

INCIDENCE AND HISTOPATHOLOGY OF AVIAN NEOPLASMS

THESIS

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I certify that this thesis has been prepared
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(Pathology) 1972, and it is the original work of
his independant study.

B.C. Nayak

(B.C.Nayak)

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INTRODUCTION

In India the poultry meat and eggs constitute an important source of animal protein to meet the protein requirement of human food. This increased demand for animal protein has aroused a great consciousness in the minds of the poultry breeders of both Government and private sectors to speed up the poultry industry. With the increased poultry farming activities and with the import of new high yielding breeds of birds many exotic diseases have been introduced and thus the disease problem has risen up. Perusal of the annual report of the Pathology department of the College revealed that among the various diseased conditions that cause a high mortality in birds of different age groups, neoplastic conditions are held responsible for a large number of death toll. It, not only, results in a heavy loss to the poultry keeper, but it impedes also the progress of poultry development.

As there are relatively little published data on the systematic investigation on the incidence and organwise distribution of spontaneous tumours in fowls more particularly in the State of Orissa, the investigation was

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As there are relatively little published data on the systematic investigation on the incidence and organwise distribution of spontaneous tumours in fowls more particularly in the State of Orissa, the investigation was

undertaken to study and classify different avian neoplasms,
so that it may help both the field and laboratory workers
to arrive at a proper diagnosis.

REVIEW OF LITERATURE

For the sake of convenience and better understanding the literature on tumours of different tissue origin have been reviewed separately.

Tumours of connective tissue:

Jackson (1936), in a series of 203 neoplasms of chickens, listed 24 malignant connective tissue tumours, which included 7 fibrosarcoma, 1 myxosarcoma, 1 osteochondrosarcoma, and 15 histiocytic sarcomas. Subsequently, Goss (1940), Olson and Bullis (1942), Campbell (1943), Iyer (1960), Parek (1960), Dhodapkar (1967), Rao (1968) Singh (1968), Singh and Singh (1968) Kolte et al. (1969), Ajinkya and Sardeshpande (1969), Parihar and Singh (1971) and Ahmed and Sastry (1972), in addition to the tumours reported by earlier workers, have recorded the occurrence of fibroma, lipoma, liposarcoma, myxoma, chondroma, myxofibroma and some undifferentiated tumours.

Tumours of muscle tissue:

Rhabdomas have been considered as one of the most rare tumours in poultry. Olson and Bullis (1942), Campbell and

Appleby (1966), Sah and Sharma (1969) and Ahmed and Sastry (1972) including many other earlier workers in their survey of various neoplasms in chickens have reported this tumour both in hens and cocks affecting the skeletal muscle of hip and pectoral regions, and the cardiac muscles. Single cases involving the mesentery, subcutaneous and thoracic tissues have been also recorded (Campbell and Appleby, 1966).

Tumours of smooth muscles are among the commoner neoplasms of chickens. Out of 43 tumours of the female reproductive system, Jackson (1936) observed 15 leiomyomas. Subsequently, Olson and Bullis (1942), Awadhiya et al. (1968), Sharma and Singh (1968), Arya (1968), Patnaik (1969), Nevole (1970 a) and Ahmed and Sastry (1972) have reported this tumour in the fowls affecting the mesosalpinx of the oviduct.

Tumours of epithelial tissues:

The reports of papillomas in chickens are extremely rare. They have been occasionally recorded on the oesophagus, comb, feet and wattles (Olson and Bullis, 1942 and Feldman and Olson, 1965). Parihar and Singh (1971) have encountered a case

of papilloma of abdominal air-sac membrane.

Adenomas occurring in the ovary, oviduct, proventriculus, gizzard, liver and thyroid of fowls have been reported by Goss (1940), Olson and Bullis (1942), Campbell and Appleby (1965) and other earlier workers. Thereafter, number of cases of adenoma arising from different organs were reported by Parihar and Chouhan (1965), Singh (1968), Arya (1968) and Ajinkya and Sardeshpande (1969). Olson and Bullis (1942), Krishnan (1966) and Awadhiya and Jain (1967) have reported papillary cystadenoma and cystic adenoma affecting the gizzard and the ovary.

Adenocarcinomas of different organs especially of the female reproductive tract are considered to be the most common neoplastic conditions. Involvement of the ovary and oviduct by this tumour were reported by number of workers (Jackson, 1936; Guarda, 1957; Kronberger, 1962; Arya, 1968; Goodchild and Cooper, 1968; Swarbrick et al., 1968; Ajinkya and Sardeshpande, 1969; Goodchild, 1969; Nevole, 1970 b; Sahu and Rao, 1971 and Ahmed and Sastry, 1972). Adenocarcinoma of the cystic type were also reported by Awadhiya and Jain (1967),

Mehrotra et al. (1969) and Rao et al. (1971). Adenocarcinomas arising from gizzard (Feldman and Olson, 1965 and Ajinkya and Sardeshpande, 1969), intestines (Jackson, 1936; Feldman and Olson, 1965; Ajinkya and Sardeshpande, 1969 and Ahmed and Sastry, 1972), pancreas (Babic, 1931 and Olson and Bullis, 1942), kidneys (Babic, 1931), lungs (Apperly, 1935; Ajinkya and Sardeshpande, 1969 and Sharma and Kuppuswamy, 1970 a) were also reported.

Granulosa cell tumour, a rare neoplasm affecting the ovary of chickens was reported by Shukla and Iyer (1960), Pandit et al. (1964), Awadhiya and Jain (1967), Sharma and Singh (1968), Sharma and Kuppuswamy (1970 b). The latter authors also reported the metastases into intestines, pancreas and mesentery.

The occurrence of hepatic tumours in chickens, both benign and malignant, have been described in the literature from time to time, Jackson (1936) in a series of 203 neoplasms of fowls encountered only one case of hepatocellular carcinoma. Olson and Bullis (1942) recorded three cases of benign hepatomas in chickens. Ratcliffe (1961) in his survey of tumours from 1901 to 1946 in birds, encountered

2 cases of malignant hepatomas. In India hepatomas and hepatocellular carcinoma in fowls have been reported by Christopher et al. (1968), Kolte et al. (1968), Sharma (1968), Zaki and Mohiuddin (1968), Singh (1968), Sah et al. (1970) and Ahmed and Sastry (1972).

Tumours of Mesothelium:

Eber and Malke (1932) recorded 4 cases of mesothelioma of peritoneum. Olson and Bullis (1942) described one case of mesothelioma in a 9 month old pullet. In India, Patnaik (1970) and Ahmed and Sastry (1972) have reported each a case of mesothelioma affecting peritoneum.

Tumours of blood vascular system:

Tumours of this nature are relatively very rare and have been occasionally reported by Babic (1931), Heim (1931), Olson and Bullis (1942), Jensen and Wammenhove (1969), Christopher and Rao (1964), Campbell and Appleby (1966), Sharma (1968), Parihar and Singh (1971) and Ahmed and Sastry (1972). Hemangioma of cavernous and papillary type were reported.

Hemangiopericytoma:

Perusal of literature did not reveal frequent reports

regarding this tumour. Only Sastry et al. (1967) and Ahmed and Sastry (1972) reported 2 cases of haemangiopericytomas from the neck region of hens.

Avian leucosis complex:

The literature on this subject is so extensive that it is not possible in a review of this nature to do more than deal briefly with the most general features encountered. Further more, much of it has been reviewed in books and monographs dealing its different aspects. Therefore, only the main works here are reported. The classification made by Burmester and Witter (1971) was followed in this case.

A. Leucosis/sarcoma group:-

1. Lymphoid leucosis (L.L.)
2. Myeloblastosis (Leucaemic)
3. Myelocytomatosis (A leucaemic or leucaemic)
4. Erythroblastosis:- a. Proliferative
b. Anaemic
5. Fibrosarcoma, endothelioma, hepatoma and nephroblastoma.
6. Osteopetrosis

B. Marek's disease group:-

Lymphoid leucosis represents the most common type of avian neoplasia. Goss (1940) in a series of 7, 408 neoplasms of birds, encountered 991 (13.4%) leucotic tumours. Olson and Bullis (1942), in their studies of the distribution of lesions in chickens found that of 213 cases of lymphocytoma, the liver, kidney and gonads were involved in 50-55% of the cases, the spleen in 43% peritoneum and adrenal 30%, bone marrow, lungs, heart, pancreas, intestine, proventriculus and blood in 10-20% and skin, muscle, thymus, thyroid, parathyroid and oviduct is less than 10% of cases. In India, Viraraghavan and Nair (1965) in their eleven year survey encountered 132 cases of avian leucosis complex among 952 chickens autopsied, giving an autopsy incidence of 13.9% and the chicks were of 5 months and above age group. Subsequently, Hemsley (1966), Campbell and Appleby (1966), Peterson et al. (1966), Carda Aparici et al. (1967), Bwanganoi (1967), Clanek (1968), Arya (1968), Singh (1968), Sahu (1970), Nayak and Pradhan (1971), Burmester and Witter (1971) and other earlier workers have reported the incidence and involvement of various organs in lymphoid leucosis.

The occurrence of osteopetrosis is a rare condition in avian leucosis complex group . Jungher and Hughes

(1965), Knezevic and Marjanovšcova (1965), Blitz and Pellegrino (1965), Sanger et al. (1965 and 1966) and Burmester and Witter (1971) have recorded the occurrence of this condition mainly in the leg and wing bones and rarely in the breast bones.

Other tumours of avian leucosis group such as myeloblastosis (Bayon, 1930 and Furth, 1931), myelocytomatosis (Olson and Bullis, 1942, Lerbovyries and Roger, 1960 and Ahmed and Sastry, 1972), erythroblastosis (Plson and Bullis, 1942, Campbell, 1945, Viraraghavan and Nair, 1965 and Wallbank and Stubbs, 1966), fibrosarcoma (Iyer, 1960, Dhodapkar, 1967, Rao, 1968, Ajinkya and Gardeshpande, 1969, Perihar and Singh, 1971 and Ahmed and Sastry, 1972), hepatomas (Olson and Bullis, 1942, Christopher et al., 1968 and Ahmed and Sastry, 1972) and nephroblastoma (Walter et al., 1962, Helmboldt and Jortner, 1966, Krishnan, 1969 and Ahmed and Sastry, 1972) were reported.

Marek's disease(Neural lymphomatosis, fowl paralysis) was first discovered by Marek (1907), Biggs (1962 and 1967), Wight (1962 a , b and 1965), Biggs and Payne (1963), Biggs et al. (1965), Nakagawa (1965), Payne and Biggs (1967), King and Chute (1969), Morris et al. (1969), Babjee (1970) and

many other workers have reported the incidence, gross and histopathology of nerves and other affected organs. Nazerian and Burmester (1968), Ahmed and Schidlovsky (1968), Epstein et al. (1968); Schidlovsky et al. (1969) have demonstrated intracytoplasmic virus particles in epithelial cells of various tissues, while Wight (1969) could not detect virus like particles in peripheral nerves. Biggs et al. (1968) studied the relationship between Marek's disease and coccidiosis and stated that infection with Marek's disease virus increases the susceptibility of chickens to coccidiosis. Burmester and Witter (1971) reported that females are more susceptible and chicks under age group of two to six weeks are susceptible with a peak mortality at 12-30 weeks.

In India Viraraghavan and Nair (1965), Devprakash and Rajya (1970), Sharma et al. (1971), Gowada and Mahiuddin (1971) reported some cases of Marek's disease in chicks affecting various nerves and visceral organs. The significance of lactate dehydrogenase activity in diagnosis of the disease has been also indicated (Devprakash and Rajya, 1970 b). Rajya and Mohanty (1971), Mohanty et al. (1971) and Sharma et al. (1971) in their exhaustive study on Marek's disease have reported that

Marek's disease agent can be isolated from both classical and acute forms, their pathogenic behaviour can be studied by producing precipitin reaction against immune sera of J.M. strain of Marek's disease by employing Agar-gel diffusion test (AGDT). Epidemiological investigation on field out-breaks and experimental transmission studies have been also made by these authors which went to show that chicks inoculated at day-old age with infective materials or remained in contact with clinically positive birds for 6 weeks had decreased growth rates in comparison to their hatch mates, when maintained under identical conditions of feed and managements.

MATERIALS AND METHODS

The present study was based on the materials collected from the routine postmortem examination of poultry birds received from college poultry farm, Tribal and Rural Welfare farm, Regional poultry farm and other private farms for diagnosis. Out of 4,840 birds necropsied during 12 years (1960-71) 245 birds showed gross lesions of various neoplastic conditions. Twenty of 245 birds manifesting leucotic lesions were subjected to a detailed examination and skin, comb, skeletal muscles, bursa fabricius, heart, liver, lungs, spleen, mesentery, oesophagus, proventriculus, gizzard, duodenum, pancreas, caecal tonsil, caecum, kidney, ovary, oviduct and testes were collected from these birds. As most of these birds were of older age group bursa fabricius was collected from a few birds. From birds showing paralysis in conjunction with leucotic lesions, nerves of brachial plexus and sciatic were collected; brain was collected from a few of these paralytic birds. The remainder of 225 neoplastic tissues belonged to the earlier collection (1960-70), which consisted only of the organs involved with the actual tumour growths. Representative portions showing gross lesions were fixed in

10% formol saline solution and after 48 hours of fixation the tissue were processed by routine histopathological techniques.

origin have been described.

TUMOURS OF CARTILAGE TISSUE

Chondroma:

A case of chondroma in a White Leg horn (W.L.H.) hen of 1 year old (R-195/71) was encountered.

Gross changes:- The neoplastic growths were found on the keel bone. They were multi nodular, round, measuring 10x10 mm. in diameter and firm in consistency. The cut surface of these growths were opaque or greyish-white in appearance. No metastatic growths could be observed in any other organs (Fig. 1).

Microscopic changes:- The tumour cells were present within the lacunae. They were round, or ovoid and of uniform in size. The mitotic figures were not seen. A fibrous connective tissue capsule encircled the group of tumour cells (Fig. 2).

Chondrosarcoma:

A case of chondrosarcoma was observed in a Rhode Island Red (R.I.R.) hen of 1 year old (R-199/72).

Gross changes:- The tumour growth was located on the hind quarter

closed to the cloacal end, probably on the flat bones of the pelvic girdle and was round and firm measuring approximately 1.7 cm. in diameter. Cut surface was opaque and greyish-white.

Microscopic changes:- The neoplastic tissue was more cellular and the cells were round to spindle shaped exhibiting anaplastic features characterised by hyperchromatic nuclei and pleomorphism (Fig. 3). Mitotic figures were evident and at some areas the tumour cells formed giant cells with multiple nuclei. Lacunae were not well formed. Invasion by the tumour tissue into the surrounding capsule was noticed.

TUMOURS OF CONNECTIVE TISSUE

Fibroma:

A case of fibroma (R-97/71) was recorded in a White Leg horn (W.L.H.) Hen of 13 months old.

Gross changes:- Right leg showed a large tumour mass approximately 35 x 60 mm. in diameter on the tibia. The tumour growth was ovoid, greyish-white and firm (Fig. 4).

Microscopic changes:- The tumour tissue was arranged in form of whorls and interlacing bundles of fibroblasts and collagen fibres. The neoplastic cells were spindle shaped with elongated nuclei. Collagen fibres were dense. Van Gieson's method of staining confirmed this to be a fibroma.

Myxoma:

One case of myxoma was observed in a Rhode Island Red (R.I.R.) hen of 2 years old.

Gross changes:- Two tumours growths to the size of 15 x 25 mm. diameter each had developed bilaterally in the right and left auricles of the heart (Fig. 5). The growths were round, greyish- white, soft and firmly attached to the endocardium. The cut surface was greyish- white and slimy.

Microscopic changes:- The tumour mass consisted of stellate or star shaped mesenchymal cells with cytoplasmic processes. In some areas, the cells were arranged in whorls. Intercellular matrix appeared vacuolated and with PAS stain slightly pink stained PAS positive materials could be noticed. Connective tissue stroma was scanty. Mitotic figure were not seen (Fig. 6 & 7).

TUMOUR OF SMOOTH MUSCLE TISSUE

Leiomyoma:

Three cases of leiomyoma affecting the mesosalpinx were encountered in two White Leg horn hens (R-162/72 and 219/66) and one Rhode Island Red (R.I.R.) hen (R-179/72) of 1 to 1 ½ years age group.

Gross changes:- In the W.L.H.bird (R-162/72) an abnormal growth to the size of 3 cm. in diameter on the ovarian ligament was

noticed and in the other W.L.H. bird (R-219/66) the growth was of 2 cm.in diameter and developed on the isthmus of the mesosalpinx. The neoplastic growths were spherical and had a slightly pinkish discolouration. The cut surface was fleshy with an well developed capsule.

Microscopic changes:- The tumour growth consisted of smooth muscle cells, which were arranged in form of whorls or bundles running in a criscrossing pattern (Fig. 8). Connective tissue stroma was abundant and supported some blood vessels. The muscle fibres had long sländer nuclei. Van Gieson's method of staining confirmed the tumour to be of leiomyoma.

TUMOURS OF EPITHELIAL TISSUE

Adenocarcinoma of oviduct:

Adenocarcinoma involving the oviduct of White Leg horn (W.L.H.), Rhode Island Red (R.I.R.) and Black Astrelop (B.A.) hens within 1-2 years of age group were observed.

Gross changes:- In the mucosa of the magnum large number of nodular neoplastic growths of varying sizes ranging from 0.5 to 2.0cm. in diameter were found scattered. In the other bird (R-214/72) these nodular growths were protruding over the serosal surface. These growths were greyish-white and were moderately soft in

consistency. The wall of this part was markedly thickened causing obliteration of the lumen.

Microscopic changes:- The tumour mass consisted of large number of acini lined with cuboidal to columnar cells. Anaplastic features were characterised by pleomorphism of the neoplastic cells with hyperchromatic nuclei. The tumour growth had infiltrated the muscular coat and serosa. The intermuscular spaces and the muscle fibres showed varying degree of separation due to infiltrating tumour cells (Fig. 9). Following serosal infiltration with the neoplastic cells, the serosa showed marked thickening. The arrangement of the tumour tissue and the features of anaplasia were similar in these layers to those of oviductal mucosa. Besides the above anaplastic features, evidence of syncytial giant cells following the fusion of neoplastic cells were recorded.

ADENOCARCINOMA OF OVARY

Nine cases of adenocarcinoma affecting the ovary of White Leg horn (W.L.H.), Rhode Island Red (R.I.R.) and Black Astrolcp (B.A.) hens within the age group of 1 to 2 years were encountered.

Gross changes:- In majority of the birds the affected ovary showed marked enlargement with nodular or lobulated tumour growths of varying sizes ranging from 0.5 to 1.5 cm. in diameter. These growths were greyish-white and softer in consistency, In the remaining birds the ovary had granular appearance and was non-functional. Metastatic growths due to this neoplasm were seen in four cases on the serosal coat of the intestine, over the mesentery and pancreas and these growths were primarily of nodular type.

Microscopic changes:- The ovarian tissue was completely replaced by the neoplastic growth, which showed acinar arrangement lined by cuboidal to columnar epithelial cells. In the other areas the tumour cells were arranged in the form of solid cords (Fig.18). Marked pleomorphism of the cells, hyperchromatic nuclei, intensely acidophilic and granular cytoplasm and mitotic figures were evident. The acini were supported by smooth muscle fibres. Some acini contained pale acidophilic albuminous material.

The secondary metastatic growths in the mesentery, pancreas and serosa of the intestinal loop had similar histological features to that of primary growth (Fig.19). The

neoplastic cells pierced the capsular wall of the pancreas as a result the capsule was thickened and focal areas of subcapsular pancreatic parenchyma were also replaced by the invading neoplastic cells (Fig. 12). The infiltration of the tumour tissue was primarily confined to the serosa of the intestine, and the muscular layer and the mucous membrane of intestine were free from invasion.

Papillary Cystadenocarcinoma of ovary:

This condition affecting the ovary was recorded in a White Leg horn hen (R-160/72) of 8 months old.

Gross changes:- Ovary was enlarged 7 - 8 times of the normal size and showed numerous cyst-like structures of 1 - 2 mm. in size. The cysts contained small amount of a thin, clear fluid. The cut surface exhibited clear cystic cavities.

Microscopic changes:- Almost all the ovarian tissue was converted to neoplastic mass. The latter showed cystic dilatations (Fig.13) and many papillary processes lined by cuboidal to columnar cells of 2-3 layer cell thickness. The neoplastic cells showed pleomorphism, but mitotic figures were not frequently seen. The cystic spaces contained some serous fluid admixed with

desquamated neoplastic cells. The connective tissue cores of these papillary projections showed the presence of blood vessels. In the tumour mass there were areas of haemorrhage and oedema.

TUMOURS OF MESOTHELIUM

Mesothelioma:

This condition was observed in a R.I.R. hen (B-95/72) of 8 months old.

Gross changes:- In the abdominal cavity the peritoneum, the mesentery and the serosa of the intestinal loop were diffusely studded with tumour growths. The growth was cauliflower-like or multiple small, round, greyish-white confluent nodules of varying sizes ranging from 0.2 to 1.0 cm. (Fig. 14). The consistency of these growths was firm.

Microscopic changes:- The neoplastic tissue showed papillary projections supported by thick fibrous connective tissue core (Fig. 15). These papillae were lined either by a single or more than one layer of cuboidal cells. The cells showed large, vesicular nuclei and prominent nucleoli. Evidence of anaplastic changes was recorded in some areas. Necrotic changes in the tumour cells characterised by strongly acidophilic cytoplasm and pyknetic nuclei were noticed. The connective tissue were showed moderate vascularity. Basement membrane was ill-defined.

TUMOURS OF BLOOD VESSELS

Haemangioma:

A case of cavernous haemangioma affecting the liver was recorded in a White Leg horn (W.L.H.) hen of 1 year old (R-195-72).

Gross changes:- The liver was greatly enlarged 10 times the normal size occupying almost the entire abdominal cavity. The affected liver was dark red, soft and showed spherical, dark red, raised up tumour growths approximately 5 mm. in diameter (Fig. 16).

Microscopic changes:- The tumour mass consisted of large vascular spaces more or less uniform in shape and size, filled with blood (Fig. 17). These spaces were lined by a thin layer of endothelial cells and in some areas they were separated by broad fibrous connective tissue septa. Areas of secondary haemorrhages were observed at places. The tumour growth was surrounded by a connective tissue capsule, which varied in thickness. The capsule was highly vascular.

LEUCOSIS/SARCOMA GROUP

Epidemiology:

In this study a total number of 245 birds were

subjected for examination. The table 2 to 10 summarised the features such as rate of incidence, age and sex in various forms of tumours of this group.

The incidence of lymphoid leucosis was high in White Leg horn (W.L.H.) birds followed by a low incidence rate in Rhode Island Red (R.I.R.) chickens. Mostly, the birds in the age group 8-12 months showed highest incidence of lymphoid leucosis. While considering sex, it was observed that high incidence and increased mortality due to lymphoid leucosis were seen in females rather than in males. Both the sexes were equally affected with other group of neoplasms. With regard to the season, occurrence of these tumours were more in colder days of the year.

LYMPHOID LEUCOSIS (LL).

In this study 212 birds were affected. Table I showed the organwise distribution of the lesions.

Table I

<u>Organs</u>	<u>No. of birds with lesions</u>
Liver	172
Kidney	118
Spleen	112
Ovary	88
Lungs	70

Duodenum	...	64
Pancreas	...	58
Heart	...	48
Proventriculus	...	47
Oviduct	...	46
Mesentery	...	38
Bursa fabricius	...	37
Caecal tonsil	...	15
Caeca	...	13
Gizzard	...	8
Skin	...	4
Comb	...	4
Testes	...	2
Skeletal muscle	...	1
Oesophagus	...	1

It was observed that the liver, kidney, spleen and ovary were frequently involved with lymphoid leucosis.

Gross Changes:- The affected organs in general showed characteristic lesions of lymphomatosis. Liver, in large number of cases, was markedly enlarged (Fig. 18) and showed both nodular and diffuse

type of growths. In the nodular type the surface as well as the parenchyma showed fleshy, greyish-white nodular growths of various sizes ranging from 0.2 to 1.0 cm. in diameter. In diffuse variety the liver had granular appearance due to numerous pin-head size grayish-white neoplastic growths primarily embedded in the parenchyma.

Kidneys, in large number of cases, were markedly enlarged involving all its lobes (Fig. 19) and had granular surface. In few cases, small nodular growths to the size of 3 - 10 mm. were also seen. The affected kidneys were greyish-white and softer in consistency.

Spleen, in many cases, was markedly enlarged to the size of 3 - 5 times of its normal size. The nature of lesions was similar to those observed in case of liver.

Ovary showed variable lesions. Diffusely affected ovaries were enlarged showing cauliflower like pendunculated or nodular growths. The growths were greyish-white and firm. In some cases, ovaries did not show any enlargement, but a granular appearance; these were nonfunctional. In others there were both matured follicles and nodular neoplastic growths.

Lungs were involved both diffusely and focally.

Diffusely affected lungs were fleshy and/or firm in consistency.

In the focal type greyish-white nodular growths were seen

scattered on the surface as well as embedded in the parenchyma.

Duodenum and pancreas were equally affected and showed greyish-white nodular growths scattered on their surface. In some birds, the neoplastic growths of similar nature were observed on the mucosa of the intestine. Pancreas, in many cases, were enlarged 6-7 times the normal size with these greyish-white nodular growths.

Heart, in many cases, showed small nodular growths of varying sizes ranging from 2-5 mm. on the myocardium of both sides. In one bird (R-127/71) the heart was enlarged to 5 times the normal size (Fig. 20), greyish-white in colour and firm in consistency. Myocardium in this case was thickened without any nodular growths and the pleura was firmly adhered.

Proventriculus, gizzard, caeca, mesentery and oviduct showed nodular growths scattered both on the mucosa and serosa. Mesentery in some cases, was diffusely involved.

Bursa, affected with this tumour in many cases, was greatly enlarged (Fig. 21) to the size of 10 - 15 mm. and occupied almost the entire pelvic cavity . The enlarged bursa

was greyish-white and fleshy in consistency.

Testes were affected in two cases and were enlarged 5 - 6 times the normal size and were greyish-white in colour.

Comb, in one bird (R-111/71) showed swelling, paleness and was soft in consistency, while in others no gross lesions were observed.

Skin and skeletal muscle did not reveal any appreciable gross lesions of this lymphoid leucosis.

Microscopic changes:- Histological alterations of lymphoid leucosis was fairly uniform in all the organs characterised by autonomous proliferation of the cells of lymphoid series.

The liver showed both diffuse and focal lesions. In diffuse type the parenchyma showed massive infiltration of lymphoid cells, which dislocated the normal cord - like arrangement of hepatic cells and also replaced them by these neoplastic cells over large areas. In focal variety, ill-defined circumscribed areas of lymphoid cell accumulations replacing the hepatocytes were evident. These neoplastic cells were small round cells resembling small lymphocytes or large immature cells indistinguishable from lymphoblasts. Some infiltration of plasma cells in these

areas were also evident.

In the spleen, both diffuse and focal accumulations of lymphoid cells involving white pulp and splenic cords were noticed. Invasion of the red pulp by these neoplastic cells were evident in some locations. The cell types were the same as those described in the liver parenchyma.

The other organs, such as kidney, lungs, testes, ovary, oviduct, proventriculus, gizzard, duodenum, pancreas, caeca, caecal tonsil, mesentery, bursa fabricius and skeletal muscle were infiltrated both diffusely and focally with the neoplastic lymphoid cells, including some plasma cells.

In the comb, the neoplastic cell infiltration was extensive obscuring the normal histological pattern of the organ (Fig. 22 and 23).

In the skin there was focal, but marked infiltration of lymphocytes, lymphoblasts and few plasma cells around the feather follicles (Fig. 24) and the dermal papillae. The feather follicular epithelium had occasional hydropic degeneration.

Fibrosarcoma:

Two cases of fibrosarcomas were encountered, one

in a White Leg horn (W.L.H.) male of 1 year old (R-96/71) and the other was in a Rhode Island Red (R.I.R.) hen of 9 months old (R-221/72).

Gross changes:- The W.L.H. bird (R-96/71) showed a globular greyish-white tumour mass on the keel bone. It was soft, friable and not encapsulated. The cut surface was homogeneous and opaque (Fig. 25). In the R.I.R. bird (R-221/72) the keel bone exhibited a similar tumour growth as observed in case of W.L.H. bird, but the growth was slightly pinkish and comparatively firm in consistency. The ovary was lobulated in appearance and consisted of nodular growths of 1.5 to 3.0 cm. in size. These growths were greyish-white and fleshy (Fig. 26).

Microscopic changes:- The tumour growths from the breast muscles were of sarcomatous in nature. There were whorls, interlacing bundles of immature fibroblasts and scanty collagen fibre (Fig. 27). The tumour cells showed pleomorphism and the nuclei of these cells were hyperchromatic, large, round or oval. The examination of the ovary revealed extensive invasion by the neoplastic growth which had completely replaced the ovarian tissue. The nature of growth and anaplastic features were the

same as those observed in the breast muscles.

Hepatoma or Hepatocellular carcinoma:

Two cases of hepatomas were encountered, one in a White Leg horn (W.L.H.) male of 13 months old (R-223/72), and other in Rhode Island Red (R.I.R.) female of 6 month old (R-207/72).

Gross changes:- In R.I.R. bird (R-207/72) the liver was enlarged 3 times the normal size and was moderately firm in consistency. There were many pin-head size greyish-white foci scattered over all the lobes. Besides, there was a tumour mass primarily located between the two lobes of liver occupying entire substance of these lobes leaving only a thin rim of hepatic parenchyma. In the other bird, (R-223/72) the liver was similarly enlarged 3 times of normal size and the surface of the lobes showed ill-defined haemorrhagic spots and minute greyish-white foci.

Microscopic changes:- The liver in the W.L.H. bird (R-223/72) showed complete loss of orderly arrangement of the hepatic cells (Fig 26). The hepatocytes exhibited varying degrees of anaplasia characterised by more basophilic cytoplasm, larger oval or

round, hyperchromatic nuclei. Mitotic figures were less. The disorganised hepatic cells, at many places, formed acinar structures enclosing a lumen (Fig. 29) and at places showed adenomatous pattern of arrangement. Connective tissue stroma was scanty. The liver parenchyma was markedly congested more particularly in and adjacent to the tumour mass. The vascular spaces in these areas showed marked dilatation. In the other bird (R-207/72) the neoplastic cells were arranged in form of tubules and irregular cords, but no acinar arrangement was observed. Connective tissue stroma was considerably larger than the previous case. The other features of the tumour cells were the same as described in the earlier bird.

Neophrblastoma:

This condition was encountered in a White Leg horn (W.L.H.) cock of 9 month old (R-161/72).

Gross changes:- At the cloacal region there was a spherial tumour mass measuring approximately 45 x 50 mm. in diameter (Fig.308). The growth was attached to the lower lobe of left kidney and was firm, greyish-white and cut surface was pinkish

and fleshy in appearance.

Microscopic changes:- The neoplastic tissue showed proliferation of equal amount of epithelial tissue and connective tissue. The proliferating epithelium formed many glomerular-like structures and tubular structures. In some areas the microscopic picture resembled that of adenocarcinoma. There were solid, branching cords of the epithelial cells and large cysts lined by cuboidal epithelium were also observed (Fig. 31). However, mitotic figures were few and there were focal haemorrhages in the tumour tissue. Metastatic lesions were not observed.

Osteopetrosis:

Three cases of osteopetrosis, two in Rhode Island Red (R.I.R.) males (R-162/72 and R-264/72) and one in White Leg horn (W.L.H.) female (R-263/72) of 6 to 16 months of age groups were recorded.

Gross changes:- In the R.I.R. birds (R-262/72 and 264/72) the femur and tibia of both the legs showed exostoses at different places. These bones showed moderate convexity and irregular thickening in both diaphyseal and metaphyseal regions. The metatarsal bones were extremely thickened and their scales were pronounced giving the typical appearance of marble bone condition (Fig. 32). The affected bones were very hard and cut surface showed a very narrow

marrow cavity. In the W.L.H. bird (R-263/72) thickening of the leg bones were moderate.

Microscopic changes:- The boney trabeculae were primarily of osseous in nature, but some showed remnants of osteoblasts. There was moderate to marked fibrosis of the intertrabecular spaces and the osteoclasts showed degeneration and necrosis. The central marrow cavity was completely occluded by the newly formed bone and it showed fibrosis similar to that of intertrabecular marrow spaces.

Marek's disease:

Out of 20 birds subjected to a detailed examination for leucosis involvement of the ovary with Marek's disease (M.D.) was encountered in one White Leg horn (W.L.H.) hen of one year old (R-119/71).

Gross changes:- At necropsy, the ovary, showed small, soft, greyish-white nodular growths ranging from 4 - 6 mm. in diameter. The ovary was nonfunctional. Similar nodular growths were also found on mesentery and pancreas.

Microscopic changes:- Ovarian tissue was extremely infiltrated with neoplastic cells of lymphoid series ranging from lymphocytes

to lymphoblasts. Among these cells there were some plasma cells present. Some of the cells exhibiting vacuolated cytoplasm and basophilic nuclei were also seen. The tumour cells showed marked pleomorphism and some mitotic figures.

DISCUSSION

Pathology of the tumour in poultry is a never ending study and more and more investigations on this field would contribute something to the realm of avian oncology. In the field of mamalian oncology, there have been extensive studies by different oncologists with regards to incidence, aetiology, immunity, age, breed, sex, effect on the host, prediliction site of tumour growth and finally characterisation of different tumours based on their benign and malignant nature.

With the avian neoplasms, reports on a similar line other than leucosis appears to be scanty. Investigation on 245 out of 4,840 chickens exhibiting different neoplasms were studied and their epidemiological, gross and microscopic features were recorded. In the preceding pages an attempt has been made to discuss these various aspects. Table 2 to 10 summarises these different aspects.

As mentioned earlier in this study classification of avian leucosis complex has been followed as per Burmester and Witter (1971) and accordingly discussion pertaining to various aspects have been made.

As in this study, neoplasms were never recorded beyond the age of 2 months, the birds postmortemed under this age group have not been taken into consideration. Similarly, those fowls in which postmortem examination could not be conducted due to unfortunate incidents like rat bites and wild animals' attacks have been deleted from the total number of birds necropsied.

Chubb and Gordon (1957) have described that fowls are more susceptible to tumours than other domestic animals and there is high percentage of mortality due to these neoplasms. A critical analysis of the incidence rate of all the 245 avian neoplasms studied together indicated that 5.06 percent of birds succumbed due to these tumours and this incidence rate was found to be lower than those described by Olson and Bullis (1942), Campbell (1945), Darcel et al. (1952), Jordan (1956) and Ajinkya and Sardeshpande (1969).

The age group of fowls sustaining a very high percentage of death due to various forms of leucosis was between 5 to 12 months (Darcel et al., 1952). Moulton (1961) while discussing the general aspects of mammalian neoplasms,

also made a mention that in chicken the peak age of tumour incidence is 2 years old. Other works by Vilaraghavan and Nair (1965) showed that the youngest age group of chicks affected with neoplasm is 3½ months of age and the oldest is 54 months. However, they opined that 12 months of age was the average age of birds mostly susceptible with the neoplasms. Devprakash and Rajya (1970 a) in their report of A.L.C. have described that the incidence is highest in the group of 15 months and are followed by decreased incidence in 6 - 9 months and lowest in 1 - 3 months age group. In this study, the age group of the birds susceptible for all types of neoplasms was analysed from the age recorded at necropsy. It was observed that the highest age group most susceptible for various types of neoplasms including the tumours of leucosis/ sarcoma group was 8 - 12 months of age(Table 3 and 4) and the lowest age of fowls found to be affected with neoplasms was 2 months of age, which confirmed the findings of earlier workers including Biggs and Payne (1967).

With regards to the sex Vilaraghavan and Nair (1965) and Devprakash and Rajya (1970 a) reported females are most

susceptible with all forms of leucosis than males. On the other hand with osteopetrosis males are affected more than the females (Moulton, 1961 and Viraraghavan and Nair, 1965). In the present study with all types of avian neoplasms, similar observations were recorded confirming the findings of earlier workers. Further it was observed that in leucosis/ sarcoma group, visceral lymphomatosis was encountered in large number of females and among the tumours other than leucosis/ sarcoma group neoplasms affecting the reproductive system were more common (Table 5 and 6).

The influence of breed on the development of neoplasms in the fowls, particularly in relation to A.L.C. have been reported by Dudley et al. (1941), Davis et al. (1947) and Nightall (1956). Chubb and Gordon (1957) observed a significant difference in the incidence of leucosis either in lighter or heavy breeds or the breeds of either group. Viraraghavan and Nair (1965) were of opinion that the incidence was highest in White Leg horn breeds followed by other indigenous graded, Rhode Island Red and Black Astrolop birds in order of frequency. In contrary highest incidence of A.L.C. was observed

in the birds of cross breed and Rhode Island Red and lowest in White Leg horn (Devprakash and Rajya, 1970). In the present study, the tumour of both leucosis/sarcoma and of other group were more in the White Leg horn breeds followed by Rhode Island Red, Black Astrolop and Indigenous breed (Table 7 and 8). Thus, this observation supported the findings of Viraraghavan and Nair (1965). The low incidence rate in the breeds of Black Astrolop and indigenous breeds of birds may be explained due to a small number of such birds received for necropsy.

Seasonal incidence of tumours in fowls have been reported by Campbell (1955), Jordan (1956), Smith and Long (1959), Jungherr and Hughes (1965). In India Viraraghavan and Nair (1965) and Devprakash and Rajya (1970 a) have stated that leucosis was highest in the colder months and lowest in the hotter days of the years. In the present investigation the highest incidence with the tumours of leucosis/sarcoma group was recorded in November to January, thus confirming the observations made by earlier Indian workers. But, with the tumours of other group more or less equal percentage of incidence was encountered in colder and hotter months, thereby indicating the absence of

significant role played by the season on the epidemiological characters on these tumours (Table 9 and 10).

Frequency of involvement of different organs in leucosis has been reported by Olson and Bullis (1942), who stated that liver, kidneys and gonads were involved in the order of frequency followed by spleen and other organs. Viraraghavan and Nair (1965) described that liver, kidney, spleen were the organs affected with higher frequency followed by ovary. Similar observations have been made by Devprakash and Rajya (1970 a) with slight variation in the involvement of gonads. In their report gonadal involvement was lower than the involvement of lungs. In this study the involvement of liver, kidney, spleen and gonads were in order of frequency, which went to support the observations recorded by Olson and Bullis (1942) and Viraraghavan and Nair (1965) and Devprakash and Rajya (1970 a) in respect of lungs. Involvement of skin, comb, skeletal muscle and oesophagus were encountered in a few fowls (Table 1).

The gross and microscopic observations of avian neoplasms of different tissue origin were similar to those reported by Moulton (1961), Ajinkya and Sardeshpande (1969),

Devprakash and Rajya (1970 a), Parihar and Singh (1971) and Ahmed and Sastry (1972). However, certain interesting observations were obtained with regards to the involvement of different body systems with leucosis. It was noticed that in majority of the cases four or more than four systems were affected and in some cases out of 9 systems, 7 systems showed the involvement of their organs (Table 2). The digestive system was involved in all the cases followed by genital system. Other three systems like haemopoietic, urinary and respiratory were affected in equal number of cases and any of these formed the combination with the organs of digestive and genital systems. It was also interesting to note that the liver, in the digestive system, was affected in all the cases. The skin and comb were affected in four out of 20 cases and the skeletal muscle only in one case.

In the present investigation attempts were made to record the incidence of Marek's disease (MD). Gross examination of the nerves of five out of twenty leucotic birds showing paralysis failed to reveal any lesions suggestive of MD. Histological examination of the tissues of these paralytic cases including 15 other leucotic birds revealed ovarian lesions

in one case indistinguishable from that of MD. However, the presence of typical MD cells as reported by Devprakash and Rajya (1970 b) were not seen in this case. The skin had also the lymphoid cell infiltration, but without any vacuolar degeneration and presence of inclusion body in the feather follicular epithelium. Mohanty et al. (1971) reported that in the classical form of the disease, in addition to pathognomonic lesions in nerves, brain and visceral organs the skin shows vacuolar degenerative changes and inclusion bodies in the feather follicular epithelium, where as in acute type the lesions are present in the visceral organs and nerves, but no evidence of inclusion bodies in the feather follicular epithelium. Although no systematic examinations could be made in this study, based upon the ovarian lesions one case of MD in a fowl was diagnosed. Further detailed investigation on this disease in this department are in progress.

While analysing the special features of other tumours in the leucosis/sarcoma group it was noticed that fibrosarcoma involved the keel bone in two birds, one of which showed metastasis to the ovary. This was in accordance with the

observation made by Ajinkya and Sardeshpande (1969) in respect of ovarian involvement.

Hepatoma and hepatocellular carcinoma with or without metastasis to the ovary have been reported by Sharma (1968), Ajinkya and Sardeshpande (1969), Sah et al. (1970), Ahmed and Sastry (1972) including many others. In this study two cases of hepatocellular carcinoma without metastasis were encountered and the gross and microscopic changes were in accordance with the earlier workers.

One case of neoplasia involving the lower lobe of the left kidney of a White Leg horn cock was encountered and its gross and microscopic observations were in agreement with those described by Moulton (1961), Krishnan (1969), Ahmed and Sastry (1972).

Avian osteopetrosis characterised by periosteal and endosteal proliferation of immature bony tissue occluding the lacunae and marrow spaces and without evidence of malignancy have been described by Knezevic and Majanovicova (1965), Blitz and Pellegrino (1965) and Sanger et al. (1966), Viraraghavan and Nair (1965) while recording 7 cases of osteopetrosis in their

investigation have also observed involvement of visceral organs in some birds. In the present study, 3 cases of osteopetrosis involving both legs of 2 R.I.R. male and 1 W.L.H. female birds of 6 to 16 months age group were encountered. The histological feature tallied to those of second stage of development of osteopetrosis as described by Moulton (1961). As the visceral organs were not examined in these cases, the nature of lesions, if there were any, could not be explained. Since there was no evidence of malignancy in the lesions examined the tumourous condition was suggested to be of primarily proliferative osseous growth.

Among the group of the connective tissue tumours fibromas affecting eyes, skin, wing, neck, chest, lungs, intestine, ovary and oviduct and myxomas involving skin and stifle joint of fowls have been reported by Singh and Singh (1968), Ajinkya and Sardeshpande (1969) and Ahmed and Sastry (1972) including others. In the present study each one case of fibroma and myxoma involving the leg bone and auricular walls of heart of one R.I.R. and one W.L.H. hens were encountered. The occurrence of myxoma on the auricular walls of a fowl in this case seems to be a rare one and no such reports appear to

be available in the literature, which went to agree with the views of Moulton (1961), who has stated that rarely this tumour arises from the endocardial surface of the heart. The gross and microscopic observations of fibroma and myxoma were similar to those observed by earlier workers except the presence of pigment laden histiocytes as reported by Singh and Singh (1968).

Tumours of cartilage cells, chondroma and chondrosarcoma are very rare in the chickens (Feldman and Olson, 1965). Kolte *et al.* (1969) and Ahmed and Sastry (1972) have described each a case of chondroma. In this present study a case of chondroma arising from the breast bone of a W.L.H. hen and a case of chondrosarcoma arising from the cloacal region of a R.I.R. hen were encountered. The exact site of development of the chondrosarcoma was not pin pointed. However, it was suggested that the possible site may be from the flat bones of the pelvic girdle. Further, the report of chondrosarcoma, in this study was a rare one and there has been no reports about this tumour in the available literature. The gross and microscopic observations of these tumours were in agreement with those described by above cited workers.

Smooth muscle tumour, leiomyoma of the ventral

ligament of the oviduct is a most common neoplasm in chicken (Feldman and Olson, 1965). They have also stated that these are slow growing tumours and their effect on the oviductal function depends upon the site of development and size of the tumour. Olson and Bullis (1942) stated that increased oviductal motility in heavy layers has a close relationship with the development of leiomyoma in the mesosalpinx. In this study of 3 cases of leiomyoma of mesosalpinx in two W.L.H. and one R.I.R. hens of 1 to 1½ year age group were encountered. The gross and microscopic changes were similar to those observed by earlier workers including Ajinkya and Sardeshpande (1969) and Ahmed and Sastry (1972). As these birds, were in their peak age of production and also were in the group of heavy layers, the genesis of leiomyoma in these cases may be similar to those described by Olson and Bullis (1942).

Epithelial tumours of either nature in this study, involving the reproductive system of fowl, were encountered in highest number. This observation was in accordance with Schneider (1926), who stated that genital tumours comprise half of all the avian neoplasms. In some cases metastatic lesions on the serosa of intestine, mesentery and pancreas were observed fulfilling the condition of transcoelomic transplantation.

The gross and microscopic features were similar to those described by Guarda (1957), Feldman and Olson (1965), Krishnan (1966), Ajinkya and Sardeshpande (1969) and Ahmed and Sastry (1972). The involvement of ovaries by neoplasms more than other organs has been reported by earlier workers. In the opinion of Jackson (1936), Kronberger (1962) and Feldman and Olson (1965), increased susceptibility of the ovary to neoplastic conditions is mainly due to its constant functional activity. In this study similar opinions were offered in respect of this organ.

Tumours of the mesothelial cells affecting the peritoneum and serous covering of the abdominal organs and with or without metastasis to liver have been reported by Patnaik and Mohanty (1970) and Ahmed and Sastry (1972). In this study one case of mesothelioma developing on the peritoneum of a R.I.R. hen was encountered and the gross and microscopic lesions were similar to those described by earlier workers. However, no sign of metastasis into any of the visceral organs was observed in this case.

Tumours of the blood vascular system, haemangiomas of cavernous type, affecting the liver and skin of fowls have been described by Christopher and Rao (1964), Ajinkya and

Sardeshpande (1969) and Ahmed and Sastry (1972). In the present study, a single case of cavernous haemangioma involving the liver of a W.L.H. hen was reported and had similar gross and microscopic features as described by above cited workers.

Multiple neoplasia in chickens is a rare condition and was described by Babic, (1931), Jackson (1936), Olson and Bullis (1942) and Zaki and Mahiuddin (1968). In bovines and canines it has been reported by Boyd et al. (1909), Feldman (1928), Mulligan (1944), Rama Rao et al. (1966) and Sastry et al. (1971). In the present study a case of multiple neoplasia in a White Leg horn hen of 1 year old was recorded. It was interesting to observe two benign neoplasms of different tissue origin, which were diagnosed as chondroma and haemangioma of Beel bone and liver respectively.

S U M M A R Y

In the present investigation the incidence and histopathology of different neoplastic conditions in chickens were studied. Out of 4,840 fowls necropsied, 245 fowls with different tumours were examined in detail and their gross and microscopic features were recorded. The incidence of these neoplasms with regard to age, breed and sex were also dealt with. The table 11 summarises the percentage of different tumours encountered.

Table. 11.*Percentage of different avian neoplasms between
2 months to 16 months age and above.

Sl. No.	Forms of tumours	No affected	Percentage
1.	Lymphoid leucosis	212	86.5
2.	Fibrosarcoma	2	0.8
3.	Hepatoma	2	0.8
4.	Nephroblastoma	1	0.4
5.	Osteopetrosis	3	1.2
6.	*Marek's disease (MD)	1	5.0
7.	Chondroma	1	0.4
8.	Chondrosarcoma	1	0.4
9.	Fibroma	1	0.4

10.	Myxoma	1	0.4
11.	Leiomyoma	3	1.2
12.	Adenocarcinoma (Ovary)	9	3.6
13.	Papillary cystadenocarcinoma (Ovary)	1	0.4
14.	Adenocarcinoma (Oviduct)	5	2.00
15.	Mesothelioma	1	0.4
16.	Haemangioma	1	0.4

* Analysis made in detail on 20 leucotic birds

The general incidence rate of the tumours was 5.06 percent. The age groups of birds mostly susceptible for all types of neoplasms was 8 - 12 months. Females showed a higher percentage of mortality than males. On the other hand, males with osteopetrosis were affected more than the females. The highest incidence of tumours was recorded in White Leg horn (W.L.H.) birds followed by a low incidence in Rhode Island Red (R.I.R.), Black Astrolop (B.A.) and Indigenous breeds. Tumours of the leucosis/sarcoma group were recorded in highest number in winter months followed by a low incidence in hotter days. But the season seemed to have no influence on

Table 2.** Organwise distribution of lesions in lymphoid leucosis

Research No./Year	Digestive system								Resp. sys.	Card- io Vas. sys.	Haem- opoie- tic sys.	Uri- nary sys.	Geni- tal sys.	Lymph. sys.	Cutane- ous sys.		Muscular sys.		
	Oesophagus	Proventriculus	Gizzard	Duodenum	Pancreas	Liver	Caecum	Caecal tonsil Mesentery							Skin	Comb			
									Lungs	Heart	Spleen	Kidney	Ovary	Oviduct	Testes	Bursa fabricius			Skeletal muscle
R-110/71	-	-	-	+	+	+	-	-	+	-	+	-	+	-	-	-	-	-	-
R-111/71	-	-	-	-	+	+	-	-	+	-	+	+	-	+	-	-	+	+	-
R-112/71	-	+	-	+	-	+	-	-	-	-	+	+	-	-	-	+	-	-	-
R-113/71	+	+	-	+	+	+	+	-	+	+	+	+	+	+	-	-	-	-	-
R-116/71	-	-	-	+	-	+	+	+	+	-	+	+	+	+	-	-	-	-	+
R-117/71	-	-	-	+	-	+	+	+	+	-	+	+	+	+	-	-	-	-	-
R-118/71	-	-	-	-	-	+	-	-	+	-	-	-	+	+	-	-	-	-	-
R-119/71	-	+	-	+	+	+	-	+	-	-	+	-	-	-	-	-	+	-	-
R-120/71	-	-	-	-	-	+	-	-	-	-	+	+	-	-	+	+	-	-	-
R-121-71	-	+	-	-	-	-	-	-	+	+	+	+	+	+	-	-	-	-	-
R-122/71	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
R-123/71	-	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	+	+	-

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the tumours other than leucosis/sarcoma group. In leucosis/sarcoma group, lymphoid leucosis, fibrosarcoma, hepatoma, nephroblastoma and osteopetrosis were recorded. Out of 20 leucotic fowls examined in detail, Marek's disease (MD) was recorded in one case. Other neoplasms encountered in this study were chondroma, chondrosarcoma, fibroma, myxoma, leiomyoma, adenocarcinoma, mesothelioma and haemangioma.

In lymphoid leucosis liver was the organ, most commonly affected followed by kidney, spleen and ovary. The gross and microscopic features of different tumours were described, classified and their different aspects were discussed.

Table 2. contd.

Research No/Year	Digestive system								Resp. sys.	Car- dio Vas. sys.	Haem- poie- sys.	Uri- nary sys.	Genital sys.			Lymph. sys.	Cutane- ous sys.		Muscular sys.	
	Oesophagus	Proventriculus	Gizzard	Duodenum	Pancreas	Liver	Caecum	Cecal tonsil	Mesentery	Lungs	Heart	Spleen	Kidney	Ovary	Oviduct	Testes	Bursa fabricius	Skin	Comb	Skeletal muscle
R-124/71	-	+	-	-	-	+	-	-	+	+	+	+	-	-	-	-	-	-	+	-
R-125/71	-	-	-	+	+	-	-	+	-	+	-	+	+	+	-	-	+	-	-	-
R-126/71	-	+	-	+	-	+	-	-	-	+	+	+	-	+	-	-	-	-	-	-
R-127/71	-	-	-	+	+	+	-	-	-	+	-	-	+	-	-	+	-	-	+	-
R-128/71	-	-	-	-	+	+	-	-	-	-	+	+	-	-	-	-	-	-	-	-
R-129/71-	-	-	-	-	-	+	-	-	-	+	+	+	+	+	-	-	+	-	-	-
R-130/71	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-
R-131/71	-	+	+	+	+	+	+	+	+	+	+	-	+	+	+	-	-	-	-	-

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** All the organs examined irrespective of gross manifestation of the lesions

+ = Histopathologically positive leucosis lesions

- = Histopathologically negative leucosis lesions

* = Not collected

Table 3. * Age incidence of tumours in Leucosis/Sarcoma Group

Forms of tumour	Age groups (months)									
	2-4	%	4-8	%	8-12	%	12-26	%	16-above	%
Lymphoid Leucosis	29	11.18	48	19.3	55	22.4	41	16.7	39	15.9
Fibrosarcoma	-	-	-	-	2	0.80	-	-	-	-
Hepatoma	-	-	1	0.4	-	-	1	0.4	-	-
Nephroblastoma	-	-	-	-	1	0.4	-	-	-	-
Osteopetrosis	-	-	1	0.4	1	0.4	1	0.4	-	-
Total	29	11.18	50	20.3	59	24.0	43	17.5	39	15.9

* Analysis made on the basis of a total number of 245 birds with tumorous condition.

Table 4. * Age incidence of tumours other than Leucosis/Sarcoma Group

Forms of tumours	Age groups (months)									
	2-4	%	4-8	%	8-12	%	12-16	%	16-above	%
Chondroma	-	-	-	-	1	0.4	-	-	-	-
Chondrosarcoma	-	-	-	-	1	0.4	-	-	-	-
Fibroma	-	-	-	-	-	-	1	0.4	-	-
Myxoma	-	-	-	-	-	-	-	-	1	0.4
Leiomyoma	-	-	-	-	1	0.4	-	-	2	0.8
Adenocarcinoma (Ovary)	-	-	-	-	4	1.6	3	1.2	2	0.8
Papillary cystadenocarcinoma (Ovary)	-	-	1	0.4	-	-	-	-	-	-
Adenocarcinoma (Oviduct)	-	-	-	-	2	0.8	2	0.8	1	0.4
Mesothelioma	-	-	1	0.4	-	-	-	-	-	-
Haemangioma	-	-	-	-	1	0.4	-	-	-	-
Total	-	-	2	0.8	10	4.0	6	2.4	6	2.4

* Analysis made on the basis of total number of 245 birds with tumourous condition

Table 5. * Sex incidence of tumours of Leucosis/ Sarcoma Group

Forms of tumours	Male		Female	
	No. affected	%	No.affected	%
Lymphoid leucosis	77	31.4	135	55.1
Fibrosarcoma	1	0.4	1	0.4
Hepatoma	1	0.4	1	0.4
Nephroblastoma	1	0.4	-	-
Osteopetrosis	2	0.8	1	0.4
Total	82	33.4	138	56.3

* Analysis made on the basis of a total number of 245 birds with tumourous condition

Table 6. * Sex incidence of tumours other than Leucosis/Sarcoma Group

Forms of tumours	Male		Female	
	No. affected	%	No. affected	%
Chondroma	-	-	1	0.4
Chondrosarcoma	-	-	1	0.4
Fibroma	-	-	1	0.4
Myxoma	-	-	1	0.4
Leiomyoma	-	-	3	1.2
Adenocarcinoma (Ovary)	-	-	9	3.6
Papillary cystadenocarcinoma	-	-	1	0.4
Adenocarcinoma (Oviduct)	-	-	5	2.00
Mesothelioma	-	-	1	0.4
Haemangioma	-	-	1	0.4
Total	-	-	24	9.6

* Analysis made on the basis of a total number of 245 birds with tumourous condition

Table 7. * Incidence of various forms of tumours in Leucosis/Sarcoma Group among different breeds of birds.

Forms of tumours	W.L.H.		R.I.R.		B.A.		Indigenous		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Lymphoid Leucosis	90	36.7	80	32.6	34	13.7	6	3.2	212	86.5
Fibrosarcoma	1	0.4	1	0.4	-	-	-	-	2	0.8
Hepatoma	1	0.4	1	0.4	-	-	-	-	2	0.8
Nephroblastoma	1	0.4	-	-	-	-	-	-	1	0.4
Osteopetrosis	1	0.4	2	0.8	-	-	-	-	3	1.2
Total	94	38.3	84	34.2	34	13.7	8	3.2	220	89.7

* Analysis made on the basis of a total number of 245 birds with tumourous condition.

Table 8. * Incidence of various forms of tumours other than Leucosis/Sarcoma Group

Forms of tumours	W.L.H.		R.I.R.		B.A.		Indigenous		Total	
	No.	%	No	%	No	%	No	%	No	%
Chondroma	1	0.4	-	-	-	-	-	-	1	0.4
Chondrosarcoma	-	-	1	0.4	-	-	-	-	1	0.4
Fibroma	1	0.4	-	-	-	-	-	-	1	0.4
Myxoma	-	-	1	0.4	-	-	-	-	1	0.4
Leiomyoma	2	0.8	1	0.4	-	-	-	-	3	1.2
Adenocarcinoma (Ovary)	3	1.2	4	1.6	2	0.8	-	-	9	3.6
Papillary cystadenocarcinoma (Ovary)	1	0.4	-	-	-	-	-	-	1	0.4
Adenocarcinoma (Oviduct)	2	0.8	2	0.8	1	0.4	-	-	5	2.00
Mesothelioma	-	-	1	0.4	-	-	-	-	1	0.4
Haemangioma	1	0.4	-	-	-	-	-	-	1	0.4
Total	11	4.4	10	4.0	3	1.2	-	-	24	9.6

* Analysis made on the basis of a total number of 245 birds with tumours conditions.

Table 9. * Seasonal occurrence of various forms of tumours in Leucosis/Sarcoma Group

Forms of tumours	Season							
	Nov. to Jan.		Feb. to April		May to July		August to Oct.	
	No.	%	No	%	No	%	No.	%
Lymphoid Leucosis	92	37.5	62	25.3	20	8.1	38	15.5
Fibrosarcoma	1	0.4	-	-	1	0.4	-	-
Hepatoma	-	-	1	0.4	-	-	1	0.4
Nephroblastoma	-	-	-	-	-	-	1	0.4
Osteopetrosis	1	0.4	-	-	-	-	-	-
Total	94	38.3	63	25.7	21	8.5	40	16.3

* Analysis made on the basis of a total number of 245 birds with tumourous condition.

Table 10. * Seasonal occurrence of various forms of tumours other than Leucosis/Sarcoma Group

Forms of tumour	Season							
	Nov. to Jan.		Feb. to April		May to July		August to Oct.	
	No.	%	No.	%	No.	%	No.	%
Chondroma	-	-	1	0.4	-	-	-	-
Chondrosarcoma	-	-	-	-	-	-	1	0.4
Fibroma	-	-	-	-	1	0.4	-	-
Myxoma	-	-	1	0.4	-	-	-	-
Leiomyoma	-	-	1	0.4	-	-	2	0.8
Adenocarcinoma (Ovary)	4	1.6	1	0.4	1	0.4	3	1.2
Papillary cystadenocarcinoma (Ovary)	1	0.4	-	-	-	-	-	-
Adenocarcinoma (Oviduct)	2	0.8	-	-	1	0.4	2	0.8
Mesothelioma	-	-	-	-	1	0.4	-	-
Haemangioma	-	-	1	0.4	-	-	-	-
Total	7	2.8	5	2.0	4	1.6	5	3.2

* Analysis made on the basis of a total number of 245 birds with tumorous conditions.

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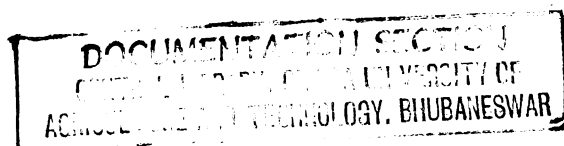
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