. Kidneys exhibited mononuclear and neutrophilic aggregates with oedema and haemorrhage in one case. Haemorrhage and necrotic changes were present in the spleen of all the five pups. Various clinical, gross and histopathological changes observed in the present study were in conformity with earlier findings reported by Sastry[2] and Soulsby[3]. The presence of *T. canis* in stomach and intestine and associated changes might have contributed significantly in the death of the pups but the immediate cause of death was acute bronchopneumonia. Vertical transmision of infection from mother to pups is a common method[1]. The role played by *Staph aureus* and *Past. multocida* in the death of the pups can not be underestimated.

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Short Communication

SEPTICAEMIA IN CROCODILE DUE TO PROTEUS SP

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Now a days crocodile industry is gaining due importance through out the world for its economic value. In order to determine the proper line of treatment it is therefore necessary for the breeders and investigators to be aware about the potential pathogenic infections. As such, the present paper describes a case of septicaemia due to *Proteus sp.* in a crocodile.

A two yr old crocodile at the Zoological Garden, Calcutta in 1988, showed clinical signs of anorexia and lethargy. It died two months after onset of these symptoms. The carcass was subjected to necropsy. Impression smears from different visceral organs were made. Microbiological isolations were attempted from heart, blood and tissue pieces were collected/fixed from different visceral organs showing lesions for histopathological examination.

Impression smear showed pleomorphic noncapsulated bacillis. Isolation studies confirmed the bacilli to be of *Proteus sp.* as reported earlier[2,3]. Gross pathology showed consolidation of lung,congestion of kidneys/spleen and pale whitish liver with focal haemorrhagic spots. Histopathology revealed focal haemorrhage and severe pneumonic changes characterized by serofibrinous exudation together with mononuclear cell aggregation. These mononuclear cell aggregates were like grape bunches and at places formed giant cells (Fig. 1). The tubular epithelium of kidney showed degeneration/desquamation with haemorrhage, and infiltration of mononuclear cells. The liver showed fatty changes, haemorrhages and isolated areas of coagulative necrosis. Spleen was severely congested. Ulceration, sloughing and necrosis occurred in the tips of intestinal villi. Similar observations were recorded in past. However, earlier workers[1] could not observe giant cells in lungs as was noted in this case. Its etiogenesis could not be properly explained but the organism might have initially produced

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acute septicaemia followed by localization in the lung resulting in chronic lesion and subsequent death due to suffocation.

Fig. 1 Section of lung showing serofibrinous exudate, mononuclear cells and gaint cells. H E x 450

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EXTIRPATION OF EYEBALL IN A HOG DEER *(AXIS PORCINUS)*

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Surgical conditions affecting the eyes in deer are very rarely reported. The present study reports the surgical management of an eye injury in a Hog deer *(Axis Porcinus)*

Case History

A male Hog deer aged about 2½ years received from Trivandrum Zoo and under quarantine for a month, was shifted to the animal moat in a wooden cage. When the animal was introduced in the moat, due to strange environment, it started running aimlessly due to excitement and its left eye was injured.

Clinical Examination

For clinical examination, the animal was sedated using 30 mg of ketamine hydrochlride[3] (@ 1.1 mg/kg) and 20 mg of xylazine hydrochloride[4] (@ 0.74 mg/kg) intramuscularly. After sedation (set in 12 minutes), the animal was examined. Detailed examination revealed that the left eyeball was injured, infected and also infested with maggots. Since the animal showed signs of recovery, an additional dose of 10 mg of xylazine hydrochloride was given intramuscularly to prolong the sedation. The animal was transferred to Zoo Veterinary Hospital for further treatment. The affected eye was irrigated with 1% boric acid lotion. Maggots were removed manually and turpentine gauze was packed. Blood sample was collected for routine examination. The hematological finding were as follows:

1. Hb : 14.8 g/dl
2. PCV : 43%
3. ESR : 4 mm/hour
4. RBC Count : 13.8 X 10^6/cmm
5. WBC Count : 3.8 X 10^3/cmm
6. Differential Leucocytic Count
   a. Neutrophils : 62%
   b. Lymphocytes : 31%
   c. Monocytes : 4%
   d. Eosinophils : 3%
   e. Basophils : Nil

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2. P.G. Student, Department of Surgery, Madras Veterinary College, Madras
3. Ketamil, Troy Laboratories Ltd., Australia
4. Xylazil, Troy Laboratories Ltd., Australia

After two days the animal was again sedated and on examination it was revealed that the eyeball was partially necrosed and hence it was decided to extirpate the eyeball.

Surgical Management

The animal was sedated using 40 mg of ketamine hydrochloride (@ 1.48 mg/kg) and 30 mg of xylazine[5] hydrochloride (@ 1.1 mg/kg) intramuscularly. After sedation (set in 2 minutes), the animal was transferred to the operation theatre. The site was prepared for surgery. Retro bulbar block was made using 3 ml of 2% lignocaine hydrochloride. The extirpation of the eyeball was carriedout in the routine manner. After removing the eyeball, a sterile gauze soaked in povidone-iodine was packed inside the orbit. The skin wound was closed with simple interrupted sutures using 1-0 black silk leaving an opening at the medial end for drainage. The whole operative procedure was completed in 40 minutes. Inj.Yohimbine Hydrochloride[6] -10mg(1ml) was given intramuscularly to reverse the anaesthetic effect of xylazine hydrochloride. After 50 minutes of sedation, the animal showed complete recovery without any side effects.

Post Operative Management

The animal was given inj. strepto penicillin[7] - 1gm-i.m. daily for 7 days and injection B-Complex with liver extract[8]-1ml-i.m. on alternate days. The surgical wound was dressed with povidone iodine gauze on alternate days. Himax[9] ointment was applied over the surgical wound. The cutaneous sutures were removed on the 9th post-operative day and the wound completely healed in 14 days.

Acknowledgement

The authors thank the Director and Deputy Director, Arignar Anna Zoological Park for their encouragement and for the facilities provided. They also thank the Director of Clinics, Tamil Nadu Veterinary and Animal Sciences University, the Professor and Head and the P.G. Students, Department of Surgery, Madras Veterinary College, Madras for the technical assistance.

5. Xylocaine, Astra-IDL limited, Bangalore
6. Antagozil, Troy Laboratories Ltd., Australia
7. Dicrysticin - S. Sarabhai Chemicals, Baroda
8. Belamyl, Sarabhai Chemicals, Baroda
9. Himax. Indian herbs, Bangalore

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EFFICACY OF HERBO STRONG IN DIGESTIVE DISORDERS IN CAPTIVE ASIAN ELEPHANTS

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Simple indigestion being one of the forms of primary indigestion commonly occurs in hand fed/stall fed ruminants because of the variability in quality and quantity of feed consumed (Blood and Radostits, 1989) and sudden change of feed and other environmental influences (Mark 1954). The present study was undertaken to evaluate the efficacy of a herbal preparation-Herbo strong, against simple indigestion and inappetance during convalescence in captive elephants at Arignar Anna Zoological Park, Madras-48.

MATERIALS AND METHODS

Five captive Asian Elephants belonging to Arignar Anna Zoological Park having the problems of simple indigestion and inappetance at various occasions between March and May 1994 were utilised for this study. The affected elephants were treated with 20 gms of *Herbostrong orally twice daily. The details of the cases and duration of treatment are given in the Table-1. During the trial, the elephants were provided usual normal diet and drinking water *ad.lib.* The clinical observations like temperature, respiration rate, pulse rate, defaecation, urination and appetite were recorded regularly before and after treatment. After the course of the treatment, the results were analysed.

* - Herbostrong :- (A Herbal product), Respel Pharma, Banglore.

Table 1

Efficacy of Herbo Strorg in clinical cases of simple indigestion and inappetance in Elephants

S.No.	Age	Sex	History	No. of days Treated	Response to Treatment
1.	33 Years	Female	Stress due to minor Surgery	3	2nd Day
2.	3 Years	Female	Prolonged oral use of Sulpha drugs.	5	4th Day
3.	4 Years	Male	Oral Tetracyline therapy	4	3rd Day
4	3.5 Years	Female	Recovery from gastro intestinal parasitism	3	2nd Day
5.	20 Years	Male	Ingestion of pulses (Horse gram) in excess	3	2nd Day

RESULTS AND DISCUSSION

All the affected elephants returned to normal within 2-4 days with the treatment of Herbostrong. The appetite as well as defaecation (mucous coated pelleting) returned to normal. Temperature, respiration rate and pulse rate ranged between 36-37^{0} C, 6-8/minute and 28-32/minute respectively both before and after treatment. No significent differences were observed in temperature, respiration rate, pulse rate and urination before and after treatment. Similar observations were also made by Misra and Singh (1974); Vashista and Singh (1989) with the use of Himalayan Batisa in domestic animals. The product Herbo strong is available in small dose concentrate with good flavour making it much palatable amd more easier to administer. In comparison to other rumenatorics and digestive tonics no side effects were observed in elephants treated with Herbostrong.

SUMMARY

Herbostrong is efficient, economical, palatable, safe and easy to administer in elephants against simple indigestion and inappetance during convalescence.

ACKNOWLEDGEMENTS

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Short communication

Occurrence and pathology of *Gongylonema* infection in captive wild herbivores

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Abstract

Gongylonema infection in 11 captive wild herbivores out of 214 animals (5.14%) was recorded at post mortem examination. Species of animals affected were spotted deer (6.06%), sambar (7.14%), mouse deer (16.66%), nilgai (11.76%), serow (16.66%) and giraffe (20.0%). The affected areas showed fibrinous inflammation. On scanning electron microscopic study, destruction and disruption of the epithelium were noted, and cuticular bosses originating from the anterior tip of the parasite were observed.

Key words: Gongylonema sp.; Epidemiology-Nematoda; Pathogenicity-Nematoda

1. Introduction

Occurrence of *Gongylonema* infection in captive wild animals has not been reported from India, although its occurrence in domestic animals has been reported (Gupta and Kalia, 1978). In wild animals, its occurrence in white-tailed deer (Prestwood et al., 1970) and in the black bear (Kirkpatrick et al., 1986) has been documented elsewhere. The present communication attempts to note its incidence and pathology in captive wild herbivores.

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2. Materials and Methods

In a study of mortality of capitve wild herbivores of Assam State Zoo from 1985 to 1989, 214 herbivores were necropsied to ascertain the cause of death (Table 1). The various tissues found to be grossly affected with this parasite from the materials for the study. The affected tissues were collected in 10% formal saline solution and processed for routine H.E. staining. For study by scanning electron microscopy (EM) the affected tissues along with the parasite were fixed in 2.5% glutaraldehyde in 0.1 M sodium cacodylate buffer for 4-6 h at 4^0C, washed in cacodylate buffer overnight. post-fixed in 1% osmium tetraoxide for 1 h and dehydrated with increasing concentration of acetone. Samples were dried by immersion in tetramethyl-silane (TMS) for 10 min and air dried at room temperature following the method of Dey *et al.* (1989). The dried samples were used for SEM at the Regional Sophisticated Instrumentation Centre, Shillong.

3. Results and discussion

Out of the total 214 animals examined, 11 animals (5.14%) from six species were found to have *Gongylonema* infection. The species of animals infected and

Table 1
Occurrence of *Gongylonema* in captive wild herbivores

Common and Zoological name	No. of animals examined	No. of animals affected	Rate of occurrence (%)
Spotted deer *(Axis axis)*	33	2	6.06
Barking deer *(Muntiacus Muntiak)*	41	--	--
Sambar *(Cervus unicolor)*	42	3	7.14
Hog deer *(Axis porcinus)*	11	--	--
Thamin deer *(Cervus eldi eldi)*	2	--	--
White fallow deer *(Dama dama)*	3	--	--
Mouse deer *(Tragulus meminna)*	6	1	16.66
Nilgai *(Boselaphus tragocamelus)*	17	2	11.76
Serow *(Capricornis sumatraensis)*	12	2	16.66
Blackbuck *(Antilope cervicapra)*	12	--	--
Ladakhi goat *(Capra ibex)*	3	--	--
Mithun *(Bos frontalis)*	4	--	--
Wild water buffalo *(Bubalus bubalis)*	1	--	--
Giraffe *(Giraffa camelopordalis)*	5	1	20.00
Hippopotamus *(Hippopatamus amphibius)*	3	--	--
Rhinoceros *(Rhinoceros unicornis)*	12	--	--
Zebra *(Equus zebra)*	4	--	--
Asiatic elephant *(Elephas maximus)*	3	--	--
Total	**214**	**11**	

the rate of occurrence are presented in Table 1. The parasite in giraffe and nilgai was identified as *Gongylonema pulchrum*. However, species identification in other animals was not carried out.

In eight cases, 3-15 parastites were noticed in the mucosa of oesophagus, cheek and base of the tongue. The parasites were loosely buried at the affected part. However, in one giraffe, three parasites were found deeply buried in the anterior part of the tongue and, on one occasion, one was found loosely attached on the serosal surface of the abomasum of a mouse deer. In a spotted deer several hundreds of parasites were seen throughout the oesophagus. In the mucosa of the oesophagus few parasites were buried, and some were coiled with other parasites and were soiled with fibrinous flakes and debris.

Microscopically, in the affected tissue, the parasites were found embedded in the epithelium, which showed a slight inflammatory reaction. Mild lymphocytic and eosinophilic aggregation together with hypertrophy and cornification of the epithelium were also noted (Fig.1). Sloughing of the epithelium and fibrinous inflammation were marked in the severely affected spotted deer. In the tongue of a giraffe, the parasite was found to penetrate deep into the muscularis layer without any significant pathological changes.

The parasite in the affected tissue was studied by SEM (Fig.2). The affected tissue showed marked distortion and disruption, together with clumping of the epithelial cells. Destruction of mucosa and clumping of cells were greater in the areas where parasites entered the tissue. An attempt was made to study the anterior part of the parasite by SEM, and cuticular bosses were seen in rows originating part of the parasite by SEM, and cuticular bosses were seen in rows originating from the anterior tip of the parasite. On higher magnification, these bodies were seen as ovoid structures with no uniformity in size (Fig.3). The parasites have cuticular transverse striation throughout the body (Fig.4). However, a detailed SEM study of the parasite was not undertaken.

Fig.1. *Gongylonema* infection in the oesophagus of a spotted deer. Note cut section of parasite with hypertrophy and cornification of epithelium H & E x 70

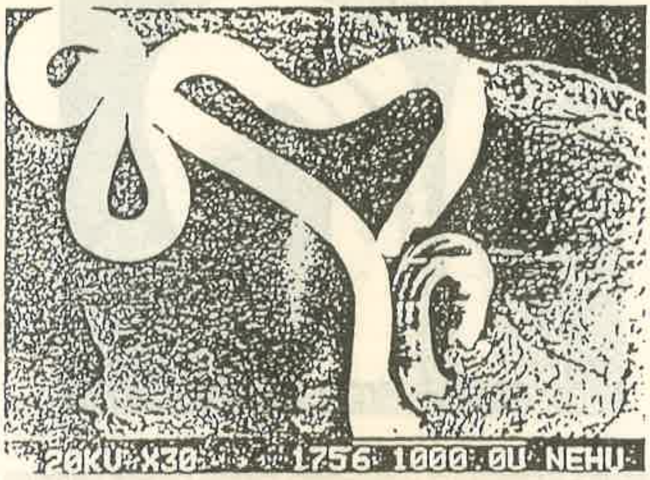

Fig.2. Scanning electron micrograph of *Gongylonema* in the oesophagus of a spotted deer. Note that both ends of the parasite are embedded in the tissue.

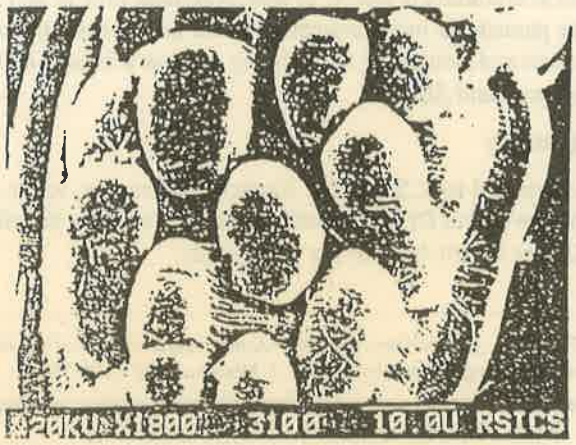

Fig.3. Scanning electron micrograph, showing the cuticular bosses.

It has been reported that all ruminants including wild species are susceptible to this parasite (Soulsby, 1965; Levine, 1968), and the involvement of six species of wild herbivores recorded in this study is worthy of note. Although Jubb *et al.* (1985) stated that the presence of the parasite is inconsequential to the host, heavy infection may cause fibrinous inflammation and sloughting of the lining cells, as was seen in the present study both by light microscopy and SEM.

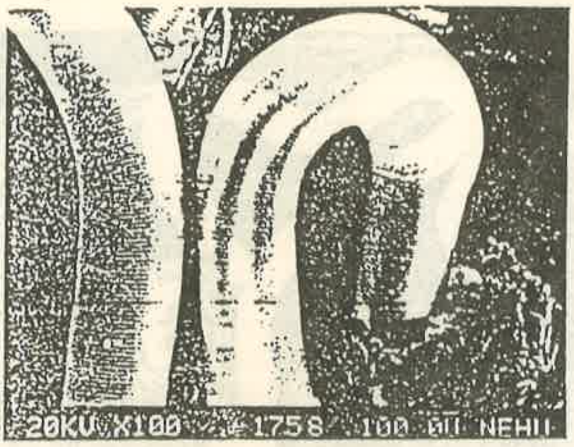

Fig.4. Scanning electron micrograph of *Gongylonema*, showing cuticular transverse striation throughout the body.

It has been reported that all ruminants including wild species are susceptible to this parasite (Soulsby, 1965; Levine, 1968), and the involvement of six species of wild herbivores recorded in this study is worthy of note. Although Jubb *et al.* (1985) stated that the presence of the parasite is inconsequential to the host, heavy infection may cause fibrinous inflammation and sloughting of the lining cells, as was seen in the present study both by light microscopy and SEM.

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Parasites of rhinoceros (*Rhinoceros unicornis*)

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Received : 19 May 1994

This communication reports on different parasites of rhinoceros recorded at necropsy.

During 1985 to 1989 at the State Zoo, Assam, 12 rhinoceroses died. These were necropsied to ascertain the cause of death. The alimentary tract and other internal organs were examined carefully to detect the parasites. The parasites were studied as per the standard procedure. In addition, pieces of various tissue samples were processed for histopathological examination to have the presence of parasites in microsection.

We recorded nematodes *Kiluluma goodeyi*, 1; *Chabertia* sp. 1; *Necator ammericans*, 3; *Bunostomum* sp. 2, trematodes (*Paramphistomum* sp.1), cestodes (*Anoplocephala* sp.7, Hydatid cyst 1), and protozoa (*Balantidium coli*).

Nematodes accounted for high infection. Hook worms like *Necator* and *Bunostomum* as reported earlier (Chakraborty and Islam 1993) were common. The details of 3 unidentified amphistomes need to be studied further. Anophocephalid infection was predominent. It corresponded with the findings of Jones (1979). *Anoplocephala* was found within the biliary system in 5 animals besides to the gastrointestinal tract. The occurrence of hydatid cyst in the liver of a rhinoceros also indicated its role as an intermediate host of *Echinococcus*. The

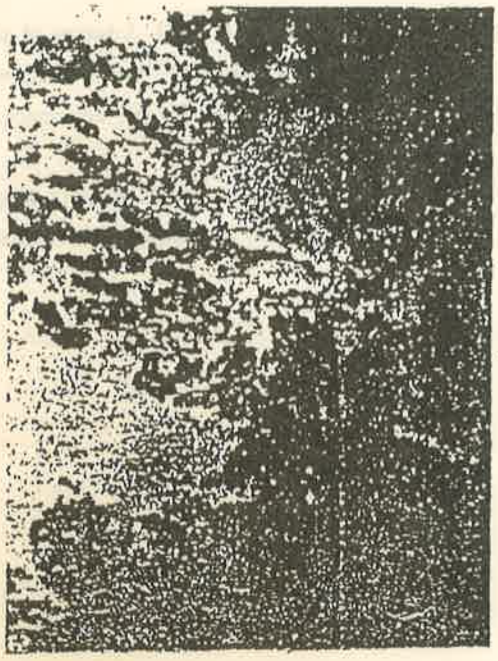

Fig.1. Trophozoites of *Balantidium coli* in intestine H. & E. x 70

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possible explanation is the maintenance of sylvatic cycle in the wild animals. Trophozoites of *Balantidium coli* were observed in the tissue section of intestine (Fig.1). These corresponded the finding of Power and Price (1967).

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PREVALENCE OF PARASITIC INFECTION IN CAPTIVE WILD HERBIVORES IN A ZOO IN ASSAM, INDIA

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ABSTRACT

Parasites found at post mortem in 214 animals of 3 orders captive wild herbivores of Assam State Zoo from 1985 to 1989 were studied. The different nematodes recorded were *Haemonchus, Ascaris, Gongylonema, Trichostrongylus, Oesophagstomum, Setaria, Dictyophyma, Cooperia, Onchocerca, Trichuris, Kululima, Chabertia, Necator, Bunostomum, Dictyocaulus, Harbronema, Chonigium, Grammacephalus and the trematodes were Fasciola, Paramphistomum, Gastrothylax, Fischoederius, Carmyerius, Cotylophoron, Gigantocotyle, Homologaster, Pseudodiscus, Pfenderius and Brumphtica*. The cestode parasites found in the study were *Moneizia, Anoplocephala, Hydatid* cyst and *Cysticerus*. In addition to these, protozoa such as *Sarcocystis, Emeria, Balantidium coli* and ectoparasite like *Boophilus microplus, Gasterophilus intestinalis* and *Cobbaldia elephantis* were recorded during the study.

Introduction

There are only sporadic reports of parasitic infections in different zoo animals in India (Chauhan *et al.*, 1973; Gaur *et al.*, 1979; Khan, 1979), but a systematic study in these animals is lacking. We report the prevalence of various parasites at post mortem in the captive wild herbivores of Assam State Zoo, India.

Materials and methods

214 captive wild herbivores of Assam State Zoo from 1985 to 1989 were necropsied to ascertain the cause of death. In post mortem examination, the alimentary tract and other internal organs including aorta were examined for presence of parasites. Blood smears from the heart of the carcasses stained with Giemsa were also examined for the presence of blood parasites. Pieces of tissue samples were preserved in 10% formol-saline solution for histopathological study to note the presence of parasite in the tissue sections.

Results and discussion

Parasites found in animals of order Artiodactyla and animals of Perrisodactyla and Proboscidea have been presented in Table 1 and 2, respectively.

Among nematodes recorded in our study, *Trichuris, Haemonchus, Strongylus, Oesophagstomum* and *Onchocerca* were reported earlier by Patnaik (1964), Khan (1979) and Acharjyo and Rao (1987), respectively. We did not find a reference to the presence of *Gongylonema, Cooperia* and *Setaria* in wild herbivores. In the present study a 4th stage *Dictyophyma* larva was found in the kidney of a black buck, this is apparently the first *Dictyophyma* infection in a black buck. *Trichurias* and *Ascaris* in giraffe have also been recorded by Dagg and Foster (1976).

Among trematodes, prevalence of *Paramphistomum* was the highest. *Fasciola gigantica* infection was seen only in spotted deer of the Cervidae family which support the findings of Rao and Acharjyo (1972), however, *F. gigantica* in other animals of Bovidae family were noticed. Prevalence of *Gastrothylax, Cotylophoron, Carmyerius, Fischoederius, Gigantocotyle* and *Homologaster* were low and were recorded earlier by Patnaik (1964), Patnaik and Acharjyo (1970), Chauhan *et al.* (1970), Chauhan *et al.* (1970), Agrawal and Ahluwalia (1980) and Padhi *et al.* (1987).

Among cestodes, the prevalence of *Cysticerus* was highest as reported earlier by Khan (1979).

Among the Perrisodactyla, only two species of animals viz., rhinoceros and zebra were studied. In rhinoceros four species of nematode parasites such as *Kililuma goodeyi, Chabertia, Necator americans* and *Bunostomum* were noticed in the study and of these the last three were documented by Silberman and Fuloton (1979).

Of the trematodes - *Paramphistomum* and two unidentified conical flukes were recorded in rhinoceros in the study. Reports of fluke infection in rhinoceros was not available in the literature.

Among cestodes, *Anoplocephala* was found to be the commonst parasite of rhinoceros. In the present study, *Anoplocephala* was found in the bile duct of 4 animals in addition to the small intestine. A hydatid cyst in the liver of a rhinoceros was noticed in the study which has not been reported earlier.

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Table 1. Parasites recovered at post mortem in animals of the order : Artiodactyla

Parasites		Family - Cervidae				Family-Traguli-dae	Family - Bovidae						Family-Giraffi-dae	Total
		Spotted deer (33)*	Barking deer (41)	Sambar (42)	Hog deer (11)	Mouse deer (6)	Black buck (12)	Nilgai (17)	Serow (12)	Ladhakhi goat (3)	Mithun (4)	Water buffalo (1)	Giratee (5)	
Nematode :	*Haemonchus*	-	3**	-	-	-	3	-	3	1	-	-	-	[illegible]
	Ascaris	-	-	-	-	-	-	-	-	-	-	-	2	[illegible]
	Gongylonema	2	-	3	-	1	-	2	2	-	-	-	1	11
	Trichostrongylus	-	1	-	-	-	-	-	-	-	-	-	-	1
	Setaria	-	2	2	-	-	-	-	-	-	-	-	-	4
	Oesophagostomum	-	-	-	-	1	-	-	-	-	-	1	-	[illegible]
	Dictyophyma	-	-	-	-	-	1	-	-	-	1	-	-	[illegible]
	Cooperia	-	-	-	-	-	-	1	-	-	-	-	-	1
	Onchocerca	3	-	1	-	-	1	1	-	-	1	-	-	7
	Trichuris	-	-	-	-	1	3	-	5	-	1	1	4	15
Trematode :	*Fasciola gigantica*	18	-	-	-	-	-	-	1	-	1	1	-	21
	Paramphistomum	26	21	31	5	2	4	3	5	2	2	1	-	[illegible]
	Gastrothylax	3	-	5	-	-	-	-	-	-	1	-	-	9
	Fischoederius	18	8	9	3	-	-	-	-	-	1	1	-	40
	Carmyerius	-	-	-	-	-	1	-	-	-	1	-	-	[illegible]
	Cotylophoron	3	-	-	-	-	-	-	-	-	-	-	-	[illegible]
	Gigantocotyle	-	-	1	-	-	-	-	-	-	-	1	-	[illegible]
	Homologaster	-	-	-	-	-	-	-	-	-	-	1	-	1
Cestode :	*Moneizia*	-	-	-	-	-	-	-	3	1	-	-	-	4
	Hydatid cyst	1	-	-	-	-	-	-	-	1	-	-	11	3
	Cysticercus	2	1	2	-	-	1	1	-	-	-	-	-	7
Protozoa :	*Sarcocystis*	5	2	2	-	1	-	2	1	-	1	-	-	14
	Emeria	2	2	-	-	-	-	1	2	-	1	-	-	8
	Balantidium coli	-	-	-	-	-	-	-	-	-	-	-	1	1
Tick :	*Boophilus microplus*	-	-	-	-	-	-	-	-	-	1	-	-	1

*Figures indicate animal examined.
**Figures indicate animal positive.

TABLE 2. PARASITES RECOVERED AT POST MORTEM IN ANIMALS OF THE ORDER PERRISODACTYLA AND PROBOSCIDEA

	Parasites	Perrisodactyla		Proboscidea	Total
		Rhinocerotidae	Equidae	Elephantidae	
		Rhinoceros (12)*	Zebra (4)	Elephant (3)	
Nematodes :	Killiluma Goodeyi	1**	-	-	1
	Chabertia	1	-	-	1
	Necator americanas	3	-	-	3
	Bunostomum	2	-	-	2
	Dictyocaulus arnfieldi	-	2	-	2
	Habronema	-	1	-	1
	Choniagium	-	-	2	2
	Grammocephalus hybridus	-	-	2	2
Trematodes :	Paramphistomum	2	-	-	2
	Unidentified conical fluke	2	-	-	2
	Pseudodiscus	-	-	1	1
	Pfenderius	-	-	1	1
	Brumptica	-	-	1	1
	Easciola Jacksoni	-	-	2	2
Cestode :	Anoplocephala	7	-	-	7
	Hydatid cyst	1	-	-	1
Protozoa :	Balantidium coli	-	-	-	1
Ectoparasite :	Gastophilus intestinalis	-	1	-	1
	Cobbaldia elephantis	-	-	1	1

* Figures indicate member of animal examined.

** Figures indicate number of animal positive.

Balantidium coli infection was also noticed in histopathological study of intestine of one rhinoceros which was also noticed by Reddy *et al.* (1984).

The nematode parasite *Dictyocaulus arnfieldi* and *Habronema* which were recorded in zebra of the present study, were earlier reported by Dooley and King (1977) and Krecek *et al.* (1987). In addition few larva of *Gasterophilus intestinalis* was also noticed in a zebra.

Among Proboscidea, three elephants were examined where nematode parasite such as *Choniagium* and *Grammocephalus hybridus* and trematode viz., *Pscudodiseus, Pfenderius, Brumptica* and *Fasciola jacksoni* could be recorded. Prevalence of these parasites were also recorded by Pillary *et al.* (1976) and Singh (1988). Larva of *Cobbaldia elephantis* was also recorded in one animal.

During the study, heart blood smear of 116 animals were screened for the presence of blood parasite and the study revealed microfilaria in two barking deer only.

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A survey of gastrointestinal parasitic infection in free-living rhinoceros of the Kaziranga National Park

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Incidence of parasitic infection of captive rhinoceros have been recorded (Silberman and Fulton 1979, Fowler 1986). However, information on it in free-living rhinoceros is meagre. The present work provides information on parasitic fauna in the free-living rhinoceros at the Kaziranga National Park, Assam.

