

PATHOLOGY OF LYMPH NODES IN CATTLE

By
P. GIRIJA
B.V.Sc & A.H

THESIS SUBMITTED TO THE
ACHARYA N.G. RANGA AGRICULTURAL UNIVERSITY
IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE AWARD OF THE DEGREE OF
MASTER OF VETERINARY SCIENCE
IN THE FACULTY OF VETERINARY SCIENCE



**DEPARTMENT OF PATHOLOGY
COLLEGE OF VETERINARY SCIENCE
ACHARYA N.G. RANGA AGRICULTURAL UNIVERSITY
TIRUPATI-517 502**

January 2004

LIBRARY C.V.Sc
HYDERABAD 30

ACC No. OD 1467

Date: 25/10/18

P. V. NARSIMHA RAO
TELANGANA VETERINARY
UNIVERSITY



LIBRARY & INFORMATION SCIENCE
COLLEGE OF VETERINARY SCIENCE
Rajender Nagar Hyderabad

PATHOLOGY OF LYMPH NODES IN CATTLE

By
P. GIRIJA
B.V.Sc & A.H



ANGRAU Central Library
Hyderabad
D7299

THESIS SUBMITTED TO THE
ACHARYA N.G. RANGA AGRICULTURAL UNIVERSITY
IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE AWARD OF THE DEGREE OF
MASTER OF VETERINARY SCIENCE
IN THE FACULTY OF VETERINARY SCIENCE

LIBRARY C.V.Sc
HYDERABAD-30
ACC No. OD 1467
Date: 25/10/18

ANGRAU Central Library
HYDERABAD-500 030.
ACC. No. D7299
Date: 05.01.2005



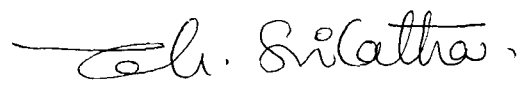
DEPARTMENT OF PATHOLOGY
COLLEGE OF VETERINARY SCIENCE
ACHARYA N.G. RANGA AGRICULTURAL UNIVERSITY
TIRUPATI-517 502

January 2004

CERTIFICATE

Mrs. P. GIRIJA has satisfactorily prosecuted the course of research and that the thesis entitled "**PATHOLOGY OF LYMPH NODES IN CATTLE**" submitted is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that the thesis or part thereof has not been previously submitted by her for a degree of any university.

Date: 29/3/04.


Major Advisor
(Dr. Ch. SRILATHA)

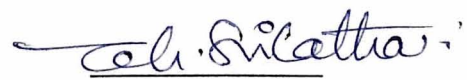
CERTIFICATE


This is to certify that the thesis entitled "PATHOLOGY OF LYMPH NODES IN CATTLE" submitted in partial fulfillment of the requirements for the degree of "MASTER OF VETERINARY SCIENCE" (in the major subject of Pathology) of the Acharya N.G. Ranga Agricultural University, Hyderabad, is a record of the bonafied research carried out by Mrs. P. GIRIJA under my guidance and supervision. The subject of the thesis has been approved by the student's advisory committee.


No part of the thesis has been submitted for any other degree or diploma or has been published. Published part has been fully acknowledged. All the assistance and help received during the course of the investigations have been duly acknowledged by the author of the thesis.


Chairwoman of the Advisory Committee ^{29/3/04}

Thesis approved by the student's Advisory Committee.

Chairwoman: **Dr. CH.SRILATHA** 
Associate Professor and University Head
Department of Pathology
College of Veterinary Science
Tirupati -517502.

Member: **Dr. D. SREENIVASULU** 
Associate Professor
Department of Microbiology
College of Veterinary Science
TIRUPATI-517502.

Member: **Dr. Y. ANJANEYULU** 
Assistant Professor
Department of Pathology
College of Veterinary Science
Rajendranagar, Hyderabad.