A total of 84 fresh faecal samples, voided at different dung heaps by individual rhinoceros were collected seperately in sterile polythene bags from 11 different forest ranges of the park during January 1990. The forest ranges were- Mihimukh, Kathpura, Satibeel, Tantibeel, Diphulu, Bagari, Bimoli, Raumari tower, Amkathani, Borbeel and Baruntika. The faecal samples were collected at random. The samples were brought to the laboratory and were examined both by sedimentation and floatation techniques as per standard method.

Of the 84 samples examined, 52 samples were positive for different parasitic infection, the percentage of infection being 61.90 (Table 1).

The different parasites recorded were of the genera *Paramphistomum* (39), *Strongyle* (17), *Coccidia* (3) and *Anoplocehala* (2).

Two different types of helminthic infections were recorded. In these the load in infection ranged from light to heavy in *Paramphistomum* (46.42%). In *Strongyle*, (20.23%) it was light to moderate. *Coccidia* and *Anoplocephalid* eggs were recorded in 3.57 and 2.38% samples respectively.

Strongyle infection has been documented by, Silberman and Fulton (1979) and Chakroborty (1991), but the *Paramphistomum* infection in rhinoceros was scantiy. Chakraborty (1991) recorded *Paramphistomum* sp. and 2 other varieties of unidentified conical flukes in the small intestine, and *Anoplocephala* species in intestine and bile-duct. *Anoplocephalid* eggs in rhinoceros were recorded by Chauhan *et al.* (1973). Jones (1979) and Chakraborty (1991) reported it to be a common parasite of rhinoceros.

The dung samples examined from the different ranges of Kaziranga National Park were limited in number to derive any conclusion about the incidence of parasitic infection in different ranges of the park. However, it can be speculated that parasitic infection towards the western side was higher than the eastern side. It might be because the western part of the park is a low lying area. During flood, snails and other intermediate hosts are washed away from the eastern side to the western part and the area becomes more endemic for parasitic infection.

Further extensive survey in different ranges of Kaziranga National Park, involving a large number of animals on seasonal basis, is essential to understand the implication of parasitism in free living rhinoceros.

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Table 1. Prevalence of parasitic infection in free-living rhinoceros in different ranges of Kaziranga National Park on the basis of faecal examination

Forest range	Number of animal examined	Number of animal affected	Ova of parasite
Mihimukh	40	28	*Paramphistomum* (21) *strongyle* (9) *coccidia* (2)
Kathpura	10	4	*Paramphistomum* (3) *strongyle* (1)
Sutibeel	2	1	*strongyle* (1)
Tátibeel	2	2	*Anoplocephala* (2)
Diphalu	2	1	*Paramphistomum* (2)
Bagori	8	8	*Paramphistomum* (1) *Paramphistomum* (6) *strongyle* (4) *coccidia* (1)
Bimoli	2	1	*Paramphistomum* (1)
Rowmari Tower	4	1	*Parmphistomum* (1)
Amkathani	3	2	*Paramphistomum* (1) *strongyle* (1)
Barbeel	6	2	*Paramphistomum* (1) *strongyle* (1)
Baruntika	5	2	*Paramphistomum* (2)
	84	52	

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TRAUMATIC RETICULO-PERICARDITIS IN A SEROW *(Capricornis sumatraensis)*

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In a five years study of mortality of captive wild herbivores in the Assam State zoo, 12 serows were necropsied to ascertain the cause of death. In the study, at post-mortem examination of an adult female serow, the pericardial sac was found distended to a diameter of 12 cm with about 300 ml thick cloudy fluid. Fibrinous adhesions connects the pericardial sac to the costal pleura and in the epicardial surface, fibrinous flakes were noticed. Corresponding compression of the lungs caudally and dorsally by the heart was evident. On close observations, the diaphragm and reticulum were found to be pierced by a 8 cm long rusted bent wires of goat proof fenching in the anterio-ventral wall of the reticulum. Adhesions of the reticulum with the diaphragm was also noted. Considerable number of *Haemonchus contortus* and *Moniezia expansa* were also recorded in the abomasum and small intestine respectively. Other abnormalities were not recorded.

Traumatic reticulo-pericarditis occurs commonly in cattle (Blood *et al.*, 1983), occasionally in small ruminants (Sharma, 1971), and its occurrence in a mule deer was reported by Forcyt and Leathers (1986). Though such condition is rare, due to fastidious feeding habit of deer (Forcyt and Leathers, 1986), the serow under report might have picked up the wire accidently along with the grass, perhaps, from its enclosure. The metalic wire caused perforation of reticulum, diaphragm and pericardium, resulting in severe inflamation and eventual death of the animal.

This case is of special interest as the serow are also fastidious in their feeding habit and the occurrence of the condition is not yet recorded.

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ESCHERICHIA COLI SEROTYPES IN CAPTIVE HERBIVOROUS ANIMALS

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The prevalence of *Escherichia coli* (*E. coli*) serotypes in captive herbivorous animals, having different pathological conditions, of the Assam State Zoo, Guwahati was studied. A total of 24 animals belonging to 11 different species died with different disease conditions during the period of 1988-1991. The species of the animals were spotted deer, barking deer, sambar, mouse deer, black buck, nilgai, serow, giraffe, elephant, rhinoceros and zebra. Twenty eight different specimens from these animals were collected aseptically at the time of post mortem (Table). The samples were brought immediately to the laboratory and processed for isolation of the bacteria. The methods of Edwards and Ewing (1972) were followed to isolate and identify the *E. coli* strains. The isolated *E. coli* strains were sent to the National Salmonella and Escherichia Centre, Kasauli, H.P. for serotyping.

All the 28 specimens examined were found positive for the bacteria. Of the 28 strains of *E. coli*, 19 strains were typable and belonged to 16 different serotypes. Six strains were untypable and the remaining 3 strains were rough. The distribution pattern of the *E. coli* serotypes in different species of the animals is shown in Table.

The study revealed the involvement of different *E. coli* serotypes with similar type of pathological conditions of different species of animals. *E. coli* serotype 037 could be isolated from the intestinal content of two barking deer having the pathological conditions of enteritis and diarrhoea, while serotype 017 and 08 could be isolated respectively from the intestinal content of a black buck and a nilgai showing the symptoms of diarrhoea. The present finding suggests that different *E. coli* serotypes may have enterotoxic activity and are associated with the cause of diarrhoea. Likewise different *E. coli* serotypes were isolated from the lung and heart blood samples of animals showing similar pathological condition (Table). This

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Table. *Escherichia coli* serotypes in captive herbivores

Animal	No. of animals	Nature of sample tested	E. coli Serotype
Spotted deer'	4	i. Pus swab from liver	097
		ii. Lung	060
		iii. Intestinal content	Untypable
		iv. Lung	05
Barking deer	4	i. Intestinal content	074
		ii. Lung	04
		iii. Intestinal content	037
		iv. Intestinal content	037
Sambar	4	i. Swab from the back wound	0154
		ii. Swab from the cervical region wound	017
		iii. Duodenal content	07
		iv. Intestinal content	Untypable
Mouse deer	2	i. Intestinal content	Rough strain
		ii. Intestinal content	Untypable
Black buck	2	i. Swab from wound	0133
		ii. Intestinal content	017
Nilgai	2	i. Intestinal content	08
		ii. Intestinal content	Untypable
Serow	1	i. Intestinal content	Rough strain
Giraffe	1	i. Heart blood	Rough strain
Elephant	1	i. Intestinal content	08
Rhinoceros	3	i. Heart blood, lung and intenstinal content	Untypable 0163 and 043
		ii. Heart blood	09
		iii. Heart blood	018
Zebra	1	i. Heart blood	0156

finding also attributes to the enteroinvasive nature of different *E. coli* serotypes. Interesting finding in the present study is the isolation of different *E. coli* serotypes from three different clinical samples of a rhinoceros. This is possibly due to the existence of different *E. coli* serotypes in the intestinal tract of the animal and enteroinvasive strains depending upon their site of predilection localized in different organs and cause pathological condition.

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PERACUTE MORTALITY IN A GIRAFFE

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In a study of mortality of captive wild herbivores in the Assam State Zoo a case of peracute mortality (0.46%) has been recorded.

The sub-adult male giraffe died suddenly without any symptoms in the night, although in the previous morning, the animal had its feed and was in perfectly normal condition. On necropsy, nothing abnormal, except paleness, was detected in all organs. However, mild degree of pneumonia was noticed. The rumen was full, indicating good appetite of the animal.

Bacteriological, virological and toxicological studies were negative and the histopathological study also could not reveal the cause of mortality... A detailed histopathological study of all the organs were done and microscopically, mild haemorrhages in the heart and kidney was noted. Mild degree of degenerative changes in the liver was evident and lung showed pneumonia and edema. No significant change could be noticed in other organs like pancreas, adrenal gland and in brain.

Dagg and Foster (1976) reported death of a giraffe peracutely when its hooves were trimmed, and in another occasion, one died suddenly when a sheep was introduced into its pen. They further reported death during thunderstorms and due to fright by a bomb explosion that occurred nearby. The authors stated that shock and heart failure were frequently mentioned as a cause of mortality of captive giraffes. Fowler (1978) has also experiences of losing three giraffes in Sacramento Zoo within 9 days without any apparent cause. In his intensive study and enquiries at other zoos with giraffe collection, he elicited the information that unexplained mortality is not a rare occurrence in captive giraffe in zoos and concluded that peracute mortality in giraffe is not uncommon. In the present case a clue was that in the night of death, there was a storm and heavy rain and hence it was diagnosed as a cause of peracute mortality as observed by Dagg and Foster (*Loc.cit*) and Fowler (*Loc.cit*). It may be concluded, as per Fowler (*Loc.cit*), that the immediate cause of peracute mortality is likely to be hypovolemic shock or cholenergic bradycardia. Giraffes are highly susceptible to stress and so efforts should be made to minimize stress in every aspect of giraffe care. In India, peracute mortality in giraffe has not been reported so far.

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PSEUDOTUBERCULOSIS IN A BLACK BUCK (*ANTILOPE CERVICAPRA*)

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A 6 -year- old male black of Assam State Zoo, showed enlargement of testicles from which pus was drained off for about two months. Following the death of the animal, it was brought to the Department of Pathology, College of Veterinary Science, Khanapara, Guwahati, for detailed post mortem examination. At post-mortem examination, grossly, it revealed enlargement of scrotum with a fistula through which pus was coming out (Fig.1). Both the testicles were adhered with the tunica vaginalis forming cavities which were filled with creamy pus. Cut surface of the testicles showed onion like concentrically laminated fibrous layers and between the fibrous layers caseated pus was deposited (Fig.2). In the lungs fibrinous adhesions of visceral and parietal pleurae were noticed. The cut surface of the lung showed numerous small whitish isolated foci through out. Similar lesions were also found in the kidneys. Inguinal, bronchial and mediastinal lymph nodes were enlarged and revealed caseated abscesses. Swab samples from the cut surface of the testicles and pieces of organ sample from lung, kidney and lymph node were collected for isolation of bacteria. Samples from all the organs including lymphnodes wre also collected in 10 percent formal-saline solution for histopathological study. All the samples were culturally positive for bacteria and identified as *Corynebacterium ovis* on the basis of morphology, staining and biochemical tests (Cruickshank *et al.*,1975).

Histopathologically, all the affected organs revealed almost similar changes except the testes, where central caseation and calcification were noted. Hyperplasia of epithelium and lymphopcytic infiltration in the tunica vaginalis were noted. In other organs the lesions were characterised by caseative necrosis surrounded by lymphocytes, epitheliod cells, macrophages interspersed with neutrophils. The areas were encapsulated by fibrous connectiove tissue of various thickness. Gram positive coccobacilli morphologically indistinguishable from corynebacterium were demonstrated in sections of lung, kidney and testicle by Brown and Brenn method (Luna, 1968). On scanning electron microscopic study, the lung showed few homogenous area and clumping of cells near the necrotic foci (Fig.3) along with few coccobacillary organism.

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Pseudotuberculosis in a black buck

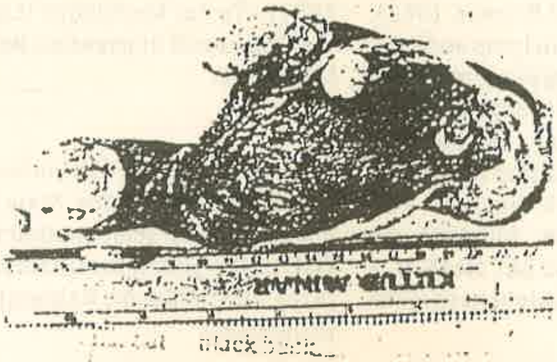

Fig.1 Enlargement of testicle. Note drainage of pus through a fistula

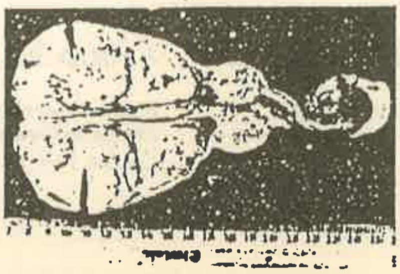

Fig.2 Cut surface of the testicle showing concentrically laminated pus

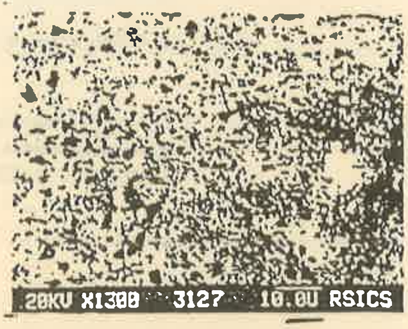

Fig.3 SEM photograph of lung showing few homogenous area and clumping of cells near the necrotic foci along with coccobacillary organism

Pseudotuberculosis has been reported in white tailed deer, fallow deer and mule deer (Clark *et al.*, 1972; Stauber *et al.*, 1973, and Wallach and Boever, 1983). The lesions recorded were in lymp node and other visceral organs of these animals, but the lesions in testes of wild animals have not been reported so far. Isolation of *Corynebacterium ovis* and histopathological study suggest that black buck is also susceptible to this infection. Although, the exact route of infection is not clear, it is assumed that the infection might have taken place through scrotal injury and then spread to other organs. Similar views in sheep, have been suggested (Lalkrishna *et al.*, 1977). To our knowledge it appears to be the first report of pseudotuberculosis in a black buck.

Acknowledgement: The authors are greatful to the authority of the State Zoo for the material and the senior author is thankful to CSIR, New Delhi, for financial assistance in the form of Senior Research Fellowship to the study.

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Journal of Veterinary Parasitology 6(2) 1992: 37-40

SHORT COMMUNICATION

TRICHURIS SP. INFECTION IN WILD CAPTIVE HERBIVORES

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ABSTRACT

Chakraborty, A. 1992. *Trichuris* sp. infection in captive wild herbivores. J.Vet. Parasitol. 6(2): 37-40

Incidence of *Trichuris* sp. infection in captive wild herbivores *viz.,* mouse deer, black buck, serow, mithun and giraffe, examined at post-mortem, was 4.67 per cent. The gross and microscopic pathology and SEM study of the affected tissue alongwith the parasites have been described. Also SEM study of the hind part of a male *T. giraffae* was undertaken.

INTRODUCTION

Incidence of trichurid infection in captive wild herbivores was reported in black buck (Patnaik,1964), nilgai and spotted deer, (Chauhan *et al.*,1973) and giraffe (Dagg and Foster, 1976; Khan, 1979). However, information on the pathological changes caused by *Trichuris* sp. in these animals is meagre. The present investigation aims to study the pathology of this infection in some of the captive wild herbivores.

MATERIALS AND METHODS

During the period from 1985 to 1989, *Trichuris* sp. infected patches of large intestine showing lesions were collected at post-mortem examination of 214 captive wild herbivores of Assam State Zoo for the present study. The affected tissue were collected in 10 per cent formol-saline solution and processed for routine haematoxylin and eosin staining. For scanning electron microscopic (SEM) study, the affected tissue along with the parasites were fixed in 2.5 per cent glutaraldehyde in 0.1M sodium cacodylate buffer for 4-6 hours at 4°C, washed in cacodylate buffer overnight, and fixed in 1 per cent osmium tetraoxide for 1 hour and were dehydrated through increasing concentration of acetone. samples were dried by immersing in tetramethyl saline (TMS) for 10 minutes and air-dried at room temperature following the method of Dey *et al.* (1989). The dried samples were utilised for SEM at Regional Sophisticated Instrumentation Centre, Shillong.

RESULTS AND DISCUSSION

Ten (4.67%) animals of six different species were found to have the trichurid infection in the present study. The animals affected were mouse deer *(Tragulus*

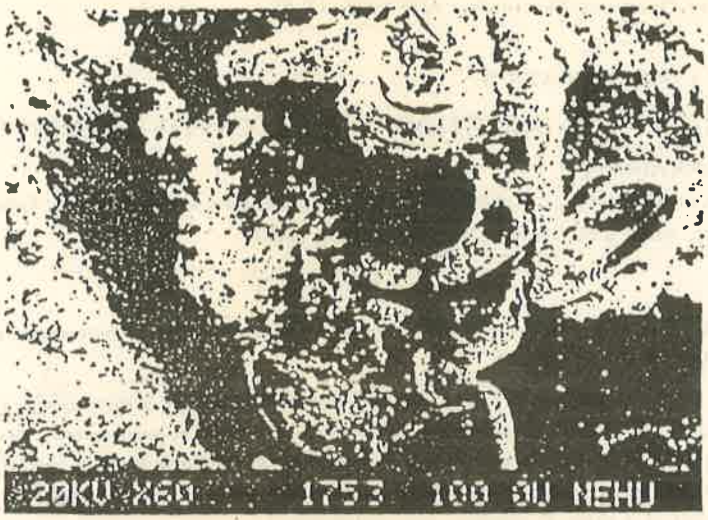

Fig. 1: SEM photograph showing distortion and disruption of the mucos of large intestine of giraffe. Note tunnel formation in the affected area. (X 60

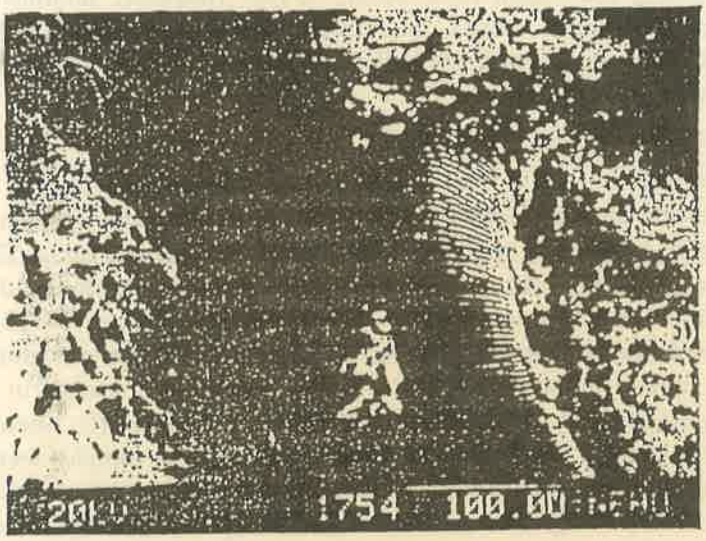

Fig. 2: Higher magnification of Fig. 1. SEM (X 260).

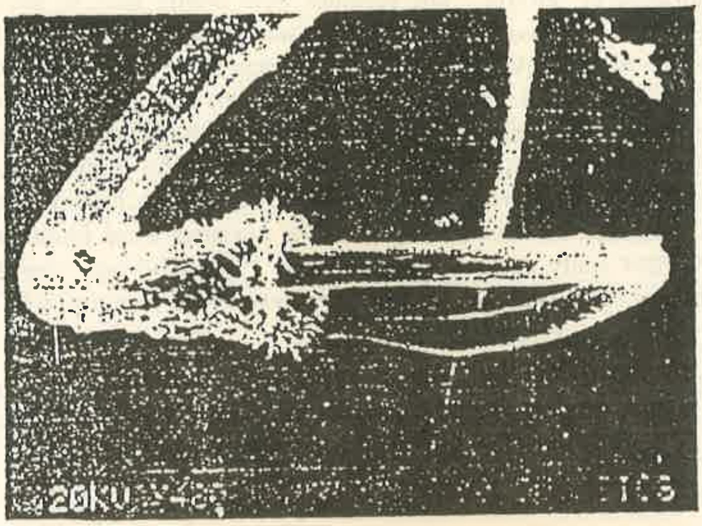

Fig. 3: Note spicule and the spicule sheath of *T. giraffae*. SEM (X 480).

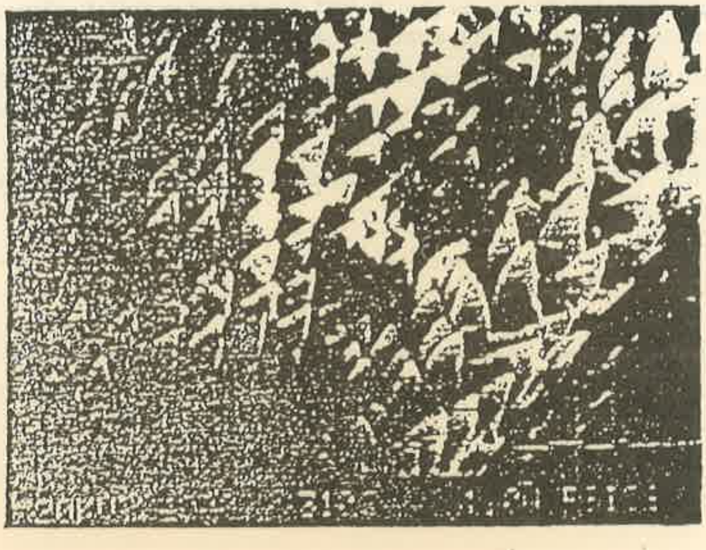

Fig. 4: Higher magnification of spicule sheath of *T. giraffae*. Note presence of spines in the sheath. SEM (X 4000).

meminna) 1, black buck (*Antilope cervicapra*) 3, serow (*Capricornis sumatraensis*) 2, mithun (*Bos frontalis*) 1, and giraffe (*Giraffa cameloporde lis*) 3. The parasites were identified as *T. cervicapra* in black buck and serow, *T. ovis* in mithun and *T. giraffae* in giraffe. The parasites were mostly seen in the caecum and colon. However, in severe infection the parasites were also noted in the small intestine of a black buck and two were also noted in the small intestine of a black buck and two giraffe. Excessive secretion of mucus in heavily infected cases was the important gross finding. Catarrhal typhlocolitis with haemorrhages and sloughing of mucosa were the microscopic changes observed in these cases. On SEM study, marked destruction and distortion of tissue leading to the formation of tunnels were well marked in which the part of the parasites were found burried (Fig. 1&2). A SEM study of hind end of a male *T. giraffae* was also attempted in which the cuticular spines on the spicule sheath were demonstrated (Fig. 3&4).

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CAPTURE MYOPATHY IN WILDLIFE: PATHOMORPHOLOGICAL AND HISTOENZYMIC STUDIES

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SUMMARY

The study was designed to elucidate and correlate histopathological and histoenzymic alterations in capture myopathy in wildlife (spotted deer, mouse deer, barking deer and one-horned rhinoceros). Histopathology showed haemorrhage and disruption, hyalinization and loss of striations in cardiac and skeletal muscles. In chronic cases oedema was also noted. Histoenzymic study exhibited the evidence of alkaline phosphatase, adenosine-triphosphatase and dehydrogenases in these lesions. X-ray micronalysis indicated the distribution of various elements in cardiac muscles.

Key words:Wildlife, capture myopathy, histopathology, histoenzymic study.

INTRODUCTION

Capture myopathy also known as straining disease is primarily a disease of recently captured wildlife in which the muscles are mainly affected[2]. The condition has been extensively studied abroad[3]. In the present study attempts have been made to correlate the histopathological changes with histoenzymic and X-ray microanalytical findings in affected muscles.

MATERIALS AND METHODS

Fourteen stressed and one unstressed (say control) animals of the same species which died due to ailment unassociated with capture myopathy belonging to the State Zoo, Guwahati, Assam were utilised in the present study. The history, clinical signs/symptoms, necropsy findings, histopathological observations and comparative X-ray microanalysis were taken into consideration while confirming the diagnosis of capture myopathy.

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Necropsy of all the animals was conducted and gross lesions were recorded. As muscles are primarily involved, pieces of skeletal and cardiac muscles of all the 14 affected and control animals were collected in 10% neutral buffered formalin and routinely processed for histopathological studies. Unfixed cryosections of muscles of both the affected and control animals were utilised to demonstrate alkaline phosphatase (AK pase), calcium activated myoadenosine-tri-phosphatse (MAT pase), succinate (SDH), malate (MDH) and lactate (LDH) - dehydrogenases by standard methods[2,9]. For comparative X-ray microanalysis, pieces of cardiac muscle of affected and control deer were air dried and coated with carbon for X-ray microanalysis by Energy Dispersive X-ray microanalyzer - Link (EDAX) through a scanning electron microscope (JEDL)

RESULTS AND DISCUSSION

All the 14 "affected" animals were having the history of recent capture. The details are an follows:

Table - 1 : Details of animals suffering from capture myopathy

Different species with no.	Mode of capture	Period of captivity before death
Spotted deer *(Axis axis)* - 4	Manually captured in Zoo with struggling	1-2 days
Barking deer *(Muntiacus muntiacus)* - 4	- do -	1-3 days
Mouse deer *(Tragulus meminna)* - 4	Mannually captured in Jungle and transported to Zoo	7-30 days
Rhinoceros *(Rhinoceros unicornis)* - 2	- do -	4-7 days

On necropsy, haemorrhage in different parts of the body, particularly on heart was seen alongwith patchy pneumonic areas in different lobes of the lungs. Cut surfaces of cardiac and skeletal muscles exhibited variable sized foci of white streaks. Histopathology confirmed the gross lesions of haemorhage. In addition disruption, hyalinization and loss of striaitions could be observed in the muscle fibres and presence of oedema in the skeletal muscles in chronic cases. There changes supported earlier observations[1,6,7,11]

The histoenzymic localization of different enzymes in these lesions are presented in table - 2. In cardiac muscle, moderate to strong MAT pase activity was concentrated in periphery of muscle fibres, leaving the central area free. However, the enzymic activity in control cardiac muscle was diffusely distributed, showing a homogenous pattern. The MAT pase activity was stronger in affected skeletal muscle than in affected cardiac muscle, and even more so in the blood vessels. In comparison, MAT pase activity was relatively stronger in unaffected cardiac and skeletal muscle fibres than the affected ones. AKpase activity in the lesions was not appreciable. As regards the activity of dehydrogenases, SDH, MDH and LDH were found in the lesions. Both SDH and MDH activities were weaker in affected cardiac and skeletal muscle fibres. However, it was reverse in case for LDH. The dehydrogenase reaction was diffusely scattered in the lesions but granular in normal muscle fibres. Thus it was concluded that degenerating skeletal muscles had lower AT pase and SDH contents than normal and regenerating muscles and supported earlier findings[8]. Relatively stronger activity of LDH in lesion might be due to greater metabolic acidosis through anaerobic glycolytic pathway, as evidenced histochemically by Harthorn and Young[5]. It has been opined that muscular lesions in capture myopathy could be the combination of direct action of lactic acid on muscle fibres and muscular spasms (due to change in PH[11] and forced exercise resulting in further damage[1].

Table - 2 : Histoenzymic activity in cardiac and skeletal muscles

Animal species	Condition of animals	SDH	MDH	LDH	ATpase	AKpase
Spotted deer	Control	++++	+++	+++	++	-
	Affected	++/+++	+++	++++	++	-

Spotted deer	Normal	++++	+++/++++	++++	++	-
	Affected	+++/++++	+++	++++	++	-
Barking deer	Control	++++	+++	+++	+++	-
	Affected	++/+++	+++	++++	++	-
Rhinoceros	Control	++	++++	+++	++	-
	Affected	++	+++	+++	++	-
Rhinoceros	Control	++++	+++	+++	++	-
	Affected	+++	+++	+++/++++	++/+++	

Negative:-, weak: +, moderate: ++, strong: +++, intense: ++++

The EDAX study showed certain remarkable differences in the distribution of different elements in normal and affected cardiac muscles (Fig. 1, 2). The concentration of silicon, potassium and iron decreased while phosphorus, sulphur and calcium appreciably increased in affected cardiac muscle as against control. Aluminium and chloride were present in normal cardiac muscle but these elements could not be seen in affected cardiac muscle. The observations in respect of phosphorus, potassium and calcium were in agreement with the findings of Haigh[4]. The remarkable elevation of surplus concentration in affected cardiac muscle might be due to degenerative changes[10]. Disturbance in the metabolism of phosphate and sodium, respectively, might be the factors responsible for the complete absence of aluminium and chloride in the cardiac muscle of affected animals[4].

The role of selenium and vitamin E deficiency as a predisposing factor in the pathogenesis of capture myopathy has been suggested by a good number of workers [7,8,14] However, in the present EDAX study selenium was found to be absent in cardiac muscle of both the affected and control animals. This aspect needs further elucidations.

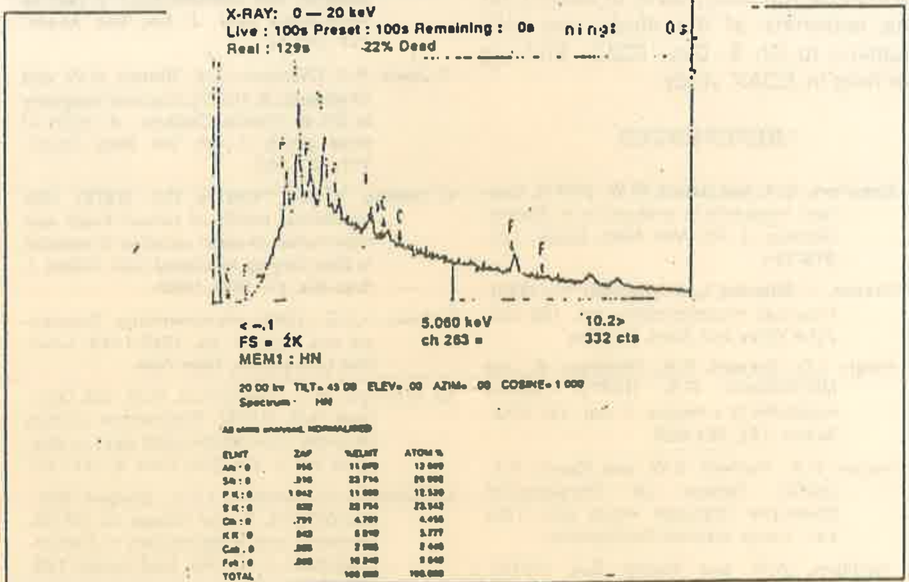

Fig 1: EDAX of crdiac muscle of a spotted deer (control)

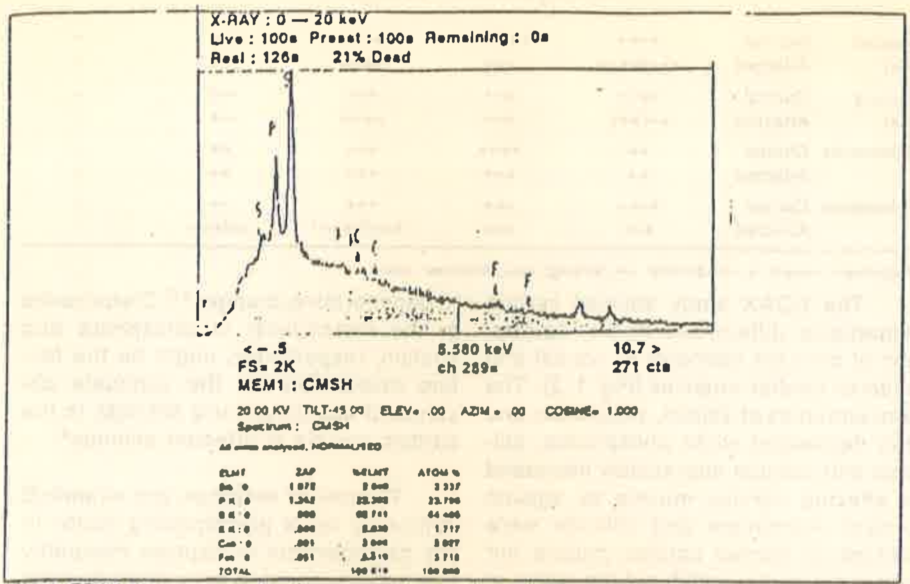

Fig 2: EDAX of cadiac muscle of a spotted deer suffering from capture myopathy.

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PNEUMONIA AS THE CAUSE OF DEATH IN DEER

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SUMMARY

During five years (1985 to 1989) mortality pattern of deer in Assam State Zoo was studies. A total of 189 deer were necropsied. Out of these 22 (10.3%) died due to pneumonia. The different types of pneumonia recorded were-viral pneumonia (2), bacterial pneumonia (17), mycotic pneumonia (2) and aspiratory pneumonia (1). Based on histopathological appearance the viral pneumonia was diagnosed as PI-3 infection. On the basis of isolation study *Streptococcus pyogenes* was recorded in highest number of cases followed by *Pasteurella multocida* and *Corynebacterium pyogenes*. In both the cases of mycotic pneumonia, the fungus was identified as *Zygomycetces*.

Key words: Deer, pneumonia, etiological agents.

INTRODUCTION

Pneumonia plays an important role in the mortality of capative herd as these animals always remain under stress. Pneumonia due to different etiological agents in different species of deer have been reported [6, 9, 11]. The present investigation is an attempt to put on record the death due to pneumonia in a captive herd of deer at Assam State Zoo.

MATERIALS AND METHODS

Deer necropsied during 1985-1989 to study the mortality pattern of captive wild herbivores of Assam State Zoo, formed the materials for the study. A total number of 189 deer were necropsied and out of these, 22 deer died due to various types of pneumonia. The affected lungs showing gross lesions were collected and representative tissues were preserved in 10% formol-saline solution for histopathological study. Besides routine haematoxyline and eosin method, special stain like Shorr's triple stain, Brown and Bernn and Grocott Gomori Methenamine Silver (GMS) stain were used when warrented. For isolation study the suspected materials were cultured as per the standard method [2].

RESULTS AND DISCUSSION

Out of 189 necropsies, pneumonia as cause of death was seen in 22 deer (10.3%) involving 7 species of deer as summarised in Table 1. Different types of pneumonia recorded were as follows:

Viral pneumonia: Necropsy of two spotted deer revealed greyish patchy areas of consolidation in different lobes of the lungs. Adhesions between the parietal and visceral pleura were found in one case with mucopurulent exudate and foci on cut surfaces. Microscopically, interstitial pneumonia with proliferation of septal cells and thickening of bronchiolar epithelium were noted. Infiltration of mononuclear cells and neutrophils were also noted. In both the cases many syncytial giant cells were

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seen in alveolar spaces as well as in bronchiolar wall. Both intranuclear and intracytoplasmic inclusion in the bronchiolar epithelium and in alveolar macrophages could be demonstrated by Shorr's triple stain.

Table 1. Types of pneumonia and bacteria isolated.

Etiological factors	No.of animal	Species of deer	Bacteria isolated
1. Viral pneumonia (PI-3)	2	Spotted deer (2) *(Axis axis)*	*Past. multocida*-1 *Streptococcus*-1
2. Bacterial Pneumonia	17	Spotted deer (2) *(Axis axis)*	*Past. multocida* -1 *Strept. pyogenes (Haemolytic)*-1
		White fallow deer (1) *(Dama dama)*	*Past. multocida* -1
		Barking deer (3) *(Muntiacus muntiak)*	*E. coli*-1
		Sambar (4) *(Cervus unicolar)*	*Strept. pyogenes (Haemolytic)*-1 *Coryn. pyogen*-2 *Past. haemolytica*-1
		Hog deer (1) *(Axix pornicus)*	Nil
		Nilgai (2) *(Boselaphus tragocamelus)*	*Strept. pyogenes*-1
		Serow (3) *(Capricornis sumatraensis)*	*Strept. pyogenes*-2
		Black buck (1) *(Antilope cervicapra)*	*Streptococcus sp*-1
3 Aspiratory pneumonia	1	Barking deer (1) *(Muntiacus muntiak)*	*Staphylococci* and *Streptococci*-1
4. Mycotic pneumonia	2	Sambar (1) *(Cervus unicolar)*	Nil
		Barking deer (1) *(Muntiacus muntiak)*	Nil
Total	22		

Pasteurella multocida was isolated from the lungs of one animal while from others *Streptococcus* sp. was isolated. Though in this study the virus could not be isolated, presence of giant cell pneumonia with demonstration of intranuclear and intracytoplasmic inclusion bodies in the bronchiolar epithelium might be taken as the indication of PI-3 virus infection as supported by Mohan Rao *et al.*[7] Jubb *et al*[5]. have mentioned that secondary bacterial infections, generally *Pasteurella* are invaliably associated with PI-3 virus as this virus pave the way for infection. Isolation of *Pasteurella multocida* and *Streptococci* sp. in the present study support their findings. Giant cell pneumonia has been reported in domestic animals like cattle [1], buffalo [13], goat [7] and sheep [10] and rabbits [12]. however, in wild animals like spotted deer it has not been reported so far.

Bacterial pneumonia: Seventeen cases of bacterial pneumonia were recorded. Grossly, the lungs showed patchy to diffuse area of consolidation mostly in the apical and cardiac lobes and with occasional involvement of diaphragmatic lobes. In a few cases intermediate lobe was completely consolidated. Froth in bronchial lumina was noticed in majority of the cases. Out of 3 serows one had fibrinous deposition in the pleura causing adhesions with parietal pleura. Red hepatisation, involving the lateral borders of the diaphragmatic lobe, was noticed in two *nilgai*. In two sambars, out of the four, the lungs had areas of consolidation with large abscesses in the diaphragmatic lobe.

Microscopically, bronchitis and bronchiolitis, with hyperplastic changes of the lining epithelium, were the common pathological changes. Fibrinous pleuritis with infiltration of polymorphs and mononuclear cells were seen in a serow. Two *nilgai* showed haemorrhages. The two sambar had multiple abscesses in the lungs, characterized by a central caseonecrotic zone with cellular debris, surrounded by a neutrophilic zone with a few mononuclear cells and finally surrounded by connective tissue capsule. Pressure atropny of the surrounding lung parenchyma was also evident. Duplicate sections, stained by Brown and Bernn stain, revealed the presence of bacteria morphologically indistinguishable from *Corynebacterium.*

On isolation *Streptococcus pyogenes* was recorded in five cases followed by *Pasteurella multocida* (4) and *Corynebacterium pyogenes*(2) (Table 1). In the present study, though bacterial pneumonia was responsible for 17 deaths, the prevalance of pneumonia was a common finding in association with other conditions. *Streptococci* were isolated in eight cases in present study, which support earlier findings [4]. *Streptococcus pneumoniae* in a bison [11] and *Pasteurella pneumonia* [14] were reported and in this study *Corynebacterium pyogenes* and *Pasteurella multocida* were the other organisms recorded. Incidences of these infections were also documented earlier[14]

Aspiratory pneumonia: It was noticed in one barking deer with impaction of rumen, having clumps of hairs along with rubber bands and few unidentified masses. Grossly, the apical and cardiac lobes showed patchy areas of consolidation and, on incision, revealed greenish material mixed with froth in the bronchi. Microscopically, the bronchi showed presence of cross and longitudinal sections of foreign bodies leading to obliteration of the bronchiolar lumina. Foreign bodies were also noticed within the bronchioles as well as within some alveoli, surrounded by a zone of inflammatory cells consisting of polymorpohs and macrophages. The adjacent alveoli were emphysematous. Cultural examination of the exudates revealed *Streptococcus* and *Staphylococcus* and the tissue sections on Brown and Brenn stain revealed gram positive cocci. Cross sections of parasite could also be seen in the bronchi.

Incidence of aspiratory pneumonia in captive animals could not be traced out in the literature and, probably, the unusual material which impacted the rumen might have caused aspiratory pneumonia leading to death.

Mycotic pneumonia : Mycotic pneumonia was recorded one each in sambar and barking deer. Grossly, the lungs of the barking deer showed diffuse areas of consolidation in the right apical and cardiac lobes and in the sambar, a greyish mass of about 10 cm x 4 cm was seen in the left diaphragmatic lobe on the parietal surface. When cut the surfaces showed nodules containing caseated pus typical of granuloma. Microscopically, the lesion showed a mixed granuloma, consisting of large number of epitheloid cells and a few Langnan's type of giant cells intermixed with mononuclear cells and polymorphs, surrounded by fibrous capsule. Within the granuloma, broad nonseptate fungal hyphae could be seen by H. E. staining. In the barking deer, the nodule was packed by fungal hyphae which could be demonstrated on H.E. stain. Duplicate sections in both the cases were stained with GMS stain and the fungus was identified as *zygomycetes*. (Fig.1)

Fig. 1 Lungs : Zygomycosis showing fungal hyphae. GMS x 180.

Informations on mycotic pneumonia in captive animals are meagre [3, 8] and does not appear to have been reported form our country.

ACKNOWLEDGEMENTS

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Indian Journal of Veterinary Pathology 17 (2) 58 - 60, June, 1993

Short Communication

TUBERCULOSIS IN CAPTIVE WILD HERBIVORES

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The occurrence of tuberculosis in different species of zoo herbivores has been reported [1,4-8] from different parts of the country. The present paper records the incidence at Assam State Zoo, Guwahati

Suitable tissues were collected in 10% formolsaline solution for histopathological examination from 214 captive wild herbivores of 18 species belonging to Assam State Zoo, after detailed post mortem examination for screening tuberculosis. The paraffin sections were stained with routine haematoxylin and eosin and Ziehl-Neelsen acid fast stains. Samples from lungs and lymph nodes (Table) were used for isolation and identification of *Mycobacterium tuberculosis*[2]. Tissues from affected lung were also fixed in 3% gluteraldehyde in 0.1M cacodylate buffer and processed[3] for Scanning Electron Microscopy (JEOL). In additon Energy Dispersive X-ray micro-analysis (EDAX) was carried out in EDS system (Link) for comparision of elements in apparently normal lung tissue of the affected animal with that of the normal lung tissue of same species.

Tuberculosis was recorded in 42 (19.6%) animals belonging to 7 species. The highest incidence (16.2%) was noticed in the members of *Cervidae*. The incidence and distribution of lesions in different organs of the affected animals are presented in table. Lung was the most frequently affected organ indicating that inhalation is the most common route of infection. Gross lesions comprised of multiple discrete encapsulated nodules of various sizes (1-5 cm in diameter) distributed in lung parenchyma. The cut surface revealed delineated dried granular and greyish tinged cheesy material.

Microscopically the tuberculous lesions showed mixed granulomatous reaction consisting of central caseated and calcified zone surrounded by aggregates of lymphocytes, macrophages and epitheloid cells, interpersed with Langhan's type of giant cells. Fibrous encapsulation of the lesion was well marked in giraffe.

Successful isolation of *Mycobacterium tuberculosis* (both human and bovine types) was achieved from all the 21 animals. However, in cases where isolation was not attempted, acid-fast bacilli were demonstrated in the tissue sections. In a culturally positive tissue sample, thin slightly curved bacilli resembling *Mycobacterium tuberculosis* var *hominis* could be demonstrated by Scanning Electron Microscope (Fig. 1). Isolation of human type of tubercule bacilli from some of the infected animals suggest that the infection might have taken place from animal attendants and visitors comming to the Zoo. Another posibility is the contact of tuberculous stray monkeys with zoo animals but it needs further elucidation.

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Table : Occurrence of tuberculous lesions in different organs and isolation of Mycobacterium

Species of animals	No. of animals affected/with %	Organs involvement												Isolation study
		Lungs	Liver	Lymph node	Kidneys	Spleen	Pleura	Hp	Genital organs	Int	Bone	Mg	Di	
Spotted deer (*Axis axis*)	10/33 (30.0)	10	4	10	2	3	7	3	1	1	2	-	-	5(human - 1, bovine-4
Barking deer (*Muntiacus muntiak*)	8/41 (21.6)	8	2	8	-	1	5	1	-	-	-	-	-	4(bovine-4)
Hog deer (*Axis porcinus*)	6/11 (54.4)	6	1	6	-	-	4	-	-	-	-	-	-	3(human-3)
Sambar (*Cervus unicolar*)	8/42 (21.0)	8	3	8	2	1	4	2	-	1	-	-	-	2(bovine-2)
Black buck (*Antilope cervicapra*)	7/12 (58.3)	7	3	7	1	1	4	1	2	1	-	2	-	5(human - 5)
Mithun (*Bos frontalis*)	1/3 (25.0)	1	-	1	-	-	-	-	-	-	-	-	-	- -
Giraffe	2/5 (40.0)	2	2	2	1	2	2	1	-	1	-	-	1	2(human - 1, bovine-1)

HP = Heart and pericardium, , Int = Intestine, Mg = Mammary gland, Di = Diaphragm.

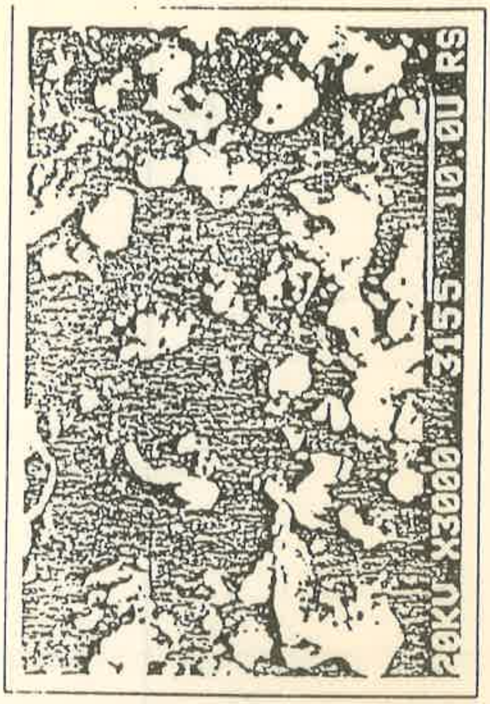

Fig. 1 Scanning photograph of a mycobacterium bacillus (arrow) X 3000.

The EDAX study revealed that the affected lung contain sodium (2.3%), phosphorus (25.2%), sulphur (41.2%), chloride (9.4%), potassium (13.9%) and calcium (8.0%) while the composition of normal lung was phosphorus (27.3%), sulphur (40.2%), chloride (8.4%), potassium (11.0%), calcium (6.6%) and iron (6.4%). Concentration of sulphur, chloride, potassium and calcium were slightly higher in tuberculous animals while phosphorus was slightly reduced. Iron was found to be absent and sodium was low in the lungs of tuberculous animal. Analysis of calcified and caseated nodules revealed calcium (64.0%), phosphorus (27.0%) and sulphur (9.0%). Further studies are required to explain the possible causes of variation of these elements.

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SPONTANEOUS AORTIC LESIONS IN CAPTIVE WILD HERBIVORES

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SUMMARY

Spontaneous aortic lesions in 68 captive wild herbivores were studied and lesions were detected in 39 (57.4%) animals. The lesions recorded were fatty streaks, fibrous plaque, calcification, aneurysm, parasitic infection, intimal thickening, fibrous nodule and metaplastic change. In addition to the histopathological study of the lesions some were also studied by SEM and EDAX. On SEM the *Onchocerca* affected endothelium showed marked disruption and distortion of the cells. The compositon of the metaplastic area of the heart on analysis by EDAX, was found to be of calcium (63.3%), sulphur (26.0%) and phosphorus (8.7%).

Key World : Aortic lesions, Captive wild herbivores

Introduction

Informations on spontaneous aortic lesions in Indian domestic animals have been reported[5,7,11] but no such attempt seems to have been made in captive wild animals. However, few such reports in wildlife have been documented from abroad[4,9,10,13]. Considering the paucity of information, the present investigation was taken up in some of the captive wild herbivores.

Materials and methods

Aortae of 68 captive wild herbivores of both sexes were collected at necropsy. After removal of the adventitial fat, the aortas were cut open longitudinally, fixed in 10% neutral formaline for 24-48 hrs. and stained with sudan IV[8]. The lesions were graded according to criteria recommenede by WHO study group on atherosclerosis[14].

For hsitopathological study, longitudinal pieces of tissue were taken from the sudanophilic lesions and unstained areas. When warrented special stainings were adopted. For scanning electron microscopic (SEM) study, tissue samples were fixed in 2.5 per cent gluteraldehyde in 0.1M sodium cacodylate buffer for 4-6 hrs at 4^0C, washed in cacodylate buffer overnight, post fixed in 1 per cent osmium tetraoxide for 1 hr and were dehydrated through increasing concentration of acetone. Samples were prepared as per the method of Dey *et al*[2] and examined in a scanning electron microscope (Joel).

Results and discussion

The spontaneous lesions in the aortae were detected in 39 (57.4%) animals (Table 1).

1. Atherosclerosis :

(a) Fatty streaks : Fatty streaks became visible only after staining with Sudan IV, and was observed in 29 animals. It was

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SPONTANEOUS AORTIC LESIONS IN CAPTIVE WILD HERBIVORES

Table 1 : Spontaneous aortic lesions

	Lesions recorded aorta examined	Atherosclerosis Fatty streaks	Fibrous plaque	Aneurysm	Parasitic	Miscellaneous Calcification	Intimal thickening	Fibrous nodule	Metaplastic change
Spotted deer	10/14	7	1	2	3	2	-	1	-
Barking deer	4/9	3	1	-	-	-	-	-	-
Sambar	7/13	6	2	1	1	2		-	1
Mouse deer	2/4	1	1	-	-	-	-	-	-
Nalgai	1.3	1	1	1	1	1		-	-
Blackbuck	2./4	1	1	2	1	1		-	-
Serow	2/4	2	-	-	-	-		-	-
Mithun	1*/1	1	1	1	1	1		-	-
Buffalo	1/1	1	-	-	-	-	-	-	-
Giraffe	3/4	1	2	2		1	1		1
Zebra	1/3	1	1	-1		-	-	-	-
Rhinoceros	4/6	3	1	-	-	-	-	-	-
Elephant	1/2	1	-	-	-	-	-	-	-
	39/68 (57.4%)	29 (42.4%)	12 (17.6%)	10 (14.7%)	7 (10.3)	8 (11.8%)	1 (1.5%)	1 (1.5%)	2 (2.9%)

* At the base of aorta a lump of lipid was deposited.

observed in as young as a 3 months old rhinoceros. Grossly, the lesions were smooth, unelevated and diffuse in nature, which mostly appeared as longitudinal sudanophilic streaks, parallel to the long axis of the aorta, in and around the aortic arch, in brachiocephalic trunk and at other sites, including the areas adjoining the orifices of intercostal arteries (Fig. 1). Histologically,

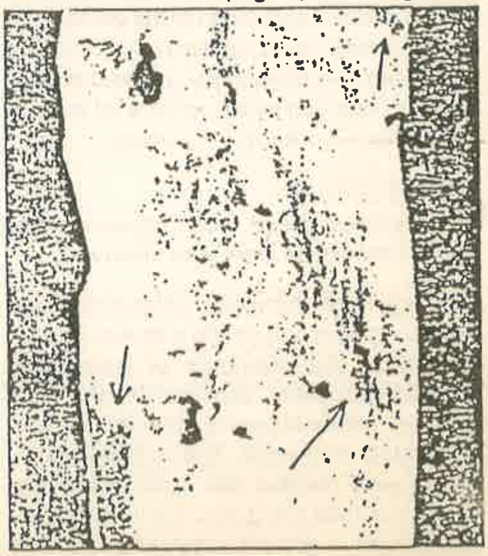

Fig. 1. : Fatty streaks in the aorta of a spotted deer. (arrow)

fatty streaks showed focal thickening of the tunica intima and vacuoles due to the removal of fat.

(b) Fibrous plaque : Fibrous plaque was noticed in 12 (17.6%) animals. All the lesions were observed in the aged animals. Generally it appeared as circumscribed or elongated, centrally depressed, white, elevated, hard and rough structure measuring 1.32 cm - 2.60 cm in diameter over the intimal surface (Fig. 2). The plaques were inconsistently sudanophilic. Microscopically, the intima was thickened with hyalinization of its innermost part and vacuolated degenerated area. There was fragmentation and duplication of internal elastic lamina with varying degree of degenerative changes. Elastolysis were noticed in tunica media.

Atheroscerosis is stated to be a rare condition in wild and captive animals[3], however, the malady in the form of fatty streaks[6,9,10] and fibrous plaques[6,9,11,12] have been reported in domestic animals.

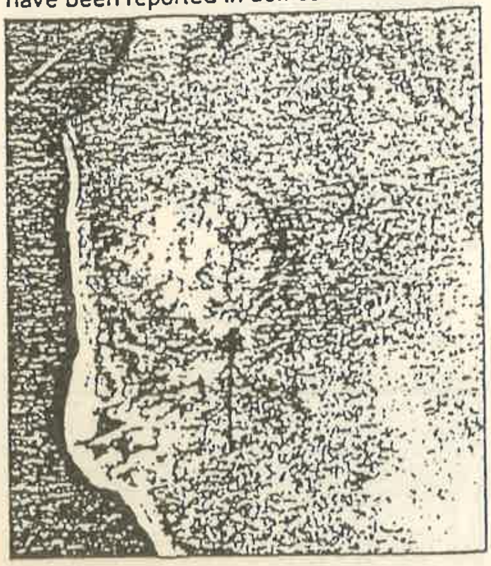

Fig. 2. : Fibrous plaque in the aorta of a giraffe. (arrow)

2. Calcification :

Calcification was recorded in 8 cases and was grossly recognised as uneven, hard, sometime raised structure invariably associated with lesions like fibrous plaque, aneurysm or parasitic infection in aged animals. Microscopically, irregular areas of various sizes were seen in tunica media. The elastic tissue in and around the area of calcification was degenerated. In one of the spotted deer, calcium deposition in tunica media was suggestive of old degenerating parasitic lesion.

3. Aneurysm :

Aneurysm was recorded in 10 cases and in almost all the cases, lipid deposition was descernible on Sudan IV stained specimen. Saccular type of lesions was generally seen (5-13 mm in diameter). These dilatations were generally recorded in the abdominal aorta. Microscopically, the saccular part of the vessel was mostly composed of collagen fibres along with fine fragment of elastic and reticulin fibres. Calcification, fibrous plaque and aneurysm were invariably associated with aged animals. These conditions have also been reported by other[1,3,4,6,12] in wild animals.

4. Parasitic lesions :

The parasitic lesions were recorded in 7 cases, maximum being in spotted deer. These were located both in thoracic and abdominal parts of aorta (Fig. 3). The parasites were Identified as *Onchocerca* sp. Occurrence of *Onchocerca* in a four horned antilope and filaroid infestation in a hippopotamus have also been documented[1,9]. Microscopically, the changes comprised of elevation and protrusions of the Intimal surface in lumina, marked degeneration of elastic fibres, disruption of internal elastic lamina, fibrosis and encapsulation of the parasite. In few advanced cases, extensive calcification was noted. On SEM study, marked disruption and distortion of the endothelial surface in the affected area was observed.

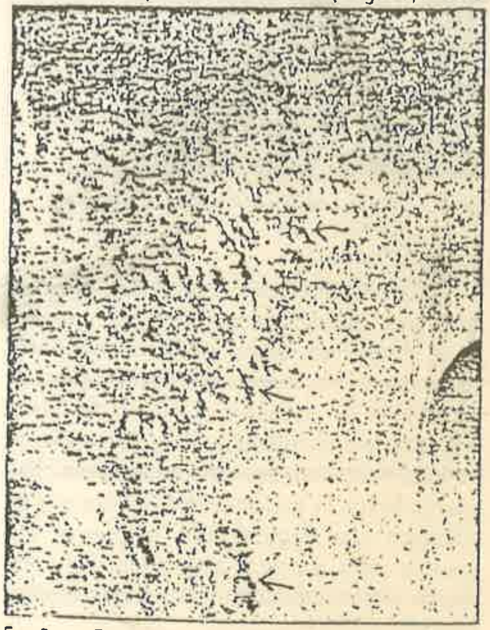

Fig 3 *Onchocerca* infection in the aorta of mithun Note the tortuous tunnels formed by the parasites (arrow)

5. Miscellaneous :

Besides these, the following non-specific conditions were also observed.

(a) Intimal thickening : Intimal elevation was detected in one giraffe and was characterised by the presence of transverse wrinkled/corrugated appearance of intimal surface. Microscopically, the intima was moderately thickened. The internal elastic lamina were swollen with focal elastolysis. The intimal thickening was mainly due to the proliferation of ground substances and few muscle cells. In tunica media, the smooth muscle cells and the bands of muscle fibres were arranged haphazardly.

(b) Fibrous nodules : Nodular lesion (5-8 mm in diameter) was noticed in one spotted deer and was localised in tunica adventitia. Microscopically, the tunica intima covering the nodule was slightly or moderately thickened as a result of increased amount of collagen and muscle fibre.

McKinney[9] and With[13] were of the opinion that atherosclerosis may develop in herbivores even on very low fat diet, as available in natural habitat. The present study lent support to these observations. However, the role played by geoclimatic environment, type of food and the physiological status of the animals in the causation of these lesions in aortae needs further study.

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Short Communication

NEOPLASMS IN CAPTIVE WILD HERBIVORES

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Spontaneous neoplasms in captive wild animals have been frequently reported[1]. While studying the etiopathology of mortality in captive wild herbivores of Assam State Zoo between 1985 to 1989, 214 animals were necropsied and out of which 7 case (3.3%) of neoplasms were recorded.

Fig. 1 : Nodular growths on the raphae of the rumen.

Fibroma : In the raphae of the rumen of a female sambar *(Cervus unicolar)*, aged 5-6 yrs. two soft reddish nodular growths measuring 1-2 cm in diameter were noticed (Fig. 1) while in a female spotted deer (*Axis axis*), aged 6 yrs, at the cervico-uterine junction on the floor of uterus, an obliquely placed growth (2.5 cm in diameter) was seen. Microscopically, these were diagnised as fibroma.

Leiomyoma: In an eight yrs old female sambar (*Cervus unicolar*), at the abomasoduodenal junction, the wall of duodenum was thickened and formed a tortuous mass. Though the area was constricted, the lump did not cause obstruction to the lumen. On histological examination the mass was found to be leiomyoma.

Adenoma : A small growth of about 1.5 cm in diameter was noticed In the stomach wall of a 59 years old male rhinoceros (*Rhinoceros unicornis*). Similar growth was also seen on the vulvovaginal junction of a 7 yrs old female barking deer (*Muntiacus muntiak*). Histologically, both these growths were diagnosed to be adenoma of multicentric origin.

Adenocarcinoma : In an adult male mouse deer (*Traqulus meminna*), the sections of liver, hepatic lymph node and mesenteric lymph node showed changes characteristic of adenocarcinoma. Oessous metaplasia was also noted in the hepatic lymph node.

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Osteochondroma : One 5.5 yrs old female serow (*Capricornis sumatraensis*) had twelve multiple cartilagenous exostoses on six ribs in different areas. On cuting, the exostoses showed eccentric cuffs around the shaft of ribs and the areas were white in colour (Fig. 2). Microscopically, the cartilagenous cap covered the hyperplastic cortical bone and the periosteal connective

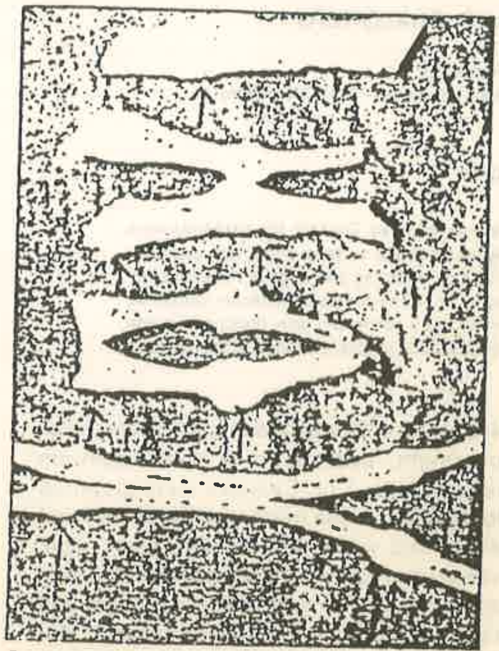

Fig. 2 Multiple cartilagenous exostoses on the ribs of a serow.

tissue covered the entire area. Based on gross and microscopic changes, the exostoses were diagnosed as osteochondroma. A detailed study of distribution and concentration of elements in an exostosis was attempted by Energy Despersive X-ray microanalysis. It was seen that the exostosis lacked iron and copper but had higher concentration of phosphorus, sulphur and calcium in comparison to the normal ribs.

Occurrence of neoplasms in Zoo animals are not uncommon and several tumours have been reported[1,4,5]. In the present study five different varieties of neoplasms (3.3%) have been reported and out of which only one was malignant in nature.

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PATHOLOGY OF *FASCIOLA JACKSONI* INFESTATION IN ELEPHANTS

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SUMMARY

In two elephants Fasciola jacksoni infestation was recorded. Grossly, the parasites were attached to biliary epithelium and microscopically the epithelial surface of the bile duct was covered by necrotic homogenous mass admixed with erythrocytes and eggs of the parasites. The infested biliary epithelium was analysed through EDAX. The infested epithelium contained aluminium, silicon, calcium and iron while in normal biliary epithelium only phosphorus and sulphur could be noticed. On SEM study both the dorsal and ventral surfaces of the parasite possessed spines.

INTRODUCTION

Fasciola Jacksoni infestation in the bile duct of indian elephants has been documented [1,2,5] but its pathology has not been studied. Hence, the present investigation was undertaken to study the changes caused by this parasite in the host tissue. In addition to the gross and histopathology, the tissues were subjected to scanning electron microscopy (SEM) and energy disperative X-ray microanalysis (EDAX).

MATERIALS AND METHODS

While studying the mortality pattern in wildlife at Assam State Zoo, Guwahati during Janurary, 1985 to December, 1989, three elephants were necropsied. Two of these showed massive infestation of *Fasciola jacksoni* in their bile ducts. The affected tissues were collected in 10% formol-saline solution for routine histopathological study as per routine method. Small pieces of tissues and a few parasites were kept in 3% glutaraldehyde in 0.1 M sodium cacodylate buffer for 4-6 hrs. at 4°C, washed in cacodylate buffer overnight, post fixed in 1.0% osmium tetraoxide for 1 hr. Samples were prepared for SEM as per the method of Dey *et al*[3]. and examined with JMS-35 CF(Joel) SEM operated at 15 KV. Unfixed affected bile duct and normal bile duct were air dried and coated with carbon in the vacuum evaporator JEE 4 (Joel). EDAX was carried out in EDS system (link) attached to JSM-35 CF.

RESULTS AND DISCUSSION

Out of the three animals, two had massive infestation of *Fasciola jacksoni* in the bile ducts. Bile ducts were packed with parasites and exudates. In both the animals liver was hard and fibrosed. Microscopic changes included excessive proliferation of fibrous tissue resulting in focal periportal cirrhosis, pseudolobulation and mild mononuclear cell infiltration. The epithelial surface of the bile duct was covered by necrotic homogenous mass admixed with erythrocytes and eggs of the parasites.

SEM study of the affected bile duct showed distortion of biliary epithelium resulting into homogenous mass (Fig.1) contain-

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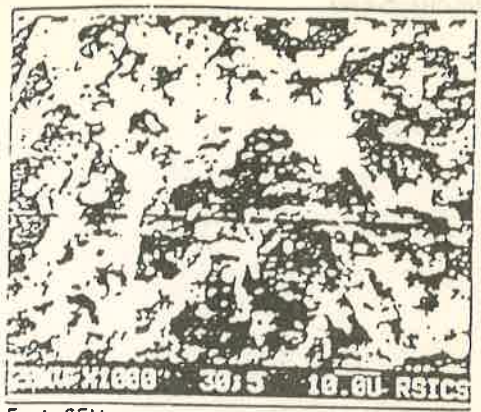


Fig 1. SEM view of distorted biliary epithelium which turned into homogenous mass x 1000.

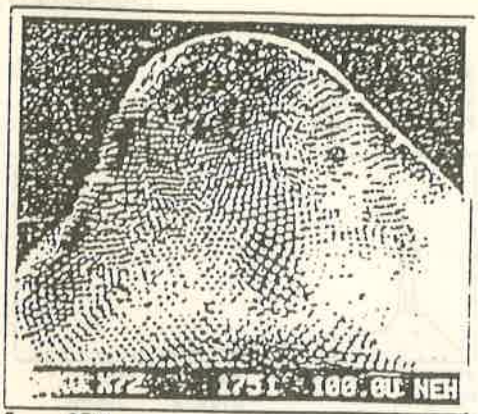


Fig 3. SEM view of ventral surface of the parasite showing spines x 220

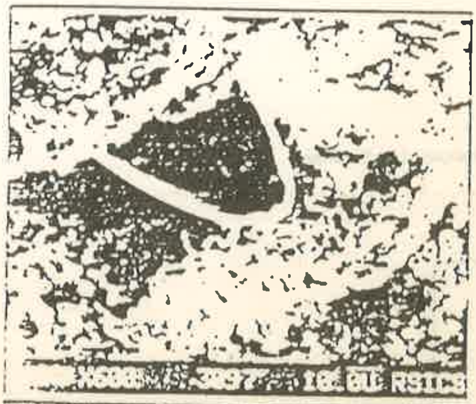


Fig 2. SEM view of an egg of F. jacksoni trapped within the necrotic mass of bile duct. x 6000.

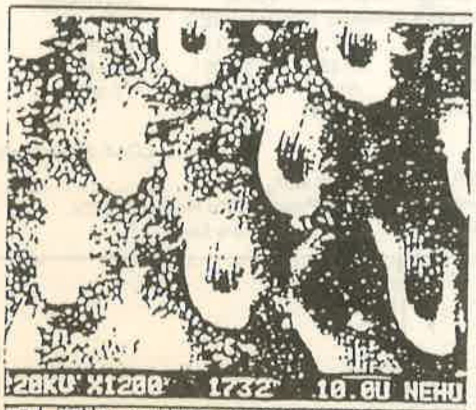


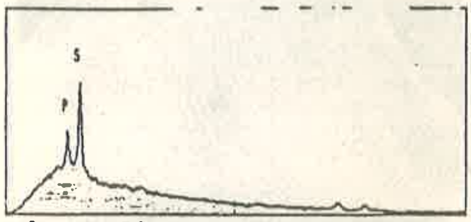
Fig 4. SEM view of higher magnification of spines x 1200.

ing the eggs of the parasite (Fig.2). SEM study of the parasite revealed the presence of spines both on the dorsal and ventral surfaces in symmetrical order (Fig.3). Higher magnification revealed that tips of the spines were sharp and ridged (Fig.-4).

EDAX study showed that normal biliary epithelium contained phosphorus (25.9%) and sulphur (74.0%) (Fig.5) whereas the infected biliary epithelium contained aluminium (2.0%), silicon (4.6%), phosphorus (11.3%), sulphur (34.1%), calcium (2.5%) and iron (45.5%) (Fig.6). It was interesting to note that the affected part contained aluminium, sillicon, calcium and iron besides the normal constituents.

Unlike, the other fasciola infestation in domestic animals *F.jacksoni* also causes tissue damage leading to fibrosis, pseudolobulation and atrophy of the liver parenchyma. However, calcification as seen in domestic animals including mithun[3] has not been recorded in elephants. Mechanical damage caused by the spines of the parasite during migration might have further aggravated the condition. This postulate is further substantiated by EDAX study in which higher percentage of iron could be seen in the af-

X-RAY: 0 - 20 keV
Live: 100s Preset: 100s Remaining: 0s
Real: 126s 21% Dead

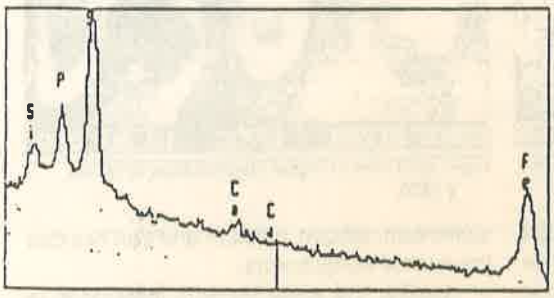


< .6 5.740 keV 10.9
FS = 4K ch 297 = 265 cts
MEM1 : BILE DUCT NORM
20.00 KV TILT = 45.00 ELEV = .00 AZIM = .00 COSINE = 1.000
Spectrum: BILE DUCT NORM BILENORM
All elmts analysed. NORMALISED

ELMT	ZAF	%CLMT	ATOM. %
P K : 0	1.428	25.951	26.618
S K : 0	.910	74.062	73.382
TOTAL	100.014	100.000	

Fig. 5. EDAX of biliary epithelium of an Elephant.

X-RAY: 0 - 20 keV
Live: 100s Preset: 100s Remaining: 0s
Real: 130s 23% Dead



< 1.5 4.040 keV 6.6
FS = 2K OS = -128 ch 212 = 516 cts
MEM1 : BILERFFECT
20.00 KV TILT = 45.00 ELEVE = .00 AZIM = .00 COSINE = 1.000
Spectrum : BILEAFFECT BILEAFFECT
All elmts analysed. NORMALISED

ELMT	ZAF	%ELMT	ATOM.
AlK : 0	.795	2.050	2.98
SiK : 0	.884	4.590	6.42
P K : 0	1.175	11.302	14.34
S K : 0 .912	34.100	41.80	
CaK : 0	.995	2.488	2.44
FeK : 0	.906	45.468	31.999
TOTAL	99.998	100.000	

Fig. 6. FDAX of biliary epithelium of an Elephant infected with Fasciola jacksoni.

fected tissue while it was absent in normal bile duct. Excecpt aluminium and silicon, elevation of other elements like phosphorus, sulphur, chloride, calcium and iron has been recorded in *Fasciola gigantica* infection in mithu[3]. Presence of these elements in the affected biliary epithelium might be due to damage of the biliary epithelium and consequent leak from underlying tissue. However, further study is needed to throw light on these aspects of the problem.

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Indian J. Vet. Path. 10, 100-101

Short Communication

GASTRIC HABRONEMIASIS IN A WILD ASS
(Equus hemionus)

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Though gastric habronemiasis is very common among horses [1-4] its incidence and pathology in wild ass is unknown in India, hence the purpose of this communication.

A male wild ass aged 6-7 years which was procured by Nandan kanan from Sakkarbag zoo, Junagarh, a month prior to death suddenly died o septicaemia. At necropsy, the fundic region of stomach showed two hard tumour like growths protruding into the gastric lumen (Fig. 1) which measured 4 x 4 Cm in size. Numerous nematode parasites (identified as *Habronema megastoma* in coiled position in the tissue debris were seen protruding through several openings. Microscopically, sections of adult male and gravid female parasites amidst necrotic tissue were seen in cystic spaces in submucosa leaving behind tortuous tunnels. The tumour-like nodule consisted of thick granulation tissue associated with infiltration of number of lymphocytes, monocytes, plasma cells, eosinophils and occasional neutrophils. In some areas of the nodules, there was lymphofollicular reaction particularly around blood vessels.

The lesions described herein were akin to those described for horses.[3] Since the species in question is endangered one, the animals have been kept in their natural habitat in and around Rann of Cutch in a saparate wildlife sanctuary. In order to conserve this species, routine deworming should be practised to eliminate this infection.

* Professor and Head.
** & *** Postgraduate students.

Acknowledgements

Thanks are given to Professor and Head, Parasitology, for identification of parasites and wildlife conservation officer, Orissa for providing facilities.

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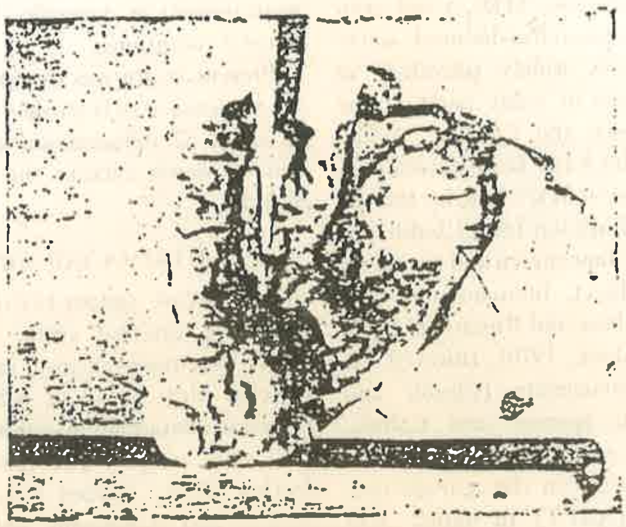

Fig. 1 Stomach showing tumour like nodule

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Epidemiology of Marek's Disease (MD): Studies on the Incidence of MD Precipitins in Some Zoo Birds

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(Received for publication August 31, 1972)

ABSTRACT Sera samples from 303 zoo birds representing 31 different kinds were examined for the presence of Marek's disease (MD) antibodies using the double diffusion agar gel test. One guinea fowl out of 28 examined was positive for MD precipitin. Domestic chickens used as feed for the large reptiles of the zoo were found to be positive for MD antibody and these chickens had contact with the guinea fowls. All other sera were found to be negative for MD antibody. The epidemiology of this condition has been discussed.

POULTRY SCIENCE 52: 963-966, 1973

MAREK'S disease (MD), a cell associated herpes-virus-induced oncogenic infection is widely prevalent in domestic chickens in many parts of the world (Ianconescu and Samberg, 1971). Serum antibodies have been detected in chickens exposed to MD virus, by the use of agar-gel precipitation test (Chubb and Churchill, 1968; Ianconescu and Samberg, 1971) and indirect immunofluorescent technique (Purchase and Burgoyne, 1970; Spencer and Calnek, 1970). Infected tissue culture homogenate (Chubb and Churchill, 1968; Spencer and Calnek, 1970; Purchase and Burgoyne, 1970) has been used as antigen in the agar-gel precipitation test (AGPT) to detect MD precipitins. Haider *et al.* (1970) have found that the MD infected feather follicle epithelium to be a good source of antigen to detect MD antibody (precipitins) in the AGPT. Morgan (1971) detected antibodies for MD in sera of domestic chickens but failed to find antibodies in the sera of some wild fowl (guinea fowl, francolins, and ostriches) in Kenya. Baxendale (1969) and Ianconescu and Samberg (1971) were unable to detect MD precipitin antibodies in ducks, turkeys and geese, although MD antibodies were present in domestic chickens under natural conditions.

Present study was designed to explore the presence of MD antibody (precipitins) in about 31 different kinds of zoo birds and its significance in the epidemiology of MD.

MATERIALS AND METHODS

Feather follicle antigen (FFA):—Feathers from the external crural and femoral tracts were removed from experimentally infected birds at about 6–8 weeks post infection containing maximum amount of MD viral antigen. The concentration of feather follicle antigen was detected by AGPT and fluorescent antibody (FA) reaction. The antigenicity of skin was also related with the infectivity of the skin and blood of the donor birds to day-old chicks. Clinical signs, mortality pattern and histopathological changes in nervous tissues and visceral organs of donors were also used as criteria of MD virus infection. Feather follicle antigen was prepared from feather tips suspended in saline (1:9) and ground in a glass grinder. The suspension was tested by AGPT and then diluted or concentrated to give the optimum reaction. The pH of the suspension was adjusted to 6.5 to 7.5 and the suspension was freeze dried. Freeze dried antigen was

* Nandan Kanan Zoo, Cuttack, Orissa.

TABLE 1.—*Incidence of Marek's disease (MD) precipitins in zoo birds and domestic chickens*

Sl. No.	Common English name	Scientific name	No. of birds available in the zoo	No. of birds from which sera were collected	Sera positive for precipitin sera tested
1.	Guinea fowl	*Numidia meleagris*	28	28	1 28
2.	Common pea fowl	*Pavo cristatus*	18	9	0 9
3.	Crested serpent eagle	*Spilornis cheela*	2	2	0 2
4.	Tawny eagle	*Aquila rapax*	2	2	0 2
5.	Black winged kite	*Elanus caeruleus*	1	1	0 1
6.	Lesser whistling teal	*Dendrocygna javanica*	2	1	0 1
7.	Adjutant stork	*Leptoptilos dubius*	7	7	0 7
8.	Black necked stork	*Xenorhynchus asiaticus*	11	2	0 2
9.	White necked stork	*Ciconia episcopus*	5	5	0 5
10.	Painted stork	*Ibis leucocephalus*	5	5	0 5
11.	Black stork	*Ciconia nigra*	1	1	0 1
12.	Europian white stork	*Ciconia ciconia*	1	1	0 1
13.	Sarus crane	*Grus antigone*	11	6	0 6
14.	Demoiselle crane	*Anthropoides virgo*	3	2	0 2
15.	Lilford crane	*Grus grus lilfordi*	1	1	0 1
16.	Black swan	*Chenopis atrata*	1	1	0 1
17.	White ibis	*Threskiornis melanocephala*	9	3	0 3
18.	Black ibis	*Pseudibis papillosa*	1	1	0 1
19.	Common pochard	*Nyroca ferina*	10	4	0 4
20.	Muscovy duck	*Cairina moschata*	1	1	0 1
21.	Brahminy duck	*Tadorna ferruginea*	12	4	0 4
22.	Pintail	*Anas acuta*	50	2	0 2
23.	Shoveller	*Anas clypeata*	6	1	0 1
24.	Brown fish owl	*Bubo zeylonensis*	2	2	0 2
25.	Barheaded goose	*Anser indicus*	2	2	0 2
26.	Common domestic goose	*Anser anser*	12	12	0 12
27.	Grey heron	*Ardea cinerea*	4	1	0 1
28.	Pigeon	*Columbia livia*	72	5	0 5
29.	Egyptian vulture	*Neophron percnopterus*	5	5	0 5
30.	Silver pheasant	*Gennaeus nycthemerus*	1	1	0 1
31.	Grey jungle fowl	*Gallus sonneratii*	7	7	0 7
32.	Domestic chicken	*Gallus domesticus*	6	6	6 6

reconstituted in saline immediately before use.

Antiserum:—Sera were collected from 125 out of 303 zoo birds representing 31 different kinds (Table 1). The birds were leg banded for identification. Sera were collected in 3 lots within a period of 3 months for AGPT. Besides these zoo birds, sera were also collected from 6 domestic chickens available in the zoo during that period. These chickens were used to feed some of the large reptiles maintained in the zoo and were periodically obtained from a private poultry farm. All these birds were apparently healthy during the collection of sera. Positive MD antisera were prepared in the chicken and were tested for the presence of MD precipitins. Individual serum was used in the AGPT test using the same lot of MD antigen.

Agar Gel Procedure:—Noble agar in 1.0% concentration in an 8% NaCl solution was prepared and autoclaved for 20 minutes at 15 lb. pressure. The pH of the agar was adjusted to 7.4, bottled and kept in refrigerator until used. Eight ml. of the agar were poured into each glass petri dish (60 × 15) mm. and allowed to solidify. Wells were punched as described by Iànconescu and Samberg (1971). The central well in the gel was filled with MD antigen and the surrounding wells with test sera except one, which was filled with MD positive antisera. Tests were run in duplicate and the charged plates were maintained in a humidified chamber at 37°C.–38°C. for 5 days. Plates were examined for precipitin lines approximately at 6 to 12 hour intervals against a black background under a Quebec colony counter.

RESULT

Precipitin lines developed as early as 6 hours after charging the plates and continued to become more distinct with time till 48 hours. Sera from all the six domestic chickens of the zoo were found positive for MD precipitins. Most of the birds of the farm from which these six birds were obtained were also positive for MD precipitins. Sera of one guinea fowl out of 28 examined, contained MD precipitins whereas the rest of sera of all other zoo birds were negative for MD antibody (Table 1). A single precipitin line of moderate intensity was produced by the guinea fowl sera within 18 hours of charging the plate. The precipitin line was contiguous with adjacent lines produced by MD positive sera.

DISCUSSION

Results of the present study indicated that out of all the sera examined, one serum of guinea fowl contained MD precipitin antibody. Besides these zoo birds, domestic chickens used for feeding of large reptiles of the zoo were obtained from a source known to be infected with MD virus. Moreover, the sera of the six domestic chickens, available at the zoo during collection of sera from zoo birds were positive for MD precipitins. On investigation it was found that these domestic chickens were kept in a pen adjacent to the pen of guinea fowl and on occasion these chickens were left with the guinea fowl for a day or more before being fed to large reptiles. The guinea fowl whose sera gave positive precipitin reaction subsequently became weak and developed leg weakness. Unfortunately, the bird was not autopsied as it was fed to the reptile. It is not possible to arrive at the conclusion that the guinea fowl was affected with MD without gross and histopathological examination and isolation of MD virus. However, the serological evidence and subsequent development of clinical signs lead one to presume that the bird was having MD virus infection. Epidemiological investigations and serological tests indicate that the bird in question might have got infected through contact with domestic chickens harbouring the MD virus. Serological tests of other zoo birds are in agreement with those reported by Baxendale (1969), Ianconescu and Samberg (1971) and Morgan (1971), for some domestic birds and wild birds other than domestic chickens. The host range of MD virus other than domestic chicken is still unknown. MD has been reported in turkeys, partridge, swans, ducks, pheasants and quail (Biggs, 1967; Busch and Williams, 1970). Natural cases of MD virus infection have also been reported in game fowl, quail (Kenzy and Cho, 1969) and in great horned owl (Halliwell, 1971). Experimental infection of turkeys (Witter *et al.*, 1970) and ducks (Baxendale, 1969) with MD virus has met with limited success but sparrows were found to be resistant (Kenzy and Cho, 1969). Although Kenzy and Cho (1969) reported natural infection in game fowl and ducks, and pheasants (Biggs, 1967), the present study with limited number of game fowls, ducks and a pheasant did not reveal the presence of MD antibody in these birds. This might be ascribed to absence of contact with the domestic chickens under the zoo condition, where these birds were maintained away from the probable source of contact with infected chickens.

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LYMPHOMATOSIS IN A PEAHEN AND A PIED MYNA

BY

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LYMPHOMATOSIS IN A PEAHEN AND A PIED MYNA

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ABSTRACT Two cases of visceral lymphomatosis affecting a peahen and a male pied myna were encountered during a surveillance of 250 pathological specimens of various species of zoo birds. The gross and microscopic lesions observed in this study simulated to those of lymphomatosis in chicken and other cage birds.

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INTRODUCTION

Lymphomatosis has occasionally been reported to occur in a variety of avian species. Isolated cases of lymphomatosis have been encountered in canaries and budgerigars (Beach, 1962; Blackmore, 1965; Petrak and Gilmore, 1969), quail (Wight, 1963; Loliger and Schubert, 1967), turkeys (Simpson, 1957; Belding, 1958), swan (Blomberg, 1949) and ducks (Cottral and Winton, 1953).

Since there is a paucity of reports of lymphomatosis in zoo birds, the following cases in a peahen and a pied myna are herein described.

MATERIALS AND METHODS

The specimens for this report were obtained from a zoo, where a variety of wild and semiwild, exotic and indigenous birds have been maintained. Histological tissue pieces comprising liver, spleen, kidneys, heart, brain, lung, trachea, proventriculus and intestines were collected at postmortem from a 6-year old common peahen (case 1) and a 2-year old male pied myna (case 2) and fixed in 10% formol-saline. Thin pieces of tissues were processed for paraffin sectioning and sections were stained with haematoxylin and eosin.

RESULTS AND DISCUSSION

Case 1 (peahen): Grossly the liver and spleen were abnormally enlarged and friable. The outer surfaces and cut substance of these organs revealed grayish confluent areas against a background of normal colour of tissue. The kidneys were enlarged and studded with grayish white foci. Intestines showed ulceration of mucous membrane and lungs and trachea were congested. Heart, proventriculus, ovary and brain were apparently free from any detectable gross lesions. Microscopically, the liver had irregularly distributed coalescing foci of lymphoid cells which also infiltrated the sinusoids, thus sequestering the hepatic cells in the form of clusters (Fig. 1). The cells were predominantly undifferentiated uniform blast-type with vesicular nuclei. Lymphoid cells with few mitotic figures diffusely infiltrated the sinuses and the red pulp of the spleen (Fig. 2). Cells of the lymphoid

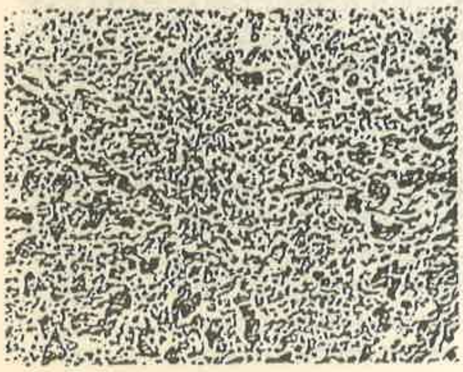

Fig. 1 Liver-showing infiltration of tumor cells into the sinusoids sequestering the hepatic cells in the form of epithelial clusters. H & E, × 100.

* Nandan Kanan Zoo, Cuttack, Orissa.

series also infiltrated the myocardium and interstitium of lung. There was diffuse infiltration of lymphoid cells in the kidneys, at places replacing the tubules (Fig. 3). The proventricular and intestinal mucosa were partially substituted by infiltrating lymphoid cells and at places completely replaced the glands. Ovary had mild lymphoid cell infiltration into the stroma.

Case 2 (pied myna): The affected organs were not as markedly enlarged as in the previous case, but revealed small grayish coloured foci in the liver and mottling of spleen. Small pin-head sized nodules were seen confined to the serosal surface of intestines. Gross lesions were not detectable in other tissues. Microscopic lesions consisted of discrete foci of lymphoid cells of uniform and more mature type. Mitotic figures were not seen. Few subpleural lymphoid cell foci were seen in the lungs. The intestinal section revealed intact and degenerated sections of helminth parasite encapsulated by connective tissue sheath in the serosa without any cellular reaction.

The gross lesions in lymphomatosis as described by Petrak and Gilmore (1969) in canaries and budgerigars simulated to those found commonly in chickens and also to those observed in peahen in the

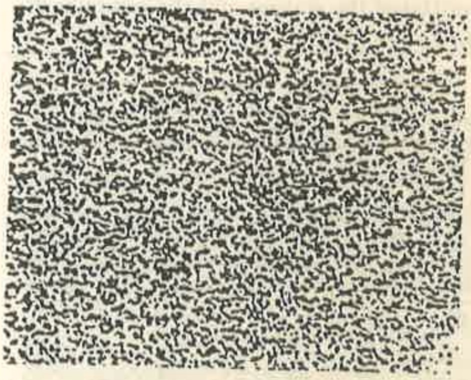

FIG. 2 Spleen—Diffuse infiltration of tumor cells into the sinuses and red pulp, H & E. ×100.

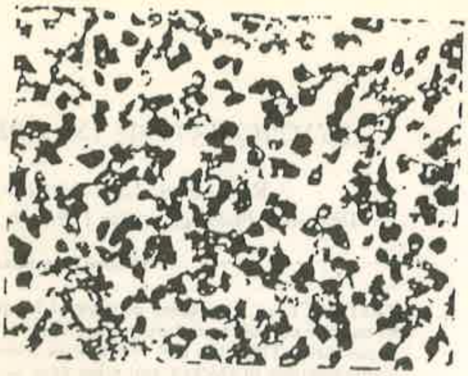

FIG. 3 Kidney—Diffuse tumor cell infiltration in the intertubular spaces, H & E, ×400.

present case. However, microscopic lesions although basically similar, varied in the type of infiltrating cells in the case of peahen, being more of blast-type rather than discrete foci of lymphoid cells of uniform and mature type. Loliger and Schubert (1967) observed high incidence of lymphomatosis in quail with an infiltration of undifferentiated primitive lymphoid cells similar to leucosis in chickens.

In the present study, 2 distinctly separate types of pathological manifestations of a single disease entity have been encountered in 2 different species of birds: one having a uniform undifferentiated primitive type of cell population with few mitotic figures implying an actively proliferating growth and the other with an infiltration of more mature type of lymphoid cells. The difference in the microscopic and gross lesions between these 2 cases might be due to varying susceptibility of the species, tissue response and difference in the strain of etiological agent involved.

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Br. vet. J. (1972), 128, 428

STUDIES ON AN OUTBREAK OF *MYCOPLASMA GALLISEPTICUM* INFECTION AMONG PEAFOWLS (*PAVO CRISTATUS*)

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SUMMARY

An outbreak of *Mycoplasma gallisepticum* infection was recorded in a batch of 21 peafowls kept in the State Biological Park, Orissa. The clinical signs manifested by the seven affected peafowls were dullness, frequent shaking of the head, sticky nasal discharge, mouth breathing and swelling of the infraorbital sinus. *M. gallisepticum* was isolated from six out of seven of the clinically affected birds. Treatment with oxytetracycline hydrochloride and vitamin A cured the condition in ten days.

INTRODUCTION

Mycoplasma gallisepticum is known to cause infectious sinusitis (IS) in turkeys and chronic respiratory disease (CRD) in chickens. Reports on the occurrence of pleuropneumonia-like organism (PPLO) infection in wild birds are scanty. Wills (1955) isolated a PPLO from a peacock which was shown to be identical with the causative organism of CRD in chicken and IS in turkeys. The present paper records the occurrence of an outbreak of PPLO infection in a flock of peafowls. Characteristic clinical symptoms exhibited by the sick birds and the result of their treatment along with methods of isolation and characterization of the causative agent are described.

MATERIALS AND METHODS

On receiving a report of an outbreak of respiratory syndromes in a group of 21 peafowls maintained in "Nandan Kanan", State Biological Park, Orissa, an investigation was undertaken. The clinical symptoms manifested by the flock in general and the individual affected birds were recorded during various stages of the outbreak.

Rapid whole blood plate agglutination test was performed at the spot by using a drop of blood from the wing vein of each bird and a drop of PPLO diagnostic antigen†. Reaction (appearance of clumps) was read within two minutes of adding the antigen.

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† Commonwealth Serum Laboratories, Melbourne.

PLATE I

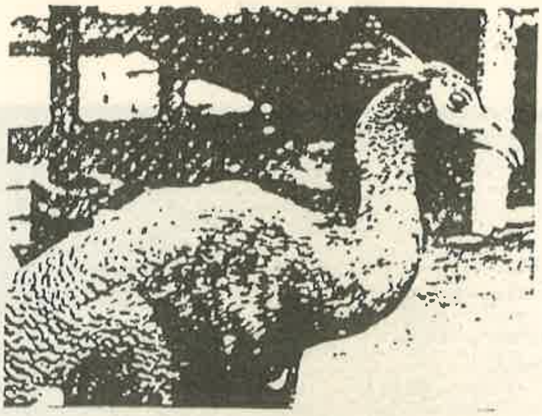

Fig. 1. Affected peafowl showing unilateral infra-orbital swelling.

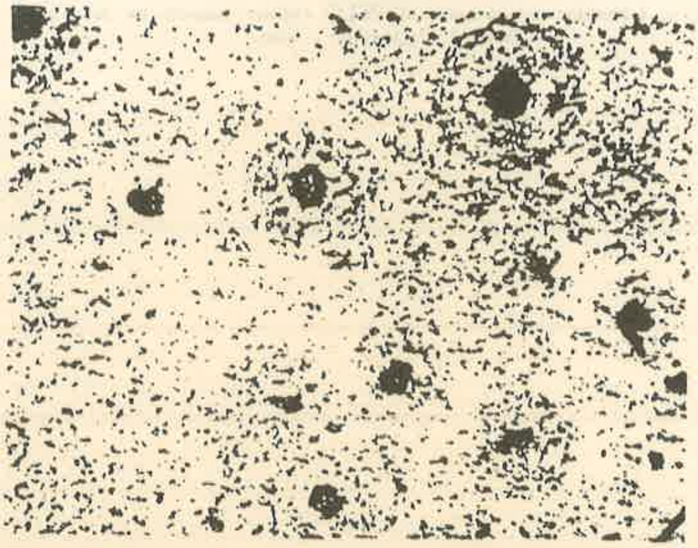

Fig. 2. PPLO agar plate showing 7-day-old PPLO colonies. × 100.

PLATE - II

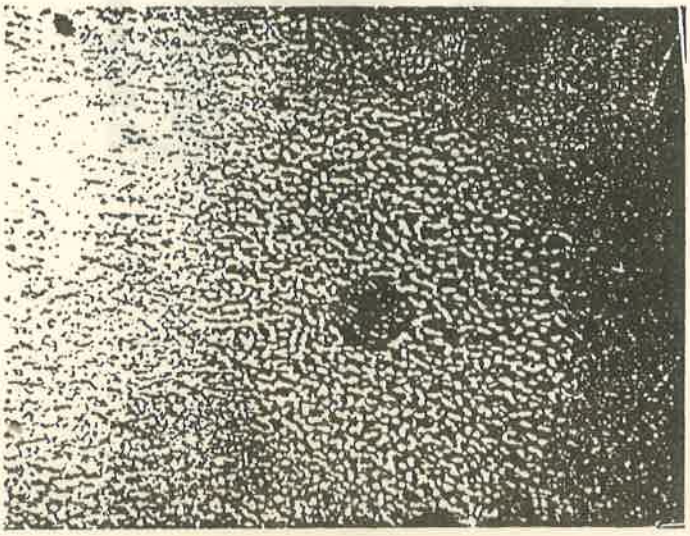

Fig. 3. Granular appearance of PPLO colony stained by Dien's method of staining. × 100.

Tripathy, Acharjyo, Singh, Ray, Misra. *Br. vet. J.* (1972). **128**, 8

Tracheal swabs were collected separately from each bird showing clinical signs. Exudates were also collected separately from birds showing swelling of the infraorbital sinus by a sterilized syringe and needle. Immediately after collection each of the tracheal swabs was dropped aseptically into a tube containing 5 ml of PPLO broth*. Similarly, 2–3 drops of infraorbital exudate was also mixed separately with 5 ml of PPLO broth in a test tube. All these tubes were mixed thoroughly by shaking 10–12 times. After these had been incubated at 37°C for 6 hours, 0·1 ml of each was transferred to another tube containing 3 ml of fresh PPLO broth and incubated at 37°C for 3 days. Three similar blind passages at intervals of three days were made and then 0·1 ml of broth culture was transferred to PPLO agar plate†. Each plate was incubated at 37°C for 5–6 days in 10 per cent carbon dioxide and then studied microscopically. Plates showing typical PPLO colonies were further studied microscopically by using Dien's method of staining (Adler, Fabricant, Yamamoto & Berg, 1958). Smears were made from the colony grown on PPLO agar and from sediment of the last passage of PPLO broth culture after centrifugation (at 4000 rev./min for 15 minutes) and stained with Giemsa stain. The morphological features were noted under oil immersion.

Haemagglutination test (Yoder & Hofstad, 1964) was performed using 0·5 per cent chicken red blood cells with 5-day-old broth culture of the isolated PPLO strain. Haemagglutination pattern was studied at hourly intervals for three consecutive hours under room temperature.

The six-day-old culture was stabbed into tetrazolium medium (Yamamoto & Adler, 1958) and the reduction of the dye, as evidenced by the appearance of blue colour in the medium, was observed at 12-hourly intervals for 72 hours.

Each sick bird showing infraorbital swelling was given a single injection of 1·5 ml of Terramycin Injectable Solution‡ intramuscularly with another 0·5 ml of terramycin solution being infused into the infraorbital swelling after removal of the exudates by aspiration with a sterilized syringe and needle. Others having no infraorbital swelling but having other clinical signs were given a single injection of 2 ml Terramycin solution intramuscularly. The whole flock was also treated with T.M. Poultry Formula§ at the rate of 4 g in 4·5 litres of drinking water for 7 days, and 2·5 ml of Vitablend W. M. Forte|| daily in the drinking water for the subsequent 7 days. Drinking water supplies from other sources were suspended.

* PPLO broth: One litre of beef heart infusion containing 10 gm of peptone (Difco), 5 gm sodium chloride, 100 ml horse serum, 300 mg thallium acetate and 1,000,000 Benzyl penicillin sodium.

† PPLO agar: One per cent Bacto-agar (Difco) added to PPLO broth without penicillin.

‡ Terramycin Injectable Solution (Pfizer): 1 ml contains 50 mg of oxytetracycline hydrochloride.

§ T. M. Poultry Formula (Pfizer): Each 4 g contains oxytetracycline 200 mg and benzethonium chloride 200 mg.

|| Vitablend W. M. Forte (Glaxo): Each ml contains vitamin A 100,000 i.u.

RESULTS AND DISCUSSION

In the flock of 21 peafowls, characteristic clinical signs were observed in 7 individuals. Affected birds were dull and inactive. Frequent shaking of the head, sticky mucoid discharge from the nostrils and mouth breathing were observed in most of the affected birds, Unilateral (Fig. 1) and bilateral swelling of the infraorbital sinus were observed in four and one peafowls, respectively. A peculiar gurgling sound audible even from a distance was marked in these affected birds. There was reduced feed intake and loss of weight among the sick birds. The above clinical symptoms were identical with those of infectious sinusitis in turkeys as has been described by Biester & Schwarte (1965).

Rapid whole blood plate agglutination test revealed the presence of *M. gallisepticum* antibodies in 15 (71·4 per cent) cases including all the seven ailing birds. In an earlier serological study by some of us, two out of the six of the above birds had shown positive reaction to whole blood agglutination test (Tripathy, Acharjyo, Singh & Misra, 1971).

Out of the seven tracheal swabs and five infraorbital exudate samples cultured from the seven clinically affected cases (cultured in PPLO broth and subsequently sown on PPLO agar plate), three tracheal swab cultures (one swab from a peacock having no infraorbital swelling) and all the five exudate cultures showed the presence of minute dewdrop-like PPLO colonies having a nipple at the centre (Fig. 2). Microscopical examination of representative colonies after staining with Dien's stain revealed small coccoid bodies at the periphery (Fig. 3). The Giemsa stain smears from all plates showed the presence of small coccoid and short filamentous bodies. Haemagglutination test was found to be positive at 1:20 dilution and the tetrazolium blue was reduced in 24 hours.

The growth characteristics, haemagglutination test, tetrazolium blue reduction test and the clinical symptoms manifested in the infected birds indicated that the isolated *M. gallisepticum* was pathogenic. The presence of *M. gallisepticum* antibodies in the peafowls before and during the outbreak and isolation of the organism from the clinically positive cases indicate that peafowls are susceptible to PPLO infection. Due importance should be paid to the fact that they can act as carriers like fowls, turkeys, ducks, geese, sparrows and many other wild birds (Anon., 1962; Doroshko & Baidevlyatov, 1966; Jain, Chandiramani & Singh, 1971).

Treatment of the affected birds with Terramycin and vitamin A resulted in the gradual disappearance of the clinical symptoms within ten days. The birds resumed their normal feed consumption. The signs have not reappeared till now, i.e., six months after treatment. Gurumurty & Mohiuddin (1964) have also reported the successful use of Terramycin in an outbreak of PPLO infection in fowls.

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Etudes concernant le début de l'infection à *Mycoplasma gallisepticum* chez les paons *(Pavo cristatus)*

(Tripathy *et al.*)

Résumé. Un début d'infection à *Mycoplasma gallisepticum* fut enregistrée dans un lot de 21 paons gardés dans le Parc Biologique d'Etat, Orissa. Les signes cliniques manifestés par les sept paons affectés furent la torpeur, des secousses fréquentes de la tête, un écoulement nasal épais, une respiration par la bouche et une inflammation des sinus infra-orbitaires. *M. gallisepticum* fut isolé chez six parmi les sept des oiseaux atteints cliniquement. Le traitement par oxytétracycline hydrochlorique et la vitamine A remédièrent à cet état en dix jours.

Beobachtungen über den Ausbruch einer *Mycoplasma gallisepticum* Infektion bei Pfauen *(Pavo cristatus)*

(Tripathy *et al.*)

Zusammenfassung. Im State Biological Park, Orissa, wurde der Ausbruch einer Infektion mit *Mycoplasma gallisepticum* bei einer Gruppe von 21 Pfauen festgestellt. Sieben der erkrankten Tiere zeigten Benommenheit, häufiges Kopfschutteln, klebrigen Nasenausfluss, Mundatmung und Schwellung des Sinus infraorbitalis als klinische Symptome. *M. gallisepticum* wurde von sechs der sieben klinisch erkrankten Hühner isoliert. Behandlung mit Oxytetrazyklin-hydrochlorid und Vitamin A brachte die Krankheit in zehn Tagen zum Stillstand.

Estudios sobre una epidemia de infección por *Mycoplasma gallisepticum* en pavos reales *(Pavo cristatus)*

(Tripathy *et al.*)

Resumen. Se registró una epidemia de infección por *Mycoplasma gallisepticum* en un grupo de 21 pavos reales conservados en el Parque Biológico del Estado, Orissa. Los signos clínicos manifestados en los siete pavos reales afectados por la enfermedad fueron un estado de letargia, movimientos frecuentes de la cabeza, descarga nasal espesa, respiración por el pico e inchazon de los senos infraorbitales. El *M. gallisepticum* se pudo aislar en seis de las siete aves afectadas con signos clínicos. El tratamiento con hidrocloruro de oxitetraciclina y Vit. A condujo a la curación en el plazo de diez dias.

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NOTES ON A NODULAR DISEASE OF THE INTESTINE OF THE OPEN-BILLED STORK — (Anastomus oscitans) CAUSED BY Chaunocephalus ferox

Although the occurrence of *Chaunocephalus ferox* (Rudolphi, 1795) Dietz, 1909, in crypts in the intestines of the Indian open-billed stork (*Anastomus oscitans*) was known (Rai, 1963, Ind. J. Helminth., 15: 6-13), detailed information on the pathology of the parasite in this host was not available. During investigation of an epizootic disease among open-billed storks, maintained on a snail diet (*Viviparu* sp.) at Nandankanan zoo, nodular lesions caused by *C. ferox* were encountered in the post-duodenal part of the small intestine of seven of ten storks examined post-mortem by one of the authors (MMP). In the foregut, concurrent infections with *Synhimantus laticeps* Rudolphi, 1819 also were observed in four of them. All birds infected with *C. ferox* had signs of diarrhcea, listlessness, loss of appetite and convulsion before death. This presentation gives the relevant descriptions of the trematode and histopathology of the parasitized nodule.

Materials and Methods

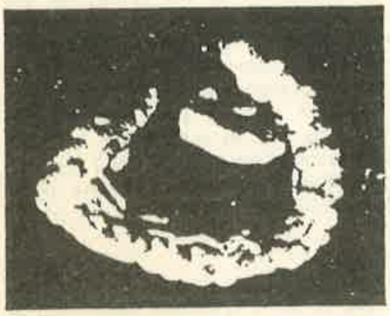
Nodular lesions of the intestines were collected during post-mortem examinations of the birds. The trematode parasites recovered from the nodules were flattened and fixed in Bouin's fluid, stained with Borax-carmine and mounted. The intestinal nodules were fixed in 10% formol-saline. The sections prepared from the paraffin embedded nodular lesions were stained with hematoxylin and eosin.

Observations

The nodules were globular, circumscribed and prominent on both the serosal (Fig. 1) and mucosal surfaces. A perforation was noticed on the summit of the protuberence on the mucosal surface through which trematode ova and cellular exudate oozed out. On squeezing the nodules, one or more viable pink trematodes were recovered. The smaller nodules invariably contained immature parasites and the larger ones contained ovigerous, adult forms.

All the parasitic trematodes were *C. ferox*. The adult mounted specimens measured 3.5-6.5 mm in length, 1.25-3.25 mm in width at the preacetabular part and 0.6-0.75 mm at the postacetabular part. There was little difference in size of the postacetabular part between the juveniles and adults in comparison with their preacetabular parts. Of the 46 specimens examined, 29 had 27 collar spines, arranged in two rows with 4 corner spines without any interruption. Only seven had 26 spines. The oral sucker of the adult was 0.14 mm and the prepharynx was 0.25 mm in diameter. The esophagus was simple, 1.8-2.00 mm long and bifurcated into two lateral caeca in front of the ventral sucker, which ran laterally to the posterior end and opened into the excretory bladder. The ventral sucker was 0.49 mm in diameter. The sucker ratio varied from 1:2.25 - 1:2.5. The pretesticular oval ovary, situated near the right caeca, measured 0.3 x 0.22 mm. The two globular testes were almost equal in size and measured 0.25 x 0.22 mm. (Fig. 2). The eggs measured 0.035 x 0.075 mm.

The sections revealed the parasites in a coiled position inside the nodule. The spinous head collar and fasciculated preacetabular part of the parasite lay in close apposition with the inner wall of the nodule and the aspinous postacetabular slim part was relatively free in a cavity, filled with fibrino-necrotic exudate. In early nodules, at the site of trematode penetration through the mucosa and submucosa, there was traumatic destruction of tissues with haemorrhage



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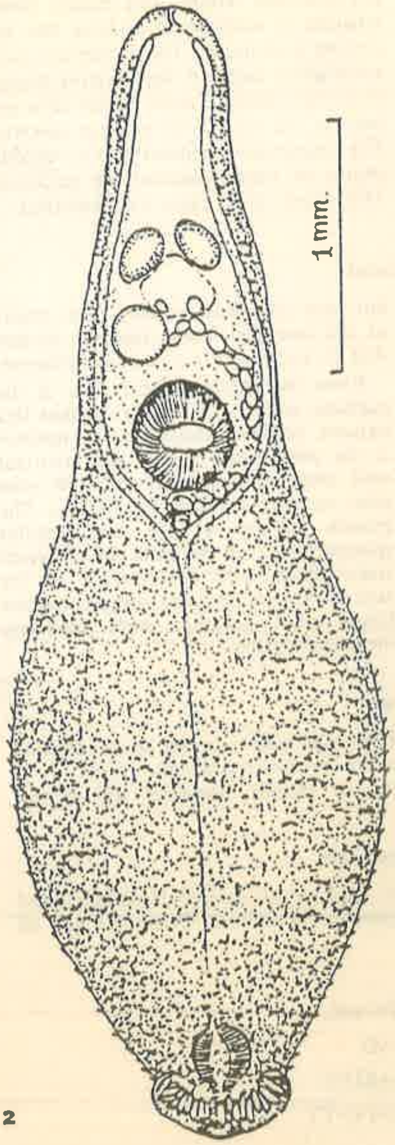

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FIGURE 1. *Nodular lesions on the intestine of heavily infected open-billed stork caused by the echinostome,* C. ferox.

FIGURE 2. *Camera-lucida drawing of a smaller ovigerous* C. ferox *specimen recovered from an intestinal nodule of medium size.*

FIGURE 3. *Section of a small nodule containing the early stages of one parasite* (C. ferox) *and migration of another into the nodule. H.E. x 60.*

and denudation of the epithelium and subepithelium. Further, the parasite left a trail of such destruction (Fig. 3) in submucosal tissues to where it settled in deeper locations, near or beyond the muscularis mucosa. There was marked thickening due to edema and excessive infiltration of granulocytes and lymphocytes. Fibroblasts and connective tissue fibres were seen at the periphery of the circumscribed lesions. The muscle fibres adjacent to early small nodules had increased granularity. The sarcoplasm was eosinophilic and had degenerative changes in the nuclei. In more advanced larger nodules the muscle fibres were necrotic. The intergrading nodules had a variable degree of fibrosis around the parasites. The serosa in all cases was thickened.

Discussion

The *C. ferox* specimens dealt with in this study were much smaller than those described by Dawes (1956, *The Trematoda*, Cambridge Univ. Press, London, 360 pp.) and closely corresponded with the given descriptions of *C. odhneri* Vrat, and *C. kirati* Vrat (1947, Proc. Nat. Acad. Sci. 17B:95-116) recorded from this host. Rai (1963, Ind. J. Helminth., 15:6-13) had considered *C. odhneri* as a possible synonym of *C. ferox*, now studied, except for the sacculated esophagus and unequal testes. It is evident from the figures given by Vrat, the trematodes were recovered from such nodular lesions but were described as being from crypts of the intestine. These findings suggest that *C. kirati* also is a possible synonym.

From the uniform distribution of the parasitic nodules, it is believed that this parasite becomes established in nodules at the predilectory site in the intestinal wall and continues histiozoic life even after attaining maturity in this host. The growth patterns of the preacetabular spinous parts of parasites of different sizes, which were proportional to the size of the nodules, also suggest that the larger adult parasites were relatively more pathogenic.

Summary

An account is given of the pathology of nodular lesions in the small intestine of open-billed storks, *Anastomus oscitans*, caused by *Chaunocephalus ferox*. It is suggested that the parasitic trematodes lead an entirely histiozoic life in this host.

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Aortic Body Tumor in a Duck

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Abstract. A chemodectoma of the aortic body was found at the base of heart of a Brahminy duck *(Tadorna ferruginea)*. It incorporated aorta and pulmonary artery at their emergence, part of vagus nerve, sympathetic ganglion, and thyroid gland. The tumor cells had infiltrated the local lymphatics only.

Tumors of aortic and carotid bodies are rare and have been reported mainly in man [4] and dog [1, 3, 6], although other animals are occasionally affected [4, 7–9]. Tumors that arise from chemoreceptive cells in these bodies are commonly referred to as chemodectomas. They are in general related to the common group of non-chromaffin paragangliomas [5].

An aortic body tumor in a Brahminy duck, a migratory bird of northern India, Nepal, and Pakistan is described. Such a tumor or related tumors has not been reported in any avian species.

Case Report

A 2-year-old male Brahminy duck in a zoo died without any specific clinical signs. It had a globular, circumscribed, 2-cm fleshy mass that was firmly adherent to the base of the heart between the aorta and pulmonary artery and enveloped these vessels at their emergence and compressed the atria. The pericardium covered the surface of the tumor, thus forming its capsule. The cut surface was pink and lobulated. A circumscribed red-brown structure about 4 mm thick was embedded in the anterior border of the tumor. The aorta and pulmonary artery were free from gross lesions. There was copious pericardial effusion. The liver, spleen, kidneys, and lungs were intensely congested. The liver was fibrosed and covered with a yellow fibrinous coating. The serous membranes were covered with fine, white crystalline urate deposits.

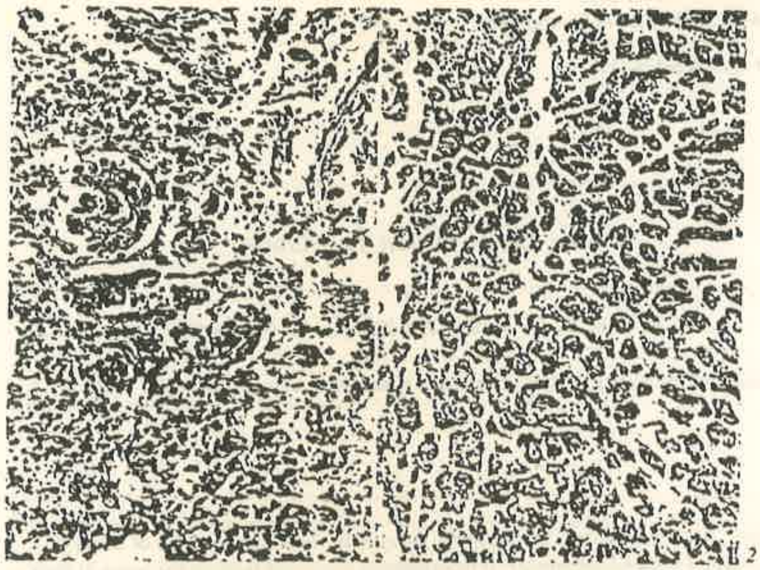

Fig. 1. Tumor cells arranged in sheets. Peritheliomatous arrangement and trabeculae are also seen. HE.
Fig. 2. Tumor cells arranged in the form of pallisades around capillaries. HE.

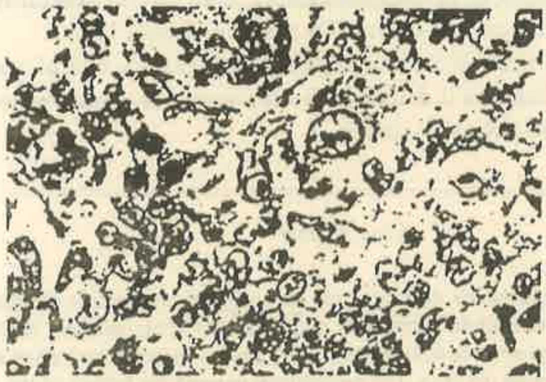

Fig. 3. Higher magnification showing some bizarre cells with vacuolated cytoplasm and large nucleus and nucleolus. HE.

Thin pieces from various tissues including several from the tumor were fixed in 10% formol-saline and embedded in paraffin. Sections were cut at 4–6 μm and stained with hematoxylin and eosin. Some were also stained with Masson's trichrome, Foot's silver impregnation method for reticulum, periodic acid-Schiff (PAS), van Gieson's, and Gomori's chromaffin.

The tumor was composed largely of cells in broad sheets or nests (fig. 1). Thin branching trabeculae extending from the capsule divided it into lobules of irregular size. The cell nests were separated by a loose and well vascularized fibrous stroma. In some places the cells were oriented around thin-walled capillaries forming peritheliomatous or perivascular pallisades (fig. 2), whereas in others they assumed an alveolar or low papillomatous pattern.

The cells in the nests and around the capillaries were round or ovoid, but were large and polyhedral when in broad sheets. The cytoplasm of these cells was abundant, faintly acidophilic and granular or finely vacuolated. Nuclei were large, spherical, and sometimes hyperchromatic, often with a single nucleolus. Cellular boundaries were indistinct. Cells with a large, irregularly-shaped nucleus, often with two nucleoli, were scattered among the tumor cells (fig. 3). Part of the vagus nerve, sympathetic ganglion, aorta and pulmonary artery were incorporated in the mass. The red-brown nodule in the anterior border was thyroid that contained normal acini with colloid. A lymph vessel was filled by a tumor embolus. The neoplastic cells had no tendency to invade the aorta and pulmonary artery or the capsule of the thyroid gland. Occlusion of the blood vessels by organized thrombi was evident in the lung; there were no tumor emboli.

Argyrophilic reticular fibres were sparsely distributed in the connective-tissue stroma, but were abundant around capillaries. PAS-positive material within nests of tumor cells was not detected. Neoplastic cells in a section treated with Gomori's chromaffin stain did not have any intracytoplasmic granules. Collagenous tissue was demonstrated by Masson's trichrome stain.

Discussion

The general structure of the tumor almost corresponds to that of tumors arising from chemoreceptor organs, namely the cardioaortic and carotid bodies in man and dogs [2, 4].

The location of a cardioaortic body is considered to be of limited diagnostic value since such a body could easily be confused with a tumor of ectopic thyroid and parathyroid in the same region [6]. It has been suggested, however [5], that the anatomic situation is important in diagnosing and substantiating the structure of the tumor.

In the present case it appears that the tumor arose from the chemoreceptor cells of the aortic body. Serous exudation into the pericardial sac and peritoneal cavity, and chronic venous congestion of visceral organs, were apparently caused by compression of the atria.

The urate deposition on serous membranes was a concurrent finding, and its presence appears to have no relation to the tumor.

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SYSTEMIC NOCARDIOSIS IN A HILL MYNAH (GRACULA RELIGIOSA) A PATHOLOGICAL STUDY

by

P. K. R. Iyer*, A. T. Rao**, L. N. Acharjyo***, S. Sahu** & S. K. Mishra**

ABSTRACT

A case of systemic nocardiosis in a hill mynah (*Gracula religiosa*) studied by pathological techniques, is described. Macroscopically, greyish white nodular lesions of 2 to 8 mm in diam. were seen in the lungs, kidneys, proventriculus, mesentery and muscles of the eye ball. Histologically, there was replacement of normal parenchyma in these organs by areas of caseation necrosis or granulomas with epithelioid and Langhan's giant cells. The organism was gram and PAS positive, but not acid fast. No culture was obtained.

Introduction

Nocardiosis has been reported in cattle, dog, cat, goat, horse, domestic rodents and man. The condition, however, is rare in birds and there are only three cases reported in the literature. Of these two were reported from fowls involving the liver and abdominal cavity respectively (Truche, 1926 and Dodge, 1935) and the third from a duck involving the lung (Iyer & Rao, 1971). Nocardiosis has not been reported from other avian species. Systemic nocardiosis in a hill mynah described herein is the first report in this species.

Materials and Methods

A black, 8 months old hill mynah trapped as a chick from forests in Orissa state and maintained in the chick rearing centre was noticed to be blind in both eyes with symptoms of lameness, malaise and loss of weight and was transferred to the local Biological Park Hospital for observation and treatment, where the bird died. Post mortem examination of the bird revealed multiple greyish white

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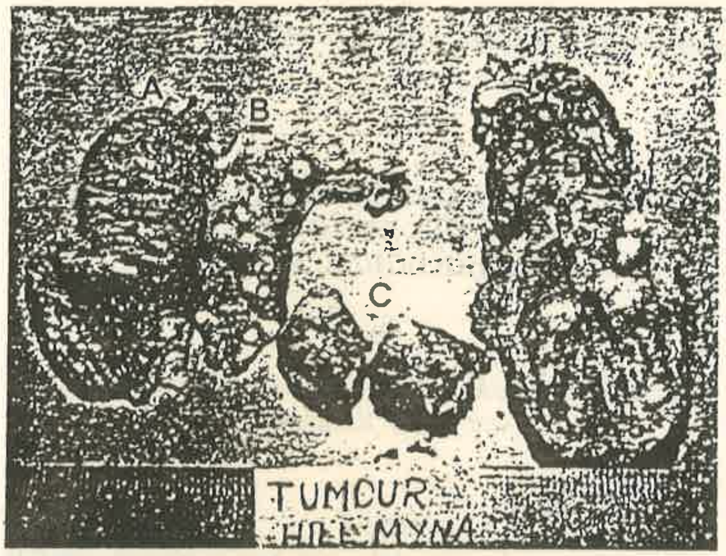

Fig. 1. Normal gizzard (A), with gross lesions on proventriculus (B), eye balls (C), Lung (D) and kidney (E).

circumscribed nodular lesions 2 to 8 mm in diam., scattered throughout the surface and substance of lungs and kidneys, mesentery, luminal side of proventriculus and muscles of eye ball (Fig.1). The condition was suspected for a neoplasm. All the affected organs were collected in 10 % formol-saline. Tissues were embedded in paraffin and sectioned at 5–6 μ thickness. Stains used were haematoxylin-eosin, Hotkiss's modification of periodic acid Schiff's technique (PAS), Ziehl-Neelsen's acid fast technique, acid-fast stain of Fite and Faraco using 1 % aqueous sulphuric acid for differentiation (Emmons, Binford & Utz, 1963), and Gram's in which differentiation was by 1 to 2 seconds exposure to acetone, for organisms.

Impression smears were prepared from cut surfaces of nodules and stained by Ziehl-Neelsen's acid fast technique for organism.

Results

Lungs revealed disorganisation of its normal architecture, leaving behind very little respiratory tissue. Two types of lesions were seen. In one, the lesion could not be differentiated from those caused by other pyogenic organisms characterized by central necrosis and peripheral inflammatory exudate with little or no evidence of fibrosis. The other type of lesion showed areas of caseation necrosis surrounded by epithelioid and Langhans' giant cells merging with granulation tissue (Fig. 2). The latter lesions resembled a tuberculoid granuloma.

Proventriculus revealed disruption and necrosis of surface tubular

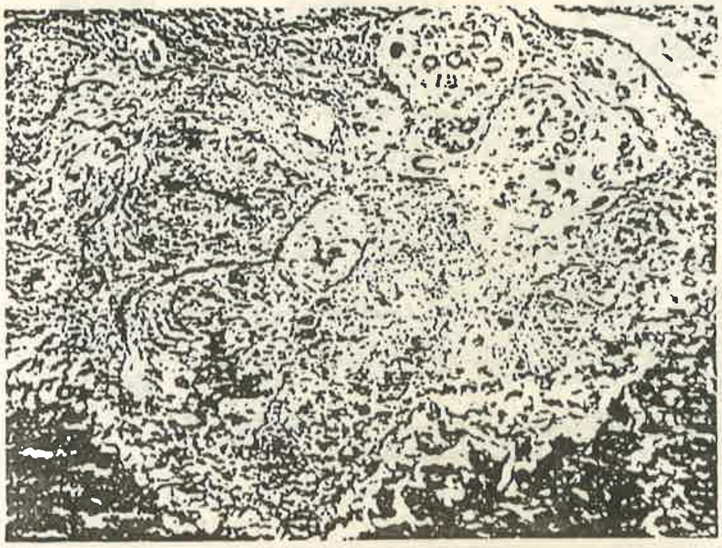

Fig. 2. Lung showing granulomatous lesion surrounded by groups of epithelioid and LANGHAN's giant cells. PAS & Haematoxylin × 65.

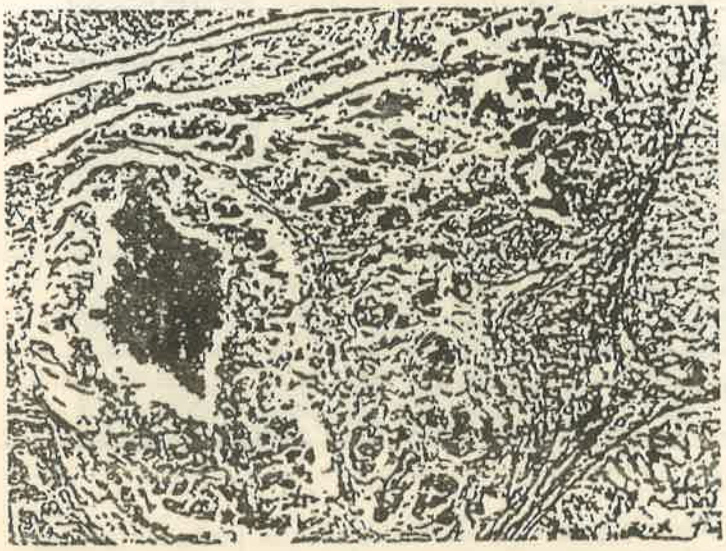

Fig. 3. Proventriculus showing granulomatous lesion in gland lobule, and surrounding small isolated lesions. H & E × 65.

glands and tunica propria. Pronounced changes were confined to the gland lobules and appeared to be the principal seat of involvement. There was obliteration of the lumen, filled with structureless caseo-necrotic mass. Scattered in this mass and particularly towards the

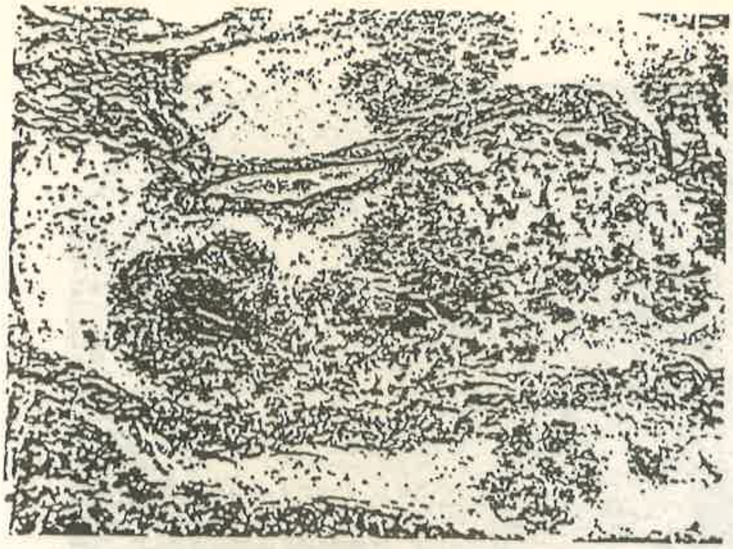

Fig. 4. Ciliary body showing caseo-necrotic lesions, H & E ×65.

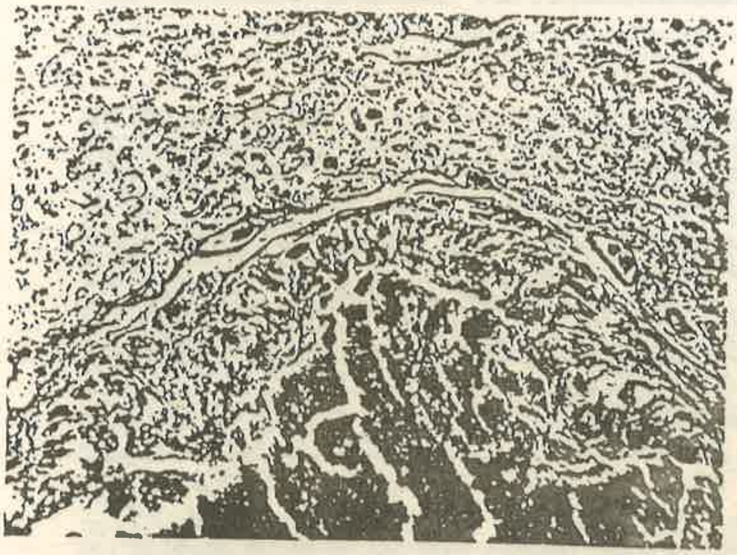

Fig. 5. Kidney showing granulomatous lesion, H & E ×65.

periphery was a large amount of blackish debris, probably the remnants of inflammatory cells. Surrounding the caseo-necrotic area was a distinct zone of epithelioid and LANGHANS' giant cells which merged with granulation tissue on the outside (Fig. 3).

In the granulation tissue were a large number of isolated lesions, each with a central eosinophilic caseo-necrotic mass and surrounded

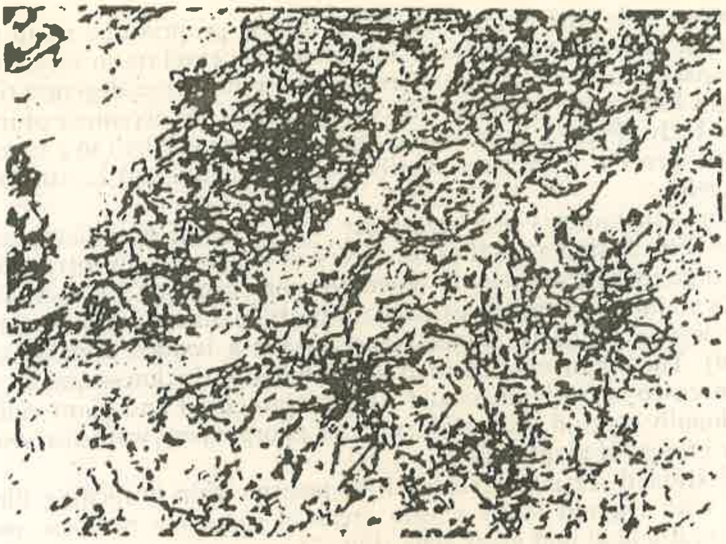

Fig. 6. Lung showing the organisms. Gram × 650.

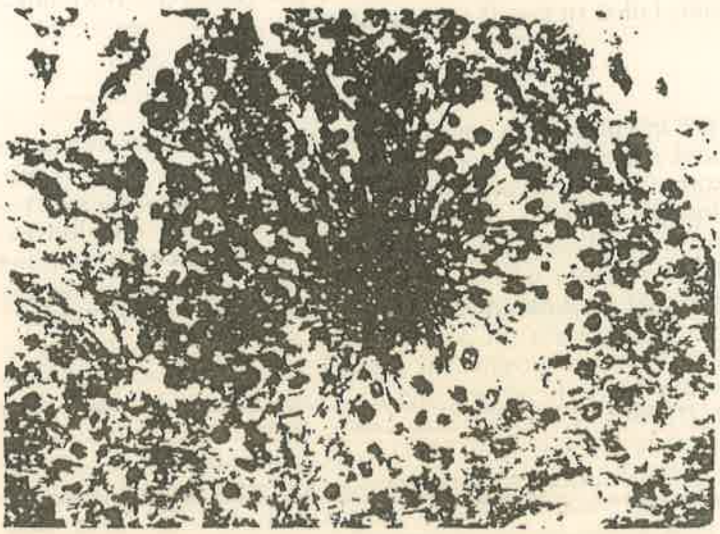

Fig. 7. Kidney showing thin PAS positive filaments in an area of abscess. PAS & Haematoxylin × 650.

by a zone of foamy epithelioid and giant cells and in turn surrounded by a thin fibrous tissue capsule. The lesions in lobules had caused considerable distention of individual lobules and pressure atrophy of neighbouring apparently normal lobules.

In the eye, the cornea showed degeneration of superficial lining squamous cells with thickening of substantia propria due to an infiltration of oedematous and/or inflammatory exudate in interlamellar spaces. Granular layer of retina showed severe degenerative changes leading to necrosis. There was diffuse involvement of iris, ciliary body (Fig. 4), choroid and muscles of the eye ball in a caseo-necrotic process with large number of epithelioid and LANGHAN's giant cells.

Lesions in kidneys and mesentery were typical granulomatous lesions (Fig. 5) similar to those observed in lung and proventriculus.

No organisms were seen in haematoxylin-eosin stained sections. Gram's stained sections revealed gram positive branching filaments, which were irregularly granular and having a beaded appearance (Fig. 6). The organism measured 0.5 to 0.8 μ in thickness and were seen in caseo-necrotic areas and within epithelioid and giant cells. Occasionally coccoid and bacillary forms of organisms were also seen within groups of giant cells.

PAS stained sections revealed PAS-positive thin branching filaments with coccoid forms within areas of caseation necrosis and within epithelioid and giant cells (Fig. 7).

Impression smears and sections stained by Ziehl-Neelsen's technique and acid-fast stain of Fite and Faraco (EMMONS, BINFORD & UTZ, 1963) failed to reveal any organisms.

DISCUSSION

The bird in question was one of the many trapped as chicks in the forests and reared at hill mynah chick rearing centre at Joshipur, Orissa state. The chicks are usually sold to bird dealers for export as pets to foreign countries, since this species of birds are considered as one of the best talking birds. It is fascinating to speculate whether the bird picked up the infection during its captivity, as it is generally considered that mycotic infections are common in captive birds.

Pathogenic *Nocardia* are known from soil where they grow as saprophytes. Animals acquire the disease from saprophytic habitats of the actinomycete in nature, and the condition has been reported in cattle (HOMES, 1908, and SHEATHER, 1920), dog (RAI & NAIR, 1958) and duck (IYER & RAO, 1971) from this country. It is believed that the various animal hosts do not play any role in the distribution and growth of *Nocardia* (EMMONS, BINFORD & UTZ, 1963). The delicate mycelial fragments of *Nocardia* sp. present in the litter and soil can easily get air-borne, particularly when a large number of birds are housed together, and the disease may be acquired through inhalation or through ingestion of contaminated food or through traumatic injury. Since the bird had been in captivity, it is logical to assume that it had picked up the infection at the chick rearing centre. Lesions in the proventriculus could be attributed to ingestion of organism from soil, in the lung to inhalation and the eyes to traumatic injuries.

Differences in the tissue reaction resulting in two types of lesions observed herein may be ascribed to the age of the lesions; early lesions being associated with caseation necrosis and older lesions resulting in typical granulomatous condition with epithelioid and giant cells.

Grossly such lesions in birds would resemble tuberculosis or neoplasms, and are accepted as such in the absence of laboratory examination. It is suggested that laboratory examination of such lesions in the birds should be carried out to gain information on the incidence, which would pave the way for its control in the flock.

Acknowledgment

Thanks are due to Mr. R. Misra, Wild Life Conservation Officer, Cuttack, Dr. B. S. Rajya, Head of Division of Pathology, and Dr. C.M. Singh, Director of Indian Veterinary Research Institute, for providing all facilities and to Mr. M.C. Tewari, Artist, for the photographs.

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J. Zoo An. Med. 10: 73-74

INTESTINAL TRICHOBEZOARS IN A CAPTIVE SLOTH BEAR

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Case Report

Trichobezoars (hair balls) are common in the forestomach of ruminants. They may, however, occur less commonly in the intestines of carnivores such as dogs and cats as well as ruminants.[2] According to Fox[1], hair balls in the alimentary tract of captive wild animals are not common and unless of large size are apparently unimportant. Out of 15 sloth bears of different age groups necropsied over a period of 11 years at Nandankanan Biological Park, Orissa (India), only one case of intestinal trichobezoars has been encountered.

An emaciated, 4-year old sloth bear *(Melurus urcinus)* which had been maintained at the park was found to be listless, dull and depressed. Prior to death, the bear had a poor appetite, had been lying on the ground pressing the abdomen to the ground, and was disinclined to move even when prodded.

At necropsy, the stomach and duodueum were distended with frothy fluid. The jejunum, which was markedly distended at two regions, contained two elongated

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Figure 1. Intestinal Hair Balls (Trichobezoars) removed from sloth bear.

masses, respectively, 14.5 cm and 16.0 cm in length with tapering ends consisting of tufts of hair. (Figure 1) The mucosa was hyperemic while mesenteric vessels were markedly injected. The alimentary canal posterior to the obstruction was devoid of ingesta. No gross lesions were observed in other organs. The cause of death was attributed to inanition resulting from intestinal obstruction. The formation of trichobezoars is probably a normal physiologic process in sloth bears because of their peculiar licking habit among themselves. In this case, the trichobezoars were of sufficient size to obstruct the intestine and cause the death of the bear.

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Intussusception of proventriculus in a common pea fowl (Pavo cristatus)

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INTUSSUSCEPTION of the proventriculus is rare in avian species. There are only three reports in the literature, one on a 10 year old parrot, one on a two year old female budgerigar (Beach 1962) and one on four chickens aged 13 days to three months (Sharma 1972). Intussusception of the proventriculus in a pea fowl is described.

A male common pea fowl aged one year 11 months, which had been maintained at Nandankanan Zoo (India) since July 1976, died on March 27, 1978 after showing clinical signs of drooping wings, disinclination to move, dullness and depression. It had been completely off its food for four days prior to its death.

At necropsy, on opening the abdominal cavity, the gizzard was markedly distended and the entire proventriculus was missing. Upon incision of the gizzard, intussusception of the proventriculus was detected and invagination was complete. The gizzard contained very little ingesta and the musculature was flabby. The proventriculus was distorted, the walls were tough to cut and fibrosed and the lumen was obliterated. Histologically, the serous and muscular coats were markedly thickened due to the infiltration of large number of heterophils and lymphocytes entangled in a fibrin network. There was fibrosis and a number of bacterial colonies were detected.

Intussusception of the proventriculus is uncommon probably due to low intensity of peristalsis. It is generally believed that the weakness of the nusculature especially near the junction of the proventriculus and gizzard and/or hypertrophy of the wall, followed by dilatation caused by dietary factors and/or microbial agents may be predisposing factors in the development of the condition. In this case, inflammation of the proventricular wall associated with bacterial colonies might have caused weakness of the musculature and consequent abnormal peristalsis resulting in this condition.

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SHORT COMMUNICATIONS

PULMONARY ASPERGILLOSIS IN A STRIATED LAUGHING THRUSH

(Grammatoptilla striata)

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Asperigillosis hs been reported in the jay, turkey, ducks, geese, pigeon, parrots, stork, raven, flamingo, hawk, bullfinch, herring, jackdaw, wood pigeon, mynah, swan, plover, pheasant, ostrich and penguin. In this report the disease is recorded as being observed in the striated laughing thrush.

Routine necropsy among captive birds revealed a striated laughing thrush (a Himalayan hill bird) with a firm yellowish white tumor occupying a major portion of the left lung. Several smaller nodules were also observed in the vicinity. Other parts of the respiratory passage were not affected.

Microscopical examination revealed a granulomatous reaction. The large nodule consisted of a caseated necrotic region characterised by eosinophilic karyorrectic and karyolytic nuclei. The margin of the nodules was formed by proliferating epitheloid cells, fibroblasts, lymphocytes and numerous foreign body giant cells. In the P.A.S. reaction, septate hyphae, dichotomous fungal branches and spores in large numbers were seen. The adjacent lung paranchyma revealed pnuemonic changes, atelectasis, congestion of capillaries and haemorrhages into the alveoli. The walls of some of the blood vessels appeared hyalinised and degenerated.

The presumtive diagnosis of Aspergillosis seems consistent with the microscopic changes and staining reaction of the infected cells and were similar to those reported in other species of birds.

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A CLINICAL CASE OF CHRONIC GLOMERULAR NEPHRITIS IN A RHESUS MONKEY *(Macaca mulatta)*

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L.N. Acharjyo, B.V.Sc., A.H.**

A Case Report

A 7 year old rhesus monkey (*Macaca mulatta*) which had been maintained at Nandankanan Zoo, Orissa (India), developed lesions of dermatitis over the hindquarters beginning April 1, 1978. Lazin^{R} Veterinary (an indigenous skin antiseptic manufactured in India) was applied to the lesions, Avil^{r} (Hoechst) was injected at the rate of 2ml intravenously per day for 4 days and 1 ml Lederplex^{R} (Lederle) per day was continued intramuscularly over a period of 9 days after which the lesions of dermnatitis disappeared. A month later the animal became totally anorectic, exhibited rhinitis and severe edematous swelling of both eyelids and the scrotum. Achromycin^{R} (Cyanamid) was administered intramuscularly at the rate of 100mg once daily for 4 days and Avil^{R} (Hoechst) at the rate of 2 ml per day for 2 days was administered. Lasix^{R} (Hoechst) 20 mg a day for 3 days was also given. Iodex^{R} (Bengal Chemical) ointment was applied every day for 5 days over the

Figure 1 : Chronic Glomerular nephritis - Rhesus Monkey

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swollen regions. The clinical signs disappeared but the animal remained dull, depressed and had not eaten for about 10 days prior to death on May 22, 1978. No supportive therapy was employed during the period of illness.

At necropsy, prominent lesions were encountered in the kidneys. Grossly both kidneys were atrophied and mottled. Their surfaces were rough and granular and the cut surface revealed multiple greyish white foci. The capsules were adherent to the parenchyma. The rest of the carcass was pale.

Microscopically, the architecture of kidneys was altered due to the replacement of large areas of parenchyma by fibrous connective tissue. The glomeruli was much reduced in number, distorted and/or atrophied (Figure 1). In some areas only remnants of glomeruli were left, in other areas they were hyalinised whereas a few glomeruli were completely fibrosed leaving behind only scar tissue. Periglomerular fibrosis (Figure 1) and hypertrophy and hyperplasia of endothelial cells of Bowman's capsule were seen in some areas. The tubules were either obliteratedor had cystic dilatations. The dilated tubules often contained hyaline casts. Microcalculi were seen in some tubules. The interstital tissue revealed marked fibrosis associated with mononuclear cell infiltration. The intima of the renal arteriole was thickened due to fibrosis resulting in narrowing of the lumen.

The clinical history together with characteristic histological changes in both kidneys and absence of lesions in other organs suggest renal insufficiency as an apparent cause of death.

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IMPACT OF GROSS AND HISTOPATHOLOGY ON DIAGNOSIS OF DISEASES IN INDIAN WILD RUMINANTS

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Introduction

In India, there are certain inherent difficulties in disease diagnosis of wild ruminants because of lack of adequate facilities for capture operations. Invaribly the animals die suddenly without exhibiting clinical signs and a thorough physical examination and laboratory tests are not feasible. Therefore, one has to resort to detailed necropsy examination and histopathology including other laboratory investigations for acurate diagnosis as has been done in the present studies.

Materials and methods

The materials formed for the study were based on gross and histopathological examination conducted in 127 Indian captive wild ruminants of nine species belonging to 3 families which succumbed at Nandankanan Biological Park during 1967-84. Different tissues with or without gross lesions from 34 spotted deer, 9 hog-deer, 18 sambar, 14 barking deer, 3 mouse-deer, 3 gaur, 8 nilgai, 31 blackbucks and 7 fourhorned antelopes were collected in 10 percent buffered formalsaline solution. The formalin fixed tissues were processed by routine histological technic and paraffin sections were stained by haematoxylin and eosin. Special staining methods such as Ziehl-Nielsen's technic, Giemsa, Gram's, periodic acid-Schiff's (PAS) reaction, Van Kossa's, Verhoeff's, Brown and Brenn, Van Gieson's, Oil Red O Fat, Phosphotungstic acid haematoxylin and Foot's modificatin of Bielchowsky's staining technics were employed, wherever appropriate.

Results

Foot-and mouth disease (FMD) : Of the 16 spotted deer, 34 sambar and 28 blackbucks at risk at the time of outbreak 4, 6 and 15 respectively, exhibited typical lesions of FMD. Type 0 virus was identified from affected cases.

Bluetongue-like disease : Four each of nilgai and fourhorned antelope and 3 of 15 baring deer succumbed to a disease simulting bluetongue. Prior to death, the animals were anorectic, lame and salivated profusely. At necropsy, all the viscera were hyperaemic. Numerous ulcers were seen on the cyanosed and swollen tongue, periople and interdigital tissue. The hypertrophied left ventricle showed a number of pale streaks which on microscopical examination revealed non-suppurative myocarditis. The myocardial fibres showed fragmentation/myolysis/atrophy and /or hyalinisation associated with sarcolemmal cell proliferation.

Tuberculosis : Typical cases - calcified and encapsulated lesions similar to bovine disease were seen in 41.18, 27.78, 42.86, 33.33, 3.23 and 14.29 percent of, spotted deer, sambar, barking deer, gaur, blackbuck and fourhorned antelope, respectively. Lungs were affected primarily in all cases suggesting respiratory route of infection, Udder was occasionally affected. The diagnosis was based on acid-fast organisms in tissue sections.

Nocardiosis : An year old male hog-deer showed numerous pulmonary nodules of 2-6 mm diameter which on microscopical examination revealed epithelioid granulomas with caseation necrosis surrounded by foreign body giant cells. Gram-positive branching filaments morphologically akin to Nocardia sp. were seen in the lesions.

Rhinopneumonic zygomycosis : An emaciated adult male hog-deer exhibited swelling on frontal region with intermittant epistaxis a month prior to death. At necropsy, the nasal chamber was filled with friable caseonecrotic mass admixed with blood clots. The fascial bones were soft and friable. The lungs had a marbled appearance which on microscopic examination, revealed necrosis surrounded by epithelioid cells, PAS stained slides showed numerous broad and thin walled hyphae with nonparallel sides in the necrotic lesions of lung and nasal chamber. The organisms were often empty and had bulbous dilatations with irregular branching.

Fascioliasis : Lesions of hepatic fascioliasis caused by **Fasciola gigantica** were seen in 29.41 and 35.48 per cent of spotted deer and blackbuck, respectively, examined. The affected livers showed pale parenchyma/haemorrhagic foci/scars. Typical lesions of biliary cirrhosis was a characteristic feature. However, the migratory immature flukes caused haemorrhagic tracts in the parenchyma. In one spotted deer, the surface of fluke eggs revealed radiating club shaped structures simulating pseudoactino bodies.

Hepatic amphistomiasis : Cirrhosis and biliary hyperplasia associated with **Paramphistomum explanatum** in bile ducts were recorded in 5 sambar. The lesions resembled those seen in cattle and buffaloes.

Parasitic arteritis : The arterial elevations in a fourhorned antelope was due to presence of gravid nematodes containing microfilaria in fibrocystic spaces of subintimal and medial coat. The parasites were identified as oncocerca sp.

Hydatidosis : Fertile hydatid cysts replacing pulmonary tissue were recorded in a spotted deer and a fourhorned antelope.

Monieziasis : The small intestine of a three month-old barking deer fawn was packed with a large number of adult **Moniezia expansa** resulting in catarrhal enteritis and obstruction.

Theileriosis : The disease was diagnosed in a blcakbuck on the basis of abomasal ulcerations and demonstration of erythrocytic forms of organisms in the peripheral blood.

Sarcocystosis : Sarcocysts displacing cardiac muscles and purkinje fibres without inflammatory reaction were seen in a sambar, nilgai and fourhorned antelope.

Non-specific pneumonia : Pneumonic lesions such as broncho, -fibrinous, interstitial and suppurative pneumonia of undetermined etiology affecting most of the species were seen in 6.30 per cent of cases.

Renal lesions : Renal lesions such as nephrosis (9.45%), glomerulonephritis (4.73%), interstitial nephritis (1.58%), pyelonephritis (0.79%) and microcalculi (2.36%) were seen in most of the species.

Cardiovascular lesions : The markedly fibrosed pericardium of an aged sambar showed a plate of metaplastic bone. The elevation of an arterial intima in a blackbuck was due to impregnation of calcium salts in the internal elastic lamina. There was fragmentation of elastic fibres and replacement fibrosis in medial coat.

Nodular hyperplasia of liver : Eight hog-deer and 2 nilgai showed multiple greyish-white nodules resembling tumours. Histopathologically, the nodules showed lossof normal hepatic lobular architecture and absence of central vein and bile duct. Megalohepatocytes were, however, numerous.

Congenital anomaly : A still-born spotted deer fawn had a peculiar congenital anomaly causing deformation of the skeleton particularly the jaw bones, vertebral column and limbs including the digits.

Foreign Bodies : A number of foreign bodies such as trichobezoar and phytobezoar in a spotted deer, trichobezoar in a mouse-deer, a number of metallic objects in a gaur and nilgai and bundle of ropes and clothes in a blackbuck were seen in the rumen.

Neoplasms : Three spontaneously occurring neoplasms namely lymphosarcoma involving most of the body lymph nodes and spleen with secondary lesions in kidney and liver of a gaur and mesothelioma involving the peritoneum with metastatic growths in liver of a nilgai and reticulum cell sarcoma of a nilgai were recorded.

Conclusions and discussion

Helminthic infestations resulting in specific lesions constituted an important problem in Indian captive wild ruminants. It was fascinating to note that only spotted deer and blackbuck were infected with fascioliasis and sambar with hepatic amphistomiasis inspite of the fact that the feeding and management practices were identical for all the nine species under study. There appeared to exist broad intraspecies similarities in Pathology of bovine fascioliasis (Sinclair, 1967) and bovine hepatic amphistomiasis (Pande *et. al.* 1968). Though bovine oncocerciasis has been reported upto 99.0% in Orissa (Patnaik, 1962), the disease was uncommon in wild ruminants.

The incidence of tuberculosis was considerably high which was in conformity with most of the Indian Zoos (Liston and Soparkar, 1924; Rathore and Khera, 1981). Though the occurrence of bluetongue among wild ruminants was known (Trainer, 1970), its prevalence in Indian wild ruminants was unrecognised. A disease syndrome simulating bluetongue was diagnosed in 3 species on the basis of clinical signs, morbid anatomy and failure ot identify FMD and rinderpest viruses from tongue epithelium and mesenteric lymph nodes. 0 type of FMD virus isolated from spotted deer, sambar and blackbucks suggested that the infection must have been contacted from domestic animals as it is the most common type recognised in India.

Zygomycosis was diagnosed on the basis of demonstration of characteristic hyphae which were significantly broader than the filamentous forms of aspergillus sp., candida sp. and phaeohyphomyces. Since the organisms are known to be widely distributed in nature, it is logical to assume that the primary infection must have occurred in nasal chamber through inhalation and then extended into lungs. As per suggestion of Chandler *et al.* (1980), the authors tempted to designate the condition as rhinopneumonic zygomycosis because of extensive involvement of nasal chamber and lungs. Hepatic nodular hyperplasia of obscure etiology constituting 7.8% of the cases were seen only in hog-deer and nilgai. The lesion was indistinguishable from heptic adenoma.

This study emphasised the importance of gross histopathology in diagnosis of diseases in Indian wild ruminants which otherwise would hve remained undiagnosed.

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Congenital Anomaly in a Still-Born Spotted Deer (Axis axis) Fawn

by

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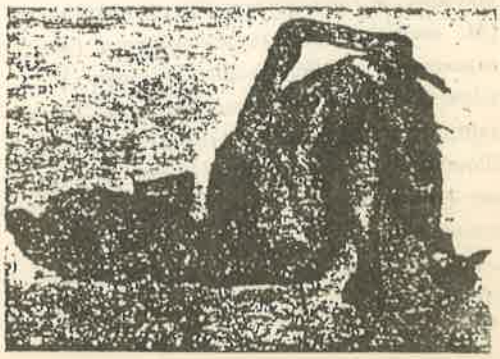

A peculiar case of congenital anomaly involving the skeleton particularly jaw bone vertebral column and limbs in a still-born Spotted Deer Fawn observed at the Nandankanan Biological Park, Orissa is reported here. The Upper jaw was longer than the lower one and was not in opposition. The vertebral column posterior to the cervical vertebrae was deformed The spinous process of thoracic vertebrae at the level of shoulder region were prominent giving a hump like elevation. The lumbar region was markedly depressed. The back region was almost flat. Both the fore limbs were deformed and curved inwards. There was only one digit instead of the usual two. The thigh region was markedly widened. Both the hind limbs were stumpy and curved outwards. The digits were ill developed and curved upwards.

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NOTES ON THE COCCIDIAN PARASITES OF WILD MAMMALS IN CAPTIVITY : AT NANDANKANAN

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SUMMARY

Screening for coccidian Infestations of the mammalian stock of the Nandankanan zoo was conducted and the findings are listed. This list includes the descriptions of four new species : Isospora pardusi from Panthera pardus I, felina and I. bengalensi form Felis bengalensis and Eimeria gaurusi from Bos gaurus.

Introduction

Informations on the coccidian fauna of wild animals is meagre. Pellerdy (1963, 1969) in his comprehensive catalogues included all the known forms of coccidian parasites reported from Indian wild animals. To this Pande, Bhatia, Chauhan and Garg (1970) have added 6 new species. Patnaik and Acharjyo (1970) earlier described two eimerian forms from a primate (*Nycticebus coucang*) and redescribed the isosporan forms from an African Iron of this Nandankanan.

Materials and methods

To study the prevalence of coccidian parasites in the faecal samples from the other 38 representative mammalian hosts of this zoo, maintained in 2.5% potassium dichromate solution at room temperature, on different occasions were examined. The sporulated and unsporulated oocysts encountered in the samples were studied in detail in order to reach the specific diagnosis and the findings were host-wise listed. The descriptions of the new forms with camera-lucida figures were also furnished.

Observations

The samplesof primates--Slender loris (*Loris tardigradus*), White browed gibbon (*Hylobates hoolock*), Common langur (*Presbytis entellus*), Capped langur (*P. pileatus*), Nilgiri langur (*P. johni*), Bonnet-macaque (*Macaca radiata*), Rhesus macaque (*M. mulatta*), Assamese-macaque (*M. assamensis*) and Stump-tailed macaque (*M. silenus*), contained no coccidail cysts. The samples from Jaguar (*Panthera onca*), Clouded leopard (*Neofelis-nebulosa*), Fishing cat (*Felis niverrina*), Golden cat (*F. temmincki*), Crab-eating mongoose (*Herpestes urva*), Sloth bear (*Melursus ursinus*), Smooth Indian otter (*Lutra perspicillata*), and Common otter (*Lutra lutra*), among carnivora were also free of coccidian parasites. The samples from the following carnivorous hosts contained the eimerian and isosporan forms of parasites :

Indian lion (*Panthera leo persica*) —
E felis, E. felina, I. leonina.

Tiger (*P.tigris*) —
E. harmani, E. novowenyoni

Leopard (*P.pardus*) —
I. pardusi n. sp.

Leopard eat (*Felis bengalensis*) —
I. felina n. sp. and i. bengalensi n sp.

Indian fox (*Vulpes bengalensis*) —
E. vulpes, E. hissani, I. vulpes

Striped hyena (*Hyena hyaena*) —
I. levinei

Small Indian mongoose (*Herpestes auropunctatus*) : *E. pandei, E. neualai, Is horai*

Veterinary Assistant Surgeon, Nandankanan

Similarly the samples from ungulates Barking deer (*Muntiacus muntjak*), Sambar (*Cervus unicolor*), were free of coccidian cysts. the samples from the following ungulate hosts contained the many eimerian parasites :

Spotted deer (*Axis axis*) :
E. Cheetalai, E. wasielewskeyi,

Black buck (*Autilope cervicapra*) :
E. antelocervi, E. cheetali

Hog deer (*Axis porcinus*) :
E. parahi,

Mouse deer (*Tragulus meninna*)
E. ramgai

Four-horned antilope (*Tetracerus quadricornis*)
E. Chousinghai

Nilgai (*Boselaphus tragocamelus*) :
E. yakimovi

Indian bison - (*Bos gaurus*) :
E. gaurusi n. sp.

Among rodents : hare (*Lepus nigricollis*). Indian giant squirrel (*Ratufa indica*). Indian porcupine (*Hystrix indica*), were free of coccidian parasites. The faecal smaples from Red-flying squirrel (*Peta-urista albiventer*) contained the oocysts - *E. Pentauristae*.

Isospora pardusi n. sp.
(Figure No. 1 and 2)

Host : Leopard cub *panthera pardus* Linnaeus

The oocysts were colourless and oval in shape. There was no distinct micropyle. They measured 40-49 μ in length and 30-36 μ in breadth. (Average 45 x 33 μ) The unsporulated oocysts contained a relatively small spherical sporont which further broke on sporulation and developed into two oval sporocysts in 72 hours time. There was no oocystic residum. The sporocysts measured 22.5 μ long and 18 μ wide and contained four elongate symatrically arranged sporozoites and a residual mass of 18 x 12 μ consisting of globular bodies. Sporozoites measured 15 x 4.5 microns.

The present material was distinct from *P. leonina* in size and *I. felis* and *I. rivolta* in shape and sporultion time.

There was no recorded evidence to indicate that *P. pardus* is a specifically known host for isosporan parasites. Humpery and Segal, 1966. Segal *et al.* 1968. Hence the species is designated as *I. pardusi.*

Isospora felina n. sp.
(Figure No. 3)

Host : Leopard cat (*felis bengalensis* Keer) aged about 5-6 months

The oocysts are thin walled colourless, ellipsoidal to globular in shpae., and their micropyle was indistinct. They measured 25 x 20 microns and contained the eccentic spherical sporont at the bottom. The oocysts sporulated in 48 hours time into two oval sporocysts of 15 x 21 μ leaving behind no oocystic residuum. The sporocysts contained four elongate to oval sporozoites of 10 x 3 μ and a grannular residual body at the end. They were distinct from both the forms of *I. bigemina* in size on being bigger and this oocyst was not discharged by the host in a sporulated stage.

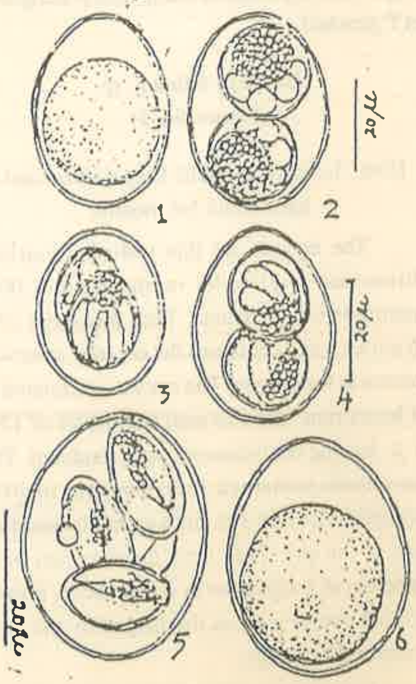
Felis bengalensis does not seem to be a known host for coccidian parasites. (Hempery and Segal, 1966, Segal *et al.* 1968) Hence the species is designated as *I. felina.*

Isospora bengalensi n. sp.
(Figure No. 4)

The oocysts were colour-less, relatively large and oval in shape. The micropyle is inperceptible. They measured 40 x 30 μ and a basely located subglobular sporont. The oocysts required 72 hours to sporulate into two oval sporocysts leaving behind no oocystic residuum. The sporocysts measured 11 x 9.5 μ and contained four banana shaped sporozoities and a globular sporocystic mass consisting of granular bodies. The intrasporocystic sporozoities measured 8.5 x 2.75 μ.

Fig. No. 1-6

1. Unsporulated oocyst of *Isospora pardusi*
2. Sporulated oocyst of *I. pardusi*
3. Sporulated oocyst of *I. felina*
4. Sporulated oocyst of *I. bengalensi*
5. Sporulated oocysts of *Eimeria gaurusi*
6 Unsporulated oocyst of *E. gaurusi.*



The oocysts were distinct from *I. felina* and *I. revolta* in size and sporulation time. This species is named after the specific name of the host as *I. bengalensi*

Eimeria gaurusi n. sp.
(Figure no. 5 & 6)

Host:-Indian bison (*Bos gaurusi* H. Smith)

The oocysts were smooth walled, colourless and oval in shape and the micropyle was indistinct. Each measured 20.5-22 x 18-19.5 μ with a shape index (L/B) of 1.01. The sporont when fresh was globular in shape and measured 15μ in diameter. In 72 hours time they sporulated into four oval sporocysts, each containing two sporozoites. The oocystic and sporocystic residual bodies were present. The sporocysts measured 10.5 x 4.5 μ and the sporozoites measured 7 x 1.5μ.

The oocysts were distinct from all other eimerian cysts described from the genus *Bos* in shape, size and sporulation time.

Since there was no earlier report of any eimerian species from this host (*Bos gaurusi*) this species was christened with the name *E. gaurusi.* (Humpery and Segal, 1966, Segal et.al, 1968),

Acknowledgement

The authors are grateful to the Director of Animal Husbandry and Veterinary Services; Orissa, and to the Wild-life Conservation Officer, Orissa, Cuttack for the facilities given to under take the study.

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INTESTINAL PATHOLOGY OF OPHIDASCARIS AJGARIS KHERA 1956-INFESTATION IN AN INDIAN PYTHON (PYTHON MOLURUS MOLURUS)

A. T. Rao[1] & L. N. Acharjyo[2]

Necropsy examination of a female python which died on December, 29. 1976 at the Nandankanan Biological Park, Orissa revealed heavy infestation with round worms all along the intestinal tract. The round worms were later identified as Ophidascaris ajgaris, Khera. 1956. Tufts of coiled round worms numbering more than 30 at one location were seen piercing deeply through the intestinal wall (Fig.)

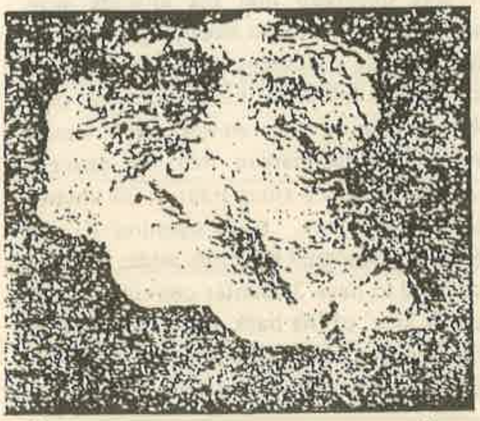

FIG: A portion of intestines of an Indian python showing tufts of round worms penetrating through the mucosa.

Histopathology of sections taken from several such foci revealed that the anterior portion of the parasites were deeply embedded in submucosa causing chronic inflammatory reaction. The reactionary cells were lymphocytes' plasma cells and macrophages in well matured granulation tissue. Perivascular accumulation of such reactionary cells and sclerotic changes in blood vessels were seen in submucosa. In some areas, the parasites had incitepd severe granulomatous response with central caseation necrosis surrounded by macrophages, foreign body giant cells and fibrous connective tissue. Gross section of parasites were also seen in the serous coat.

REMARKS :

Histopathology indicated that the heavy parasitic invasion results in severe damage to the intestinal wall ending in death.

Acknowledgements are given to Dr. K. Ramaswamy, Scientist S_1, Division of Parasitology, I.V. R.I. Izatnagar for identification of parasites.

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Treatment of an obstinate type of fistula in a Zoo Elephant

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Veterinary surgeons rarely have an opportunity of treating elephant (Evans, 1910). McGaughhey (1961) reported that there is meagre information on surgical diseases of elephant even in countries such as Burma, Thailand, India and Ceylon. Evans (1910) stated that in neglected abscesses of the spine of elephant the cause is usually found to be the presence of a portion of dead bone. Angelo et al. (1974) reported that a two year old fistulous tract in an elephant healed in 40 days leaving a cutaneous wound which was dressed with Himax ointment until it was healed.

CASE REPORT

An elephant of Nandan Kanan was presented in the clinic (O. P. No. 2865 dt. 18. 3. 74) with the history of an abscess on its back. The abscess had already been opened and the animal had taken Dicrysticins injection (2.5 gms × 6 vials) daily for four days. On examination it was observed that the abscess was situated in the region overlying the lumbar spinous processes and the abscess cavity was full with thick yellowish pus. After cleaning the wound with dettol solution it was marked that the abscess was leading to a sinus tract of 20 inches long over spines. At its opening it was 6 inches deep and 8 inches wide. It was decided to have 3 counter openings, 2 on either side of the back bone parallel to the opening of the abscess and another one at the middle of the sinus tract of the

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posterior end. This was done to facilitate better drainage and for better approach to the whole length of the sinus. The counter openings were made with a curved abscess knife and the whole sinus wound was curretted with a 10 inch long currator having automatic flushing provision. The necrosed tissues were removed and the wound was packed with magsulf.

The wound was irrigated daily with dettol solution and the magsulf dressing was continued for 10 days. But there was no improvement with the presence of thick discharge of pus from the abscess. For the next 4 days the wound was dressed with gauze soaked in Lugols iodine, the gauze pieces passing through the counter openings. Following this, a treatment with 50 ml of terramycin liquid sprayed inside the sinus tract with the help of a syringe was carried out on every alternate days. The counter openings were packed with sterile gauze. On 22-4-74, it was marked that the depth of the sinus has been reduced to some extent and granulation tissue has formed. Since there was no housing facilities for the elephant and she was in the habit of throwing dust over the wound, it was decided to send back the animal to Nandan Kanan. It was advised to dress the sinus with B.I.P.P. at 2 days intervals.

The elephant came to the clinic on 10-7-74 and it was observed that the sinus had thick exudation without much of improvement. So another counter opening was made at the extreme end of the sinus and it was sent to Nandan Kanan with an advice to continue the dressing with terramycin liquid and intermittently with magsulf.

The elephant was presented next on 18-11-74. It was deteriorating day by day and there was constant discharge of pus from the sinus wound. It was decided to open the whole thickness of the sinus wound.

The elephant was controlled by the "Mahout" in the sternal position. The wound was irrigated with dettol solution and then painted with spirit acriflavin.

ANAESTHESIA :

Novocaine (2%) was infiltrated in the skin over the whole length of the sinus tract.

SURGERY :

One sterilized wire saw was chosen for the operation. One end of the wire was introduced into the sinus and removed through the posterior counter opening at the extreme end of the sinus. The thick wall was cut open with the wire saw. Several patches of necrosed tissues present in the sinus were removed by means of curved Mayo scissors. The wound was cleaned, irrigated with warm saline for 30 minutes and then dressed with terramycin liquid. As there was a gaping of the wouud four stay sutures were given using thick nylon. Daily dressing was advocated by opening the suture, flushing the wound with dettol lotion and by the application of B.I.P.P. The sutures were tied after every dressing inorder to protect the wound from outside exposure and dust. Intermittently the wound was treated with magsulf. Later on the dressing was carried out at an interval of 2 to 3 days. The granulatiou tissue formed very rapidiy. The sinus gradually healed up and came to the surface level.

The elephant was discharged on 17.12.74. completely cured excepting a cutanious wound. Very soon the skin wound healed up and the elephant regained its ability to carry on all types of work.

DISCUSSION

In elephant the most cammon sites of sinus are on the spine and the temporal gland (Evens, 1910). This elephant of Nandan Kanan was used for carrying the visitors inside the zoo and for collecting greens for other animals from the forest. The sinus wound might have occurred due to constant pressure and chronic irritation by the howdah while carrying loads.

The sinus wound did not heal for a long period of 8 months even after the treatment with systemic antibiotics, mal.-ing. surgical drainage, flushing with antiseptic soultion, counter irritants and local antibiotics. The same sinus wound healed very quickly within a period of one month after the exploration of the whole length of the sinus. The wound did not contain any foreign body or fractured piece of dead bone. Singh (1971) observed that due to rich glycogen content present in the elephant and rubbing the wound against hard obiect the healing of the wound is always slow. For the first few months of treatment the elephant was kept under a tree while it was throwing dust over the wound and rubbing the wound constantly with the tree. But later on it was housed inside a building. It might be the fact that the presence of necrosed tissues in patches inside the sinus were responsible for non-healing. Due to excessive length and depth of the sinus the dead tissues were not approchable through the counter openings. After the exploration of the sinus tract and removal of those tissues the wound healed within a period of one month.

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Orissa vet. J. 7 (2 & 3) : 67-69 June-September, 1972

Notes on liver fluke infection in a guinea fowl— *Numida meleagris*

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SUMMARY

Liver fluke infection by a *Opisthorchis* species in a guinea fowl has been recorded and concomitant tissue changes in the biliary ducts and liver parenchyma has been described.

INTRODUCTION

Of all helminthic infections in poultry liver fluke infection seems to be of lesser consequence and *Opisthorchis* species have usually been incriminated. Although there are several records of massive infection in canine and feline hosts incidence of liver fluke infection in poultry have been less frequently reported. There seem to be no record on the occurrence of liver fluke infection in guinea fowl (Humphery and Segal, 1966 and Segal *et. al*, 1968) except for a rare record of its incidence in a wild gallinaceous bird by Srivastava S. C. in 1970 (personal communication by Dr. B. P. Pande).

This paper attempts to place on record a case of liver fluke infection with characteristic histopathological lesions, encountered accidentally, in a guinea fowl (*Numida meleagris*) in captivity at Nandankanan zoological park.

MATERIAL AND METHODS

Entire liver along with other visceral organs collected at autopsy from a guinea fowl by one of the authors (LNA) and preserved in 10% formol-saline was received at the State Veterinary Laboratory for histopathological examination on 27-12-1969. The liver was slightly enlarged and presented a greenish dark look. The gall bladder was full with high coloured bile. The lesions on the liver had the appearance of minute, discrete white foci and were located in the periphery of the lobes. They were not many in number. These lesions apparently did not suggest liver fluke infection (hence entire specimen of the trematode parasites could not be collected at necropsy).

The liver tissue was processed for routine histopathology. The paraffinised tissue was sectioned at 5 to 6μ and stained by haematoxylin and eosin.

OBSERVATIONS

The microanatomy of the sections revealed that many of the larger bile ducts were parasitised by trematode parasites. In *situ* the parasites had assumed either coiled, elongated or variable position inside the bile

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ducts. In some as many as six to seven trematode parasites were found.

The morphology was studied from the serial sections and identified as *Opisthorchid* fluke. Speciation was not achieved due to lack of entire mounted specimen.

The damage to the liver parenchyma was variable and depended on the location of the parasites. The trematode parasites for the most part were confined to the bile ducts (Fig. 1). The biliary epithelium frequently displayed extensive proliferative changes and throwing the single layer columnar epithelium into folds. The epithelial cells showed evidence of active mucin secretion. The biliary ducts containing the opisthorchids were greatly enlarged and hypertrophied. Proliferation of many new bile ducts was noticed. Some of the bile ducts were completely occluded by these trematodes. Mild multilobular cirrhosis was discernible. Blood vessels were congested and exhibited some degree of thickening of their intimal layers. The sinusoids were dilated and abundance of Kuffer cells were noticed. Some of the Kuffer cells had phagocytised some pigments. At some places the hepatic cells appeared conspicuously vacuolated which indicated fatty degeneration.

The principal cellular changes consisted of infiltration of submucosal layer of the bile ducts with eosinophils, plasma cells, lymphocytes and few heterophils. All these were

Fig-1. Photomicrograph showing the presence of trematode parasites in the bile ducts. H & E 150

Fig-2. Photomicrograph showing extensive proliferative changes in the biliary epithelium, presence of mucin in the lumen, proliferation of new bile ducts and lympho follicular aggregation near the periphery of cystic bile duct. H. & E 150 suggestive of chronic cholangitis. Another characteristic feature was the lymphofollicular aggregation near the periphery of the cystic bile ducts containing the trematodes (Fig. 2). In general the pathological changes were mostly confined to the parasitised bile ducts and the surrounding tissue and the picture was varied.

DISCUSSION

The opisthorchids usually parasitise birds living on fishes and other crustacia, since the latter act as intermediate host and harbour the infective stage. Birds maintained purely on grains will usually have remote chance of contracting the infection. In the present case, however, the host involved was a gallinaceous bird being maintained on premixed poultry ration, had probably accidentally picked up an infective fish or a crustacia thereby establishing the parasite in its biliary system.

It is also interesting to note that although several guinea fowls died at later dates none of them revealed liver fluke infection. Significantly the location of the zoological park is on the bank of lake which attracts lot of ducks, geese, water fowls and other game birds. In all probability these birds are parasitised by liver flukes and as such accidental infection of a guinea fowl, though not known to be a definitive host, bears some ecological relationship of the surroundings of the park. The histopathological findings were in consonance with typical cases of liver fluke infection.

ACKNOWLEDGEMENTS

The authors are grateful to the Director of Animal Husbandry and Veterinary Services, Orissa and Dean, Faculty of Veterinary Sciences for the facilities. The authors express their sincere gratitude to Dr. B. P. Pande, Emeritus Scientist, C. D. R. I. Lucknow for confirming the identification of the trematode parasites.

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FUNGAL DERMATITIS IN A CAPTIVE TIGRESS (*PANTHERA TIGRIS*)- A CLINICAL CASE REPORT*

BY

S. B. Triarthy[1], and L. N. Acharjyo[2] and N. C. Sahoo[3]

Fungal dermatitis in domestic canines and felines is not uncommon (Ainsworh and Austwick, 1955; Kaplan & Ivans, 1961 & Misra, 1971) and considered to be quite an important zoonotic disease (Blank, 1955; & Kaplan, 1967.) There appears to be very little information (Mckeever *et el*. 1956 & Groves, 1969) on the dermatomycosis of wild cats specially of the tiger. The present communication is intended to place on record a clinical case of fungal dermatitis in a captive tigress of the Nandan Kanan Biological Park, Orissa.

CASE HISTORY.

A zoo born tigress, aged about 3 years, of the park was marked on 7.3.1978 with patchy dermatitis almost throughout the body except head, neck, tail and lower portions of the limbs exposing the reddish skin underneath in some area, The body coat was rough and the animal was looking ugly. On close observation, the tigress exhibited signs of severe itching which was menifested by rubbing her body against the chain-link mesh wall & trees inside the enclosure and biting her own skin. Some times the tigress very much irritated and excited due to severe itching sensatition.

At first it was thought to be a case of allergic dermatitis and the following treatment was given :—

1. Hostacortin' H' tablet (Hoechst) was adminstered orally through beef or mutton at a daily dose @ 20 mg for 3 days. This was followed by daily dose 15 mg for 3 days, 10 mg for 3 days & 5 mg for 3 days.

2. Vitablend AD 3(Glaxo)was given orally @ 2 g daily per beef/mutton for 15 consequitive days.

3. Dettol lotion was sprayed (1:1000) all over the body and in the feeding chamber daily for 20 days.

The symptoms of itching, falling of hairs and dermatitis subsided 20 days after the stating of treatment, Hoping a speedy recovery all treatment were stopped.

Again the same clinical signs reappeared after 12 days of stopping the previous treatment. Due to chronic nature of the disese and circular patchy lesions of the body, this time it was suspacted to be ringworm.

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work done under a scheme financed by B. S. T. R. (Orissa)

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CLINICAL FINDINGS.

Closer observation revealed that large quantities of body hairs come out during the process of rubbing of the chainlink mesh wall and biting. The dehaired exposed portion of the skin. which were mostly circular & oval, were reddish in color and moist at the begining which later on turned blakish brown.

The body hairs sticking to the chainlink mesh wall were collected for examination. Some of the hairs were mounted in 20% potassium hydroxide solution and examined under high dry microscope after keeping over night at room temperature, Ectothrix invasion of hair by fungal spores was detected. Isolation of dermatophyte concerned was tried several times in Sabouraud's dextrose agar with actidione and chloramphenicol, but could not succeed due to heavy contamination with *Aspergillus* on 3 rd or 4 th day of incubation at room temperature.

DIGNOSIS AND TREATMENT

Basing on the clinical signs, type of lesion and the finding of entothrix invasion of hair, it was tentatively diagnosed to be a case of fungal dermatitis and the following treatment were given.

1. Griseovin — F.P (Giaxo) was given oraiiy × 500 mg (4 tablets) twice daily through beef / mutton for 25 days.
2. Avil (Hoechst) was given @ 75 mg (3 tablets) twice daily orally for 4days
3. Tetmosal solution (I.C.I.) was spreyed over the affected areas of the body (1:1000) once a week for 3 weeks.
4. Vitablend AD3 was continued for 25 days.

RESULT OF TREATMENT

The clinical signs of dermatitis i.e. rubbing against the chain-link mesh wall, biting, rolling on the ground etc were no longer detectable by 20 th days after institution of Grisovin-F.P. treatment. The tigress was seen with her new normai coat round about middle of May, 1978. There is no recurrence of the condition till now.

ACKNOWLEDGEMENT

The authors wish to express their sincere gratitude to the wild life conservation officer, Orissa, Bhubaneswar-7 for providing necessary facilitis.

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· SOUVENIR
Vol. XI THE ORISSA VETERINARY JOURNAL No. 1—1977

Short Communication

REMARKS ON *ISOSPORA BENGALENSI* PATNAIK AND ACHARJYO 1971, FROM LEOPARD CAT

Patnaik and Acharjyo (1971 : *Orissa Vet J.* 6 : 135-137) described two new isosporan forms from the leopard cat (*Felis bengalensis* as *Isospora felina* and *I. bengalensi*.) Earlier Mandal and Chakravorty (1964 : *Proc. Zool. Soc.* Calcutta, 17 : 35-45) have described a distinct species from house crow (*Corvus Splendens*) as *I. bengalensis*. Though the names of both the species are slightly different they appear as simillar and some are apt to consider the name of the felina species as an homonym of the form from avian host. Hence a new name *I. nandankanani* for *I. bengulensi* Patnaik and Acharjyo 1971 is here by proposed, after the place of record to avoid confusion.

We are thankful to Dr. A. K. Mandal, Zoologist, Z. S. I., 8-Lindsay Road, Calcutta-700016 for the helpful sugestions.

Nandankanan (P. O. Barang)
Dated 14th July 1976

M. M. PATNAIK
L. N. ACHARJYO

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INTUSSUSCEPTION AND HERNIATION OF INTESTINES IN SOME ZOO ANIMALS AT NANDANKANAN

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SUMMARY — Routine necropsy examination of the Indian and exotic mammals which were maintained at Nandankanan zoo was conducted on the animals which had natural death. About 400 necropsies were performed during the period of 1967-73. This communication records four cases of intussusception, one in an adult female langur involving a portion of ileum, the second in an 8 year-oldmale barking deer involving Jajunum, the third in adult male common giant flying squirrel involving large intestine and the fourth in an adult female slow loris involving the intestine near about ileocaecal valve. In addition, a case of ventral hernia in a male sloth bear cub was also recorded. The cause of intussusception in langur was ascribed to intense struggling in the cage while in slow loris to enteritis resulting from worm infestation.

Intussusception is telescoping of a portion of bowel and its mesenteric attachments to an adjacent part, the causes of which are not too clear but they tend to accompany enteritis, worm infestation, foreign bodies, sudden violent movements etc. Increased peristalsis and dysperistalsis may be important in the absence of focal lesions. Intussuscaption and herniation in wild animals have been rarely reported. Fox (1923) described a case of intussusception in a primate in which a 4" portion of ileum invaginated into the colon and two cases in carnivores both occured in ileum, one restricted there to and other extended in to colon. He also described a case in an ungulata—a tapir, with chronic enteritis in which the ileum had passed into caecum for a distence of

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Table — 1

Details of cases of intussusception and herniation of intestines in zoo animals at Nandankanan

Name of animals	Date of ~~birth~~ Death	age	sex	clinical history	Salient findings
Common Langure (*Presbytis entellus*)	29-7-69	Adult	Female	The Animal was caught locally and kept in a wooden cage on 28-3-69. Since then it was struggling and was found dead on 29-7-69.	Intussuception of ileum involving about 15 cm. in length. Gangrenous changes were observed Liver was congested.
Barking deer (*Muntiacus muntjak*)	20-9-62	8 yrs.	Male	Died suddenly.	Intussusception of jejunum involving about 20 cm. in length. Gangrenous changes were observed.
Common giant flying squirrel (*Petaurista Petaurista*)	27-3-73	Adult	Male	The animal was brought to the zoo on 20-3-73 and died suddenly.	Intussusception of large intestine. (15 cm. in length) Protruding through the anus. Liver showed an abscess on perietal surface.
Slow Loris (*Nycticebus Coucang*)	20-4-72	Adult	Fimale	No symptoms were noticed.	Small intestine about 5 cm. away from ileo-caecal valve had intussusception. Parts of intestine anterior to intussusception were congested. There was severe catarrhal enteritis associated with large number of hook-worm, uterus was gravid and contained a fully developed foetus.

(Contd.…

(Table 1 Contd.)

Sloth Bear Cub (*Melursus ursinus*)	6-1-68	4 weeks	Male	The animal was received at the zoo on 18-12-67. prior to death the animal was suffering from colic.	There was an open wound of about 5 cm. behined the sternum on the abdomen through which intestines protruded out and was pulpable just underneath the skin. The intestine was twisted at its lower third and gangrenous. It was diagnosed as ventral hernia

9' it being much swollen and congested but not gangrenous. The same author described diaphragmatic hernia in a black buck, ventral hernia in an Indian entelope. In all these cases traumatic injuries were found to be the causes of herniation.

The materials formed for this study were made available from the routine necropsies conducted on veriety of Indian and exotic wild animals which were dead at Nandankanan zoo. Over 400 necropsies were conducted during the period from 1967-73 This communication places on record 4 cases of intussusception one each in a langur a barking deer, a common giant flying squirrel and a slow loris and a case of ventral hernia in a sloth bear cub. The details of intussusception and herniation are given in the Table-1.

In all the cases of intussusception, the invagination was found to have a three layered tube. Microscopically the mucosa revealed varying degrees of degenerative and necrobiotic changes associated with hyperaemia. The condition was readily diagnosed at necropsy. In cases where gangrene was a conspicuous feature the cause of death was ascribed to toxaemi:. In the present investigation intussusception in langur was ascribed to intense struggling while in slow loris to enteritis associated with worm infestation and consequent hyperistalsis of the intestine. In the other two the causes could not be traced out. This communication confirms the observations of Fox (1923) for the condition could occur in any species of animal and involve any region of the intestines.

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EIMERIA NYCTICEBI N. Sp. AND *E. COUCANGI* N. Sp. FROM INDIAN SLOWLORIS (*NYCTICEBUS COUCANG*), AND NOTES ON *ISOSPORA LEONINA* FROM AN AFRICAN LION (*PANTHERA LEO LEO*)

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SUMMARY: Eimeria nycticebi n. sp. and E. coucangi n. sp. from Indian slowlorises (Nycticebus coucang) are described. Occurrence of Isospora leonina Mandal and Ray. 1960. and I. felis (Wesielewsky, 1904) Wenyon, 1923 in an African lion (Panthera leo leo) with redescription of the former is reported.

Introduction

In the course of survey on coccidian parasites of wild animals of Nandan Kanan Zoo, Barang, two coccidia belonging to the genus *Eimeria* Schneider in the intestinal scrapings of three dead slowlorises (*Nycticebus coucang*) and two coccidia belonging to the genus *Isospora* Schneider in the faecal samples of an African lion (*Panthera leo leo*) were encountered.

Study of them, in 2% potassium dichromate solution, revealed two new eimerian species, as there was no previous record of such parasites from *N. coucang* (Humpery and Segal, 1966; Pellerdy 1963, 1965, 1969; Segal, Humpery, Edwards and Kirby 1968). The two isosporan froms recovered from *P. leo leo* were *I. leonina* Mandal and Ray, 1960 and *I. felis* (Wasielewsky, 1904) Wenyon 1923. The descriptions of the two new eimerian parasites and the redescription of *I. leonina* are hereunder given.

Eimeria nycticebi n. sp.

HOST :- Slowloris (*Nycticebus coucang*)
ORIGIN :- Assam.

The oocysts were smooth, colourless, thin-walled, approximately spherical showed no evidence of micropyle and measured 15 to 18 μ in length by 14.5 to 18 μ in width (average 17 x 16.5 μ) with a shape index (L/B) of 1.03. The sporont when fresh almost filled the inner-space, and sporulated into four sub-globular sporocysts in ten days time leaving behind a small oocystic residuum. Each sporocyst measured 6 to 7 μ long and 4 to 5 μ in wide. The almost curved sporozoites lay in a semicircular shape around the granular sporocystic mass (Fig. No. 1. a and b).

Since there was no earlier report of any coccidia from the genus *Nycticebus*, this species was designated as *E. nycticebi*.

Eimeria coucangi n. sp.

HOST :- Slowloris (*Nycticebus coucang*)
ORIGIN :- Assam.

The oocysts were oval colourless, thin-walled and had no visible micropyle. They measured 18-24 μ in length by 15-21 μ in width (average 21 x 17 μ) with a shape index (L/B) of 1.23 The sporont was granular and spherical with a diameter of 15 microns. They sporulated into four pyriform sporocysts

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of 8 by 5μ in 12 days time. The oocystic residuum was absent. Each sporocyst contained two linearly arranged sporozoites of 5μ long and a granular sporocystic residuum (Fig. No. 1. c and d).

This species was distinct from *E. nycticebi* in shape, size and in not having any oocystic residuum. It was named, after the specific name of the host, as *E. coucangi*.

Isospora leonina Mandal and Ray, 1960

HOST :- African Lion (*Panthera leo leo*)
ORIGIN :- Africa.

The oocysts were thin-walled, colourless and subglobular in shape. They had no visible micropyle and measured 28 to 30μ by 30 to 33μ (average 29 x 31.8 μ) with a shape index (L/B) of 1.1. The eccentric spherical sporont consisted of a fine granular mass and measured 22-24μ in diameter. Sporulation was completed within 5 days. Oocystic residuum was absent. A small polar body in some cases, adjascent to the greater side, was observed The oval sporocyst measured 14-16 x 19-20μ (average 15 x 19.5 μ) and contained four longitudinally and symetrically arranged sporozoites and a coarsely grannular residual body of 5μ in diameter. Each sporozoite measured 12 x 3μ (Fig. No. 1 e, f and g.).

I. leonina was described from *Panthera leo* (30-32X28-31μ ave. 31.8X28.2). Present study shows that this species is distinct from other four *Isosporan* forms recorded from felidae viz: *I. felis* Wenyon, 1923; *I. canis* Nemeseri, 1959, and *I. revolta* Grassi, 1879, all of which are oval in shape, and *I. bigemina* (18-29X14-16μ) in size.

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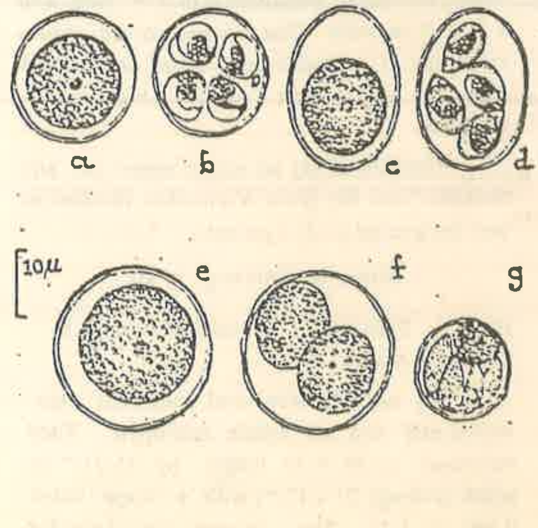

FIGURE No. 1.

a. Unsporulated oocyst of E. nycticebi
b. Sporulated oocyst of E. nycticebi
c. Unsporulated oocyst of E. coucangi
d. Sporulated oocyst of E. coucangi
e. Unsporulated oocyst of I. leonina
f. Sporulated oocyst of I. leonina
g. Sporocyst of I. leonina
(All were drawn to same scale with the help of a camera lucida).

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Tuberculosis in a sloth bear

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The prevalence of tuberculosis in animals caused by *M. tuberculosis* has been reported by Karlson (1951), Cohrs (1967) and Jubb and Kennedy (1971). The purpose of this report is to put on record a case of natural infection of tuberculosis in a sloth bear which may be useful to veterinarians in charge of treatment of animals in zoos.

Pieces of tissues from lungs, liver, kidney and intestine from a necropsied sloth bear with history of chronic cough and anorexia were received from Nandan Kanan Zoo near Bhubaneswar, Orissa for histopathologic diagnosis. Grossly the lung tissue was consolidated with numerous widely scattered white to yellowish-white, firm, resilient non-capsulated tubercles of verying sizes (1-10 mmdia) throughout the parenctyma. Some yellowish-white opeque tubercles revealed central caseation with gritty feeling. Other tissues from liver, kidney and intestine did not reveal any gross pathological change.

Sections and smears from lung lesions stained with Ziehl Neelson's method revealed presence of numerous acid fast organisms. They variedly appeared as slender, straight, curved and, some beaded rods and few with relatively plump and solid staining. They occurred singly, in pairs, small bundles or in clumps Microscopically some lesions revealed typical granuloma delineated from the sorrounding tissues by concentration of macrophages, lymphocytes, plasma cells and few fibroblasts along with caseation and little calcifications at the centre (Fig). There was minimal attempt at formation of connective tissue capsule The giant cells of Langhan's type were in consistent in the lesion. Both cellular and effusive types of lesions were seen within pulmonary tissues.

Grossly varying sizes of tubercles with caseating centre and microscopically the acid-fast character of the organisms resembled pulmonary tuberculosis.

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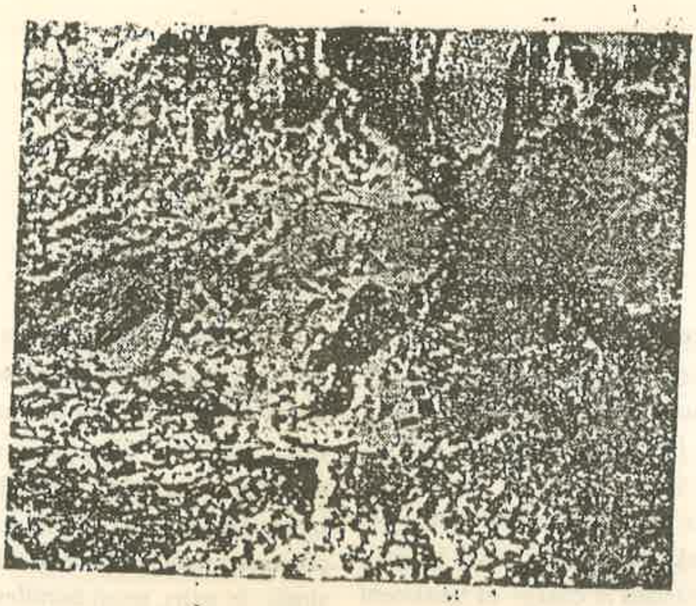

Fig Section of lungs showing caseation and calcification H & E×80

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DIAGNOSIS AND CLASSIFICATION OF COMMON DISEASES OF CAPTIVE BIRDS AT NANDANKANAN ZOO

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SUMMARY:—The purose of the present communication is to report the results of survey of common diseases affecting Indian wild birds at Nandankanan zoo. The diagnosis and classification of diseases described here were based an detailed necropsy examination coupled with histopathological studies attempted on 100 out of the total 600 birds of different kinds necropsied during the period of July 1967 to August 1971. The diagno.is was based upon clinical classification such as Parasitic infestation, bacterial and mycotic diseases, neoplastic conditions, metabolic disorders and miscellaneous diseases. Systemic classification was based on the frequency distribution of various systems showing lesions in different kinds of birds. The present survey indicated that parasitic infestations and neoplastic conditions are important problems in zoo birds.

Meagre information is available at present on common diseases affecting Indian wild-birds. Though various zoos and sanctuaries located in the country provide a valuable source of materials for such studies, unfortunately, so far no efforts have been made to fill up the gap in that field as a result there is fear of extinction of some of the rare species of birds. However, the growing importance of study of wild life diseases has been recognised in recent years in view of the fact that the wild birds act as a reservoir/carrier of various infecticus agents known to affect domestic birds and play an important role in maintenance and spread of such diseases. The purpose of the pressnt communication is to report the results of survey of common diseases affecting Indian wild Birds at Nandan Kanan zoo. The diagnosis and classification of diseases described here under were based on detailed necropsy examination coupled with histopathological studies attempted on 100 out of total 600 birds of different kinds necropsied during the period of July 1967 August 1971

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RESULTS AND DISCUSSION.

The results of survey of common diseasas of wild birds were presented in Table Nos. 1 to 3.

Table No. 1 Clinical classification of diseases of wild birds in captivity.

A. PARASITIC DISEASES–

Sl. No.	Name of birds	No. of birds affected	Name of parasite	Site
1.	Open billed storks	7	Chaunocephalus ferox	Intestine
2.	Pea fowls	6	Coccidia sp.	—do—
3.	Varigated laughing thrush	1	—do—	—do—
4.	Sarus crane	1	Tetrameres sp.	Proventriculus
5.	Paddy bird	1	Tetrameres sp.	Proventriculus
6.	White ibis	1	—do—	—do—
7.	Sarus crane	1	Echinoparyphium sp.	Intestine
8.	Pigeon	1	Tape worms	—do—
9.	Common Myna	1	—do—	—do—
10.	Hill Myna	1	Spiruroid larvae	Serosa of gastrointestinal tract
11.	Jungle Owlet	1	- do -	—do—
12.	Sarus crane	1	Opisthorchis Sp.	Liver
13.	Pin tail	1	*Fimbriaria fasciolaris*	Intestines
14.	Pea fowl chicks	2	Ascaridia sp.	—do—

B. BACTERIAL AND MYCOTIC DISEASES:

Sl No.	Name of disease	Name of bird	No. of birds	Organs affected	Remarks
1.	Tuberculosis (IB)	1. Pigeon	2	Liver	Acid fast bacilli in tuberculous Lesions
		ii. Lesser whistling teal	1	Liver, spleen and lungs	—do—
		iii. Domestic Duck	1	—do—	—do—

2.	Ulcerated enteritis resembling Quail disease	i. Large India Parakeet	1	Intestine	Gram positive coccobacillary organisms in tissue sections of intestine & liver
		ii. Blossom headed parakkeet	1	Intestine	
3.	———	Grey herons	2	Liver Lungs & spleen	Gram negtive bacilli in necrotic lesions of liver, lungs and spleen tissue sections
4.	———	Brahmini duck	1	Liver, lungs & spleen	Gram negative bacilli in granulomatous lesions of liver, lungs and spleen
5.	Nocardiosis	Hill myna	1	Lungs, kidneys, mesentery, proventriculus and muscles of eye ball	Nocardia sp. in tissue sections
6.	Aspergillosis	i. Striated laughing thrush	1	Lungs	Aspergillus sp., spores & hyphae in tissue sections
		ii. White-eyed buzzard	1	Lungs	
		iii. Rosypelican	1	Kungs & muscles of thorax & abdomen	

C. NEOPLASMS:

Sl. No.	Name of bird	No. of birds affected	Type of tumour	Organs affected
1.	Pea fowls	3	Bronchogenic carcinoma	Lungs. In one metastatic growths in proventriculus
2.	Pin tail	1	Carcinoid tumour of lung	Lungs & muscles adiacent to thyroid
3.	Turkey hens	2	i. Cystadeno carcinoma of ovary ii Papillary adenocarcinoma of ovary	i. Ovary & spleen ii. ovary, pancreas Intestines, mesentery & spleen
4.	Sarus crane	3	i Hepatoma ii. Adenocarcinoma i. Concomitant neoplasia (Mesothélioma and hepatoma)	Liver Intestines Peritoneum' Lungs & Liver

D. METABOLIC DISORDERS:

Sl. No.	Name of the disease	Name of bird	No. affected	Organs affected
1.	Uraemic nephritis	Goose	1	Kidney
2.	Visceral gout associated with avitaminosis A	Ring necked pheasant	1	Kidney, pericardium, glisson's capsule & oesophagus

E MISCELLANEOUS CONDITIONS:

Sl. No.	Name of the condition	No. of birds affected
1.	Death due to undetermined causes (absence of gross and/or microscopic lesions)	14
2.	Hepatitis and other lesions in liver	8
3.	Affections of lungs like congestion & consolidation	8
4.	Affection of heart like pericarditic, cysts and hypertrophy	4
5.	Cannibalism	3
6.	Traumatic injuries	2
7.	Paralysis of undetermind causes	2
8.	Enterititis	2
9.	Ascitis and hydrothorax	2
10.	Pneumo enteritis	1
11.	Peritonitis	1
12.	Granulomatous lesions in lower eye lid & beak	1
13.	Conjunctivitis	1
14.	Lameness due to bumble foot	1
15.	Synovitis	1
16.	Abscess in abdominal region	1

Table 2. Systemic classification of diseases of wild birds in capitivity

Sl. No.	Name of the system	No. of birds Showing lesions
1.	Digestive system-i. Gastrointestinal tract including mesentery and peritoneum	38
	ii. Liver	20
2.	Respiratory system	23
3.	Haemopoetic system (spleen)	5
4.	Urinary system	4
5.	Cardiovascular system (Only heart)	4
6.	Muscular system	2
7.	Nervous system	2
8.	Genital system	2
9.	Integumentary system	2
10.	Eye	2
11.	Bones and joints	1

Table No. 3. Kinds of bird affected in relation to different causas of death.

Sl. No.	Kind of birds	Parasitic infections	Bacterial & mycotic diseases	Neoplastic conditions	Misc. conditions	Undetermined
1.	Pea fowls	i. Coccidiosis (6) ii. Ascariasis (1)	—	Bronchogenic carcinoma (3)	i. Induration of fibrinous pleuritis (1) ii. Traumatic pericarditis due to a-nail (1) iii. Granuloma in lower eye lid & beak (1)	1
2.	Turkey fowls	—	—	Adenocarcinoma of ovary (2)	i. Cyst on heart (1) ii. Canibalism (1)	1
3.	Guinea fowls	—	—	—	—	1
4.	Pheasants	—	—	-	i Avitaminosis A associated with visceral gout (1) ii. Pneumonia (1)	
5.	Ducks	*Fimbriaria fascioliaris* infection (1)	i. T. B. [1] ii Granuloma associated with non-acid fast gram negative bacilli [1]	Carcinoid tumour lung [1]	Haemosiderosis associated with Aflatoxicosis in liver [1]	—
6.	Geese	—	—	-	i Uraemic nephritis [1] ii. Cirrhosis associated with ossification in liver (1)	
7.	Whistling teals	—	T. B. [1]	—	Hepatitis [1]	—
8.	Pelicans	—	Aspergillosis [1]	—	—	—
9.	Gadwall		—	—	—	
10.	Buzzards	—	Aspergillosis [1]	-	—	1
11.	merlins	—	—	—	i. Conjunctivitis [1]	2

12.	Owls	spiruroid infection [1]	—	—	i. Canibalism (1)	
13.	Sarus Crane	i. Tetrametiasis and echinoparyphium infection [1], ii. Opisthorchis infection	—	i. Hepatoma [1] ii. Adeno-carcinoma of intestine [1] iii. Concomitant neoplasia (1)	i. Bumble foot and hypertrophied heart [1] ii. Aflatoxicosis [1] iii. Canibalism [1]	
14.	Storks	*C. ferox* nodules [7]	—	—	i. Leg paralysis [1] ii. Pneumoenteritis [1] iii Traumatic injuries [1]	
15	Ibis	Tetrameriasis [1]	—	—	i. Traumatic injuries [1] ii. Ascitis & hydrothax [2]	
16.	Padd birds	Tetrameriasis [1]	—	—	—	—
17.	Grey hercns	—	Necrotic lesions in liver spleen and lungs associated with Gram negatvie bacilli [2	—	—	—
18.	Pigeons	Tape worms [1]	T. B. [2]	—	i. Liver abscess [1] ii Necrohi hepati tis [1] ii peritonitis [1]	4
19.	mynas	i. Tapeworms [1] ii. Spiruroid infection [1]	Nocardosis (1)	—	Pneumonia (2)	2
20.	Horn bills	—	—	—	i. Enteritis [1] ii. Pneumonia [1]	
21.	Thrushes	Coccidiosis [1]	Aspergillosis [1]	—	Pheumcnia [1]	
22	Drongo	—	—		Hepatatitis [1]	
23.	Parakeets	—	Ulcerated enteritis (2)	—	—	1

Note--Numbers in parenthesis indicate number of birds affected

Limited Pathological studies carried out on captive birds dead at Nandan Kanan zoo during 1967-71 indicated that the incidence of parasitic infections of gastrointestinal tract is considerably high. In many instances, though no clinical signs were observed during life large number of parasites were detected in gastrointestinal tract with severe lesions in postmortem examination. Bassin (1960) also reported that common diseases of wild birds in captivity were coccidiosis and intestinal parasitism. Keymer *et al.* (1962) made an extensive study of parasitic diseases in British wild birds and concluded that a large number of them harboured helminths (338 out of 2044 birds examined) and in about 64 cases, the mortality was attributed to helminth burden. According to McDonald (1963) 9% of the total deaths of 206 wild birds of 59 species in Britain were due to parasitism. Hediger (1964) stated that helminths play an important role in pathology of wild animals in captivity.

Tuberculosis is considered as one of the major causes of losses in birds especially kept in groups and may attack every bird species. Surveys of mortality in wild birds indicated that tuberculosis was responsible for 1% or fewer deaths though wilson and McDonald (1965) mentioned 28%. The present survey revealed only 4 cases of tuberculosis affecting three kinds of birds and it is not considered to be a problem at present in the zoo. Ulcerated enteritiis of bacterial origin is an emerging problem in poultry industry in India and two cases reported herein indicated threat to the zoo birds as well. Golebiowski (1961) and McDonald (1963) reported pasteurellosis in a varieties of zoo birds. Cooper (1969) reported an out break of an acute disease diagnosed as anthrax in birds of prey of chester zoo. Such instances were, however, not encountered in the present inquiry on histopathological examination of tissues. An interesting mycotic diseases of zoo birds at Nandan Kanan was systemic noacrdiosis in a hill myna which was reported else where (Iyer *et al.*, 1972). Aspergillosis is known to affect a wide variety of captive wild birds. Ainsworth and Rewell (1949) diagnosed Aspergillosis in 78 captive wild birds. Davies *et al*, (1971) had not mentioned its occurrence in some of the Indian birds like Rosy pelicans, striated laughing thrush and white eyed buzzard. Keahey and Tropp 1969) made a survey of diseases affecting exotic birds at necropsy at diagnostic laboratory, Michigan State University from 1966 to 1968. The data were compiled from a total of 132 avian accessions of this 112 birds were submitted from Detroit Zoological park. They found that the incidence of fungus infections specially Aspergillosis affecting respiratory system was highest. Next in importance was helminthiasis affecting digestive tract. It was found that the important disease of penguins was Aspergillosis. It is beyond the scope here to pin point the most common disease affecting a specific kind of bird since only limited number of birds of each kind was available for study. However, it is observed that in general the organs of digestive system was more frequently affected than other systems. Next in importance was respiratory system.

Though only 100 birds out of the total 600 birds necropsied were taken up for detailed pathological investigation, special attention was paid to screen out neoplastic conditions during necropsy examination. Seven types of tumours affecting nine birds of four kinds were reported in this survey. Though adequate date is not available, various types of neoplastic conditions were reported from wild birds. They were quite similar in character to those found in chicken (Biester and schwarte, (1965) Fox (1923) listed 44 neoplasms affecting captive birds. Eleven varieties of tumours were identified in a family of psittacidae and the highest record was in undulated Grass parakeets. Babic (1931) reported 16 cases of neoplasms in birds other than chicken. Ratcliffe (1933) reported 5 tumours in family anatidae at Philadelphia zoological gardens. Lombard and Whitte (1959) reported 12 malignant tumours from the same zoo. Kronberger (1962) reported 39 tumours in zoo birds from 1917-1961 at Lipzig pathological institute. Stewart (1966) while discussing tumours in wild birds in captivity, commented high incidence of lung tumours. Beer (1968) stated that the incidence of respiratory cancer in water birds has considerably increased in the last 20 years in most of the larger zoos of the world. Jenning (1969) recorded 44 avian tumours in 21 species of 13 families of wild birds in Britain. Davies *et al*. (1971) stated that the incidence of tumours in captive parakeets was much higher then wild population. According to them the environment and feed had some influence. In one report, 24. 2% of all deaths in 866 parakeets were caused from neoplasms, Among 55 other birds representing several species only two tumours were found. Further, they stated that the incidence of tumours in wild birds might be higher than records.

It may be concluded that the results obtained here would have been more informative, if the studies are supported by bacteriological and virological investigation so that some of the unrecognised diseases could have come to lime light.

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TREATMENT OF DIPHYLLOBOTHRID TAPE WORM INFECTION IN WATER MONITORS (*VARANUS SALVATOR*)

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Summary : Occurrence of Duthiersia fimbriata (Dics, 1850) in 3 Varanus salvator Laurenti and their treatment with Dichlorophen (Dicestol - M & B) is repoted.

Introduction

Informations on the treatment of *Duthiersia fimbriata* (Dies, 1850) Mont. et. Crety, 1891, the common dyphyllobothrid tape worm, infection in water monitor, *Varanus salvator* Laurenti, is not readily available. Three new water monitors received at Nandankanan Zoo from Calcutta were found to be infected with *D. fimbriata*. Their successful treatment with dichlprophen (5:5-dichloro 2:2' dihydroxy-diphenyl methane) is hereunder reported.

Case Report

At the time of arrival (2.7.70) the three water monitors were dull looking. Examination of their faecal samples revealed the operaculated eggs of *D fimbriata*. They were all (Case, Nos.753 and 754 dt.22.7.70) treated with Dichlorophen (*Dicestol* M & B), after assessing their body weight (about 10 kg), at dosage rate of 150 mg/kg body weight. The tablets were powdered and concealed in beef before they were administered; and watched for elimination of the tapeworms in their faeces on the subsequent day. Since no tapeworms were expelled again were given with 3 tablets on 24.7.70. in the sameway.

On 25.7.70, three whole adults, of 40-45 cm long with their expanded fan shaped scolices, were recovered from their faccal matter. The parasites were pressed and fixed in 10% formalin and stained with Borax carmine. The diagnosis was confirmed ad *D. fimbriata* from their scolex and gravid segments.

Remarks

Dichlorophene is found to be equally effective against tape worm infection of cold blooded animals. (reptiles) at the above mentioned dosage rate. No ontoward symptoms were menifested by the treated reptiles.

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A NOTE ON TUBERCULOSIS IN SOME WILD ANIMALS AND BIRDS IN CAPTIVITY.

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SUMMARY:- Out of 95 necropsies conducted at Nandankanan Zoo during 1967-69, one stumpy-tailed macaque, a duck, a lesser whistling teal and two pigeons were found affected with tuberculosis. The histopathological changes in lungs, liver and spleen of them have been described and discussed.

INTRODUCTION

Tuberculosis (T. B.) is rarely encountered in wild animals under feral conditions but in captivity its frequent occurrence has been reported from time to time. The pathology of T. B. in primates have been studied in detail notably by Iyer (1940); Chatterjee (1960); Wolf, Bullock and Clarkson, (1967); Crisp, Cohen, Ringler and Abraham (1968); and Hessler and Moreland (1968).

Apart from fowls, T. B. has also been reported in wood pigeons (Feldman, 1938), ducks (Gurumurthy, 1962; Singh, Joshi, Lall and Iyer 1968); whistling swan (Iyer and Nanda, 1966) and lesser whistling teal (Rao and Acharjyo, 1969). An account of the histopathological changes encountered in a primate and three kinds of birds are herein presented.

MATERIALS AND METHODS

The material for this study were the lungs of a stumpy-tailed macaque: lungs, liver and spleen of a duck, a whistling teal and two pigeons collected in 10% formal-saline out of the 95 necropsies conducted at Nandankanan Zoo during 1967-69. The representative portions from these organs were processed by routine histological procedures. The impression smears and the sections were stained with Ziehl Neelsen carbol fuchsin method.

OBSERVATIONS

The lungs of the stump-tailed macaque, died on 6-8-67, on gross examination, had multiple creamy white foci of various sizes and shapes distributed throughout the lung parenchyma. On histological examination, each foci consisted of extensive areas of caseation necrosis together with heavy infiltration of macrophages and few giant cells. There were areas of fibrosis of lung parenchyma in some areas and broncho-pneumonic changes in other areas. Acid-fast organisms morphologically indistinguishable from *Mycobacterium tuberculosis* were demonstrated in tissue sections and impression smears of the foci.

The organs affected with typical tubercles in order of preponderance were spleen, liver and lungs in duck; spleen, lungs and liver in lesser whistling teal, and only liver in pigeons. The identical histological features of the tubercles encountered in chicken, are not described but only the differential features are herein dealt with. In the duck, spleen was enlarged and a single large encapsulated tubercle leaving a thin rim of the

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parenchyma was seen. The sections revealed extensive areas of caseation necrosis surrounded with a dense zone of infiltrating macrophages, lymphocytes, giant cells and a thick connective tissue capsule. Similarly a solitary tubercle was noticed in the lungs. The liver was enlarged and its capsule was thickened. Multiple grey tubercles of varying sizes were scattered throughout the substance. There were amyloid infiltration and atrophied hepatic cords.

In lesser whistling teal the spleen was enlarged, and contained many multiple yellow tubercles protruding from the surface (which could be ennucleated easily). A number of daughter tubercles adjacent to the larger ones. were also noticed. In the lungs one such solitary encapsulated tubercle was noticed. The liver was enlarged and hard to cut. The capsule was thickened. The parenchyma was pale in colour and at places revealed grey circumscribed lesions. The liver cells revealed degenerating changes and/or atrophy leaving the reticulin network intact. The reticulin fibres revealed fibrinoid degeneration.

In pigeons the spleen was normal in size with ut any evidence of tubercle formation. ..ever, there was mild proliferation of ..iculoendothelial cells and haemosiderosis. No changes of pathological significance were observed in lungs excepting for a mild venous congestion. The livers were enlarged, mottled in appearance and only few tubercles were noticed in the parenchyma. In many areas, there were mere accumulation of macrophages. Some of there macrophages were undergoing degenerative changes. The sinusoids manifested "sinus catarrh". In all the Z. N stained tissue sections and impression smears from the tubercles, acid fast organisis were detected.

DISCUSSION

Our histological observations in stump tailed macaque closely resembled to those described in baboons by Iyer (*loc. cit.*) except for the presence of few giant cells but differed from those of Wolf *et al* (*loc. cit.*) as there was no calcification.

Marked differentiating features were observed in the organs of the three species of birds studied. In the spleen of the lesser whistling teal, multiple caseonecrotic lesions were scattered throughout with the formation of secondary tubercles adjacent to the primary ones, whereas in duck a solitary large tubercle without the formation of secondary tubercles were observed. In pigeons, there was only mild proliferation of reticuloendothelial cells suggesting unsuitabililv of the organ for tubercle formation. Like the teal and duck the lungs of the pigeons was not involved.

The major differentiating features were observed in the affected livers of these birds. The liver of the duck and the teal were enlarged and revealed multiple tubercles whereas in pigeons, there were few tubercles. In the teal, the reticulin fibres revealed fibrinoid degeneration whereas in duck there was amyloid infiltration and absence of either of these changes in pigeons. Calcificafion was not a feature in any of the species dealt under report. From these observations, it is believed that the tuberculous lesions are less extensive in pigeons than in the duck and the teal.

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