LIST OF CONTENTS

Chapter	Title	Page No.	
I	1	INTRODUCTION	1
II	2	REVIEW OF LITERATURE	2
	2.1	Incidence	2-3
	2.2	Edematous /Hyperplasia of Lymphnodes	3-5
	2.3	Hemorrhagic lymph nodes	5-6
	2.4	Lymphadenitis	6-9
	2.5	Parasitic Lymph nodes	9-13
	2.6	Pigmentation in lymph nodes	13
	2.6.1	Carotinoid pigmentation	13
	2.6.2	Hemosiderosis	13-14
	2.6.3	Melanosis	14
	2.7	Mineral deposition in lymph nodes	14
	2.8	Neoplasia of lymph nodes	15-16
	2.9	Cytological smear examination	16-17
III	3	MATERIALS AND METHODS	18
	3.1	Source	18
	3.2	Mode of collection	18
	3.3	Methods employed	19
	3.3.1	Bacterial isolation	19
	3.3.2	Cytological smear examination	20
	3.3.3	Histopathological examination	20
IV	4	RESULTS	21
	4.1	Incidence	21-24
	4.2	Edematous lymph nodes	24-25
	4.3	Hemorrhagic lymph nodes	25

✓

4.4	Hyperplastic lymph nodes	25-27	
4.5	Lipidosis	27-29	
4.6	Lymphadenitis	29	
4.6.1	Acute lymphadenitis	29	
4.6.2	Caseous lymphadenitis	30	
4.6.3	Chronic lymphadenitis	30-32	
4.6.4	Suppurative lymphadenitis	32	
4.6.5	Parasitic lymphadenitis	34	
4.7	Pigmentations	36	
4.7.1	Hemosiderosis	36	
4.7.2	Carotenoid pigmentation	36	
4.7.3	Melanosis	37	
4.8	Lymphoid depletion	38-41	
4.9	Neoplastic changes	41	
4.10	Cytological smear examination	41	
4.10.1	Mast cells	41-42	
4.10.2	Neutrophils	42	
4.10.3	Eosiniophils	42	
4.10.4	Bipolars	43	
4.10.5	Lymphoblasts	43	
4.10.6	Plasma cells	43	
4.10.7	Fibroblasts	44	
4.10.8	Macrophages	44	
4.10.9	Parasites	44	
V	5	DISCUSSION	48-56
VI	6	SUMMARY	57-58
VII		LITERATURE CITED	59-64

LIST OF ILLUSTRATIONS.

Figure No.	Title	Page No
1.	Graph showing histopathological lesions of Lymph nodes.	23
2.	Enlarged and edematous preascapular Lymph node.	26
3.	Edematous preascapular lymph node on cut section	26
4.	Edematous bronchial lymph node on cut section.	26
5.	Bronchial Lymph node:Edematous cortex H&E x70.	26
6.	Focal areas of Hyperemia in mesenteric lymph node.	26
7.	Hemorrhagic bronchial lymph node on cut section.	26
8.	Mesenteric lymph node: Large number of erythrocytes in cortex. H&E x 70.	28
9.	Mesenteric lymph node: Massive distension of sinuses. H&E x 280.	28
10.	Enlarged grey colored hyperplastic lymph node with prominent follicles and hemorrhages in pre scapular lymph nodes.	28
11.	Precural lymph nodes Hyperplasia:Enlarged gray color lymph nodes with prominence of follicles.	28
12.	Paracortical hyperplasia with large number of lymphoid cells. H&E x 280.	28
13.	Medullary hyperplasia: Distension of sinuses with immature cells. H&E X 70.	28
14.	Medullary hyperplasia: Distension of sinuses with macrophages, lymphocytes and plasma cells. H&E x 280.	31
15.	Follicular hyperplasia. H&E x 280.	31
16.	Lipidosis: Dark white areas of lymphoid tissue on cut section in precrual lymph node	31
17.	Distension of sinuses with round and empty spaccs. H&E x 280.	31
18.	Enlarged bronchial lymph node with hyperemia on cut section.	31
19.	Enlarged, edematous and moist appearance of preascapular lymph node.	31

20	Prescapular lymph node showing congestion in cortical areas. H&E x 280.	33
21	Plasma cells and lymphocytes in lymphoid sinuses. H&E x 280.	33
22	Enlarged and indurated bronchial lymph node with white caseous mass.	33
23	Dry and indurated appearance of prescapular lymph node on cut section.	33
24	Severe fibrosis in cortical areas of lymph nodes H&E x 70.	33
25	Infiltration of large number of plasma cells in medullary sinuses. H&E x 280.	33
26	Severe necrosis and cellular infiltration with calcified areas in cortex and medulla . H&E x 70.	35
27	Enlarged and edematous mesenteric lymph node showing presence of <i>Lingatula serreta</i> larvae on cut section.	35
28	Presence of parasitic cut sections in medullary sinuses with cellular infiltration in. H&E x 70.	35
29	Presence of large number of parasitic cut sections in medullary sinuses H&E x70.	35
30	Section showing severe arteriolitis with infiltration of eosinophils in medulla. H&E x 70.	35
31	Section showing severe arteriolitis with eosinophilic infiltration. H&E 280.	35
32	Hemosiderosis: Brownish discoloration of precruar lymph nodes.	37
33	Hemosiderosis: Coarse brown granules in reticular and sinusoidal macrophages of cortex and medulla H&E x 70.	37
34	Hemosiderosis: Coarse brown granules in reticular and sinusoidal macrophages of cortex and medulla. H&E x 280.	37
35	Dark plant pigment in medullary areas of bronchial (top) and mesenteric lymph node (bottom).	37
36	Brown discoloration in medullary sinuses .H&E x70.	37
37	Dark blackish-brownish diffuse discoloration of lymphoid tissue in precruar lymph node.	39
38	Blackish-brownish discoloration in cortical areas of mesenteric lymph node.	39
39	Blackish irregular granular pigment in medullary sinuses. H&E x 280.	39

40	Precurral lymph node showing pale appearance and severe atrophy of lymphoid follicles.	39
41	Severe depletion of lymphoid follicles and atrophy of cortex. H&E x 280	39
42	Swollen and firm prescapular lymph node with elevated areas in cortical portion.	39
43	Cytological smear showing presence of mast cells with meta chromatic granules. Leishman x 70.	45
44	Cytological smear showing presence of eosinophils. Lieshman stain 700.	45
45	Bipolar organisms in cytological smear. Leishman stain. X700.	45
46	Lymphoblasts in cytological smear. Leishman stain. X700.	45
47	Plasma cells in cytological smear. Leishman stain. X700.	45
48	Cytological smear showing the presence of more number of fibroblasts. Leishman stain. X700	45
49	Epitheloid cells in cytological smear. Leishman stain. X700.	46
50	Microfilarial organism in cytological smear. Leishman stain. X700.	46
51	Cytological smear showing larvae of <i>Oncocerca armillata</i> . Leishman stain. X280.	46
52	Presence of <i>Oncocerca</i> larvae in cytological smear. Leishman stain. X700.	46

LIST OF TABLES

Table No	Title	Page No
1.	Incidence of histopathological lesions of Different lymphnodes	22
2.	Bacteriological isolation	40
3.	Cytological smear examination results of different lymphnodes	47

×

ACKNOWLEDGEMENTS

I wish to express my deep sense of gratitude and tremendous pleasure to my major advisor **Dr. Ch. SRILATHA**, Associate Professor, Department of Pathology, College of Veterinary Science, Tirupati for her valuable guidance and cooperation throughout my research work.

I sincerely acknowledge my profound gratitude to **Dr.Y. ANJANEYULU**, Assistant Professor, Department of Pathology, College of Veterinary Science, Rajendra Nagar, Hyderabad, member of my advisory committee for his valuable suggestions and encouragement during my research work.

I humbly express my thanks to **Dr. D. SRINIVASULU**, Associate Professor, Department of Microbiology, College of Veterinary Science, Tirupati, member of my advisory committee for his practical advice and support during the period of my study.

I express my sincere thanks to **Dr. K. SUJATHA** and **Dr. N. SAILAJA**, Assistant Professors, Department of Pathology, College of Veterinary Science, Tirupati for their cooperation during the period of my study.

I duely acknowledge and express my thanks to **Dr.V.DURGA PRASADA RAO**, Professor and **Dr.D.RANI PRAMEELA**, Assistant

Professor, Department of Microbiology, College of Veterinary Science, Tirupati for their help and encouragement in the microbiology part of work.

I duely acknowledge and express my thanks to **Dr.MURALI MANOHAR** Professor and Head of the Department and **Dr.G.V.SUDHAKAR RAO** Assistant Professor, Department of Pathology, College of Veterinary Science, Chennai for their help and encouragement in the literature and guidance of work

Appreciation is extended to Sri **C.M. NAIDU**, Senior Technician and Sri **M.KARIMULLA**, Record Assistant and other non-teaching staff of the Department of Pathology, College of Veterinary Science, Tirupati for their help and cooperation.

I owe my profound affection and thanks to my friends and colleagues **Dr.S.VASUNDHARA, Dr.J.CHAITANYAKISHORE, .M.PARIMALA, Dr.K.ARUNA** and **A.ANAND RAJA** for their encouragement and timely support during my research work.

I asset my heartfelt thanks to **LIBRARY STAFF** for providing all necessary details. I respectfully acknowledge my gratitude to the **ANGRAU** for providing facilities to work in this department.

I sincerely acknowledge the authorities of **DEPARTMENT OF ANIMAL HUSBANDRY OF ANDHRA PRADESH** for sanctioning leave to complete my Degree.

I avail this opportunity to convey my highest respect to my beloved husband **SRI.S.RAMANJANEYULU**, children **ASWARTHINI & BHARGAV TEJA** and sister **VASUNDHARA** for their moral support during all endeavours in my life.


P. GIRIJA.... 

Name of the author : P. GIRIJA

Title of the thesis : "PATHOLOGY OF LYMPHNODES IN CATTLE"

Degree to which it is Submitted : MASTER OF VETERINARY SCIENCE

Faculty : VETERINARY SCIENCE

Department : DEPARTMENT OF PATHOLOGY

Major Advisor : **Dr. Ch. SRILATHA**, M.V.Sc., Ph.D.,
Associate Professor
Department of Pathology
College of Veterinary Science
Tirupati - 517 502



University : Acharya N.G.Ranga Agricultural
University, Rajendra Nagar,
Hyderabad - 500030 (A.P)

Year of Submission : January 2004

ABSTRACT

Lymphnodes are important organs involved in providing resistance. Various antigenic substances initiate tissue reaction when pass through lymphnodes and some time cause diseases. The present work was undertaken to study the pathological lesions of lymphnodes of cattle, which provides a valuable information to all the veterinarians who are concerned in meat hygiene and immunological status to scientists who are involved in lymphatic system in particular.

I avail this opportunity to convey my highest respect to my beloved husband **SRI.S.RAMANJANEYULU**, children **ASWARTHINI & BHARGAV TEJA** and sister **VASUNDHARA** for their moral support during all endeavours in my life.


P. GIRIJA.... 

Name of the author : P. GIRIJA

Title of the thesis : " PATHOLOGY OF LYMPHNODES IN CATTLE"

Degree to which it is Submitted : MASTER OF VETERINARY SCIENCE

Faculty : VETERINARY SCIENCE

Department : DEPARTMENT OF PATHOLOGY

Major Advisor : **Dr. Ch. SRILATHA**, M.V.Sc., Ph.D.,
Associate Professor
Department of Pathology
College of Veterinary Science
Tirupati - 517 502

University : Acharya N.G.Ranga Agricultural
University, Rajendra Nagar,
Hyderabad - 500030 (A.P)

Year of Submission : January 2004

ABSTRACT

Lymphnodes are important organs involved in providing resistance. Various antigenic substances initiate tissue reaction when pass through lymphnodes and some time cause diseases. The present work was undertaken to study the pathological lesions of lymphnodes of cattle, which provides a valuable information to all the veterinarians who are concerned in meat hygiene and immunological status to scientists who are involved in lymphatic system in particular.

In the present investigation 1892 cattle carcasses were routinely screened for any abnormalities in the lymphnodes in slaughter houses in Chittoor District and surroundings. The regional lymph nodes like bronchial, mesenteric, suprascapular and prescapular were examined for any gross pathological lesions. Only 329 (23.56%) lymph nodes were found to be abnormal.

The present investigation revealed the pathological involvement of different regional lymph nodes in cattle viz mesenteric 144 (43.77%), bronchial 70 (21.28%), precural 62 (18.8%) and supra scapular 53 (16.1%) lymphnodes. Among different regional lymph nodes the lesions were more in mesenteric lymph nodes followed by bronchial lymph nodes.

Higher incidence of enlargement and oedematous lymph nodes followed by hemorrhagic, hemosiderosis and acute lymphadenitis were noticed. The various pathological lesions that were observed in lymph nodes were enlarged, oedematous 45 (13.6%), hemorrhagic 39(11.9%), hemosiderosis 32 (11.25%), plant pigment 20 (6.07%), melanosis 8(2.43%) lipid depositions 20 (6.07%), acute lymphadentis 30 (9.12%), parasitic infections in 18 (5.4%), abscess 16(4.86%), lymphoid depletion 25 (7.6%), caseous lymphadenitis 8 (2.43%) and chronic lymphadenitis 28(8.51%).

The cytological smear examinations revealed 191 cases of abnormalities out of total 329 lymph node impression smears examined. Cytological smears revealed macrophages in 38 cases, eosinophils in 32 cases, plasma cells in 24 cases, bipolars in 35 cases parasitic larvae in 12

cases, lymphoblast in 14 cases, epitheloid cells in 48 cases, neutrophils in 12 cases, mast cells in 11 cases, theileria in 8 cases, filarial worms in 8 cases and fibroblasts 5 cases.

Variable cytology was observed depending upon pathological conditions. Enlarged hyperplastic lymphnodes and chronic lymphadenitis case revealed the presence of macrophages, lymphoblasts, and plasma cells. More number of neutrophils were noticed in suppurative lymphadenitis. Parasitic lymphadenitis cases revealed eosinophils and persence of parasitic larvae. Whereas most of the chronic lymphadenitis cases revealed fibroblasts also.

Out of 108 lymph nodes examined microbiologically 65 cases showed positive for bacterial isolates. In 8 , 4, 13, 3, 32 and 5 cases *E.coli*, *Pseudomonas*, *Staphylococci*, *Streptococci*, *Pasteurella* and *Mycobacterium* were isolated respectively.

Most of the acute lymphadenitis cases revealed bacterial organisms such as pasturella, streptococci, *E. coli* and *Pseudomonas*. In suppurative lymphadenitis cases, staphylococci and mycobacterium were isolated. Whereas caseous lymphadenitis cases showed only mycobacterium isolates.

Chapter I

INTRODUCTION

CHAPTER I

1. INTRODUCTION

All living organisms are built with natural resistance by various mechanisms against diseases inflicted by bacteria, viruses, parasites, fungi, chemicals and toxins etc. In the body the lymph nodes are important organs involved in providing such a resistance. The important function of lymph nodes is to filter and help in removing various substances from system and thus provides surveillance in the body. Various antigenic substances incite tissue reaction when pass through lymph nodes and sometimes cause disease.

The studies on pathological lesions of lymph nodes provides a valuable information to all veterinarians who are concerned with meat hygiene, public health, and to those scientists who are involved in lymphatic system in particular. It also helps in understanding the disease pattern of concerned location.

A perusal of the literature revealed scanty information on lymph node pathology (Al - Sadi and Ridha 1994 and Maity *et al* 2000). In view of this the present work was undertaken with the following objectives:

1. To study gross and histomorphological changes in lymph nodes of cattle.
2. To study cytological smears in different pathological conditions.
3. Isolation and identification of bacteria from lymph nodes.

Chapter II

REVIEW OF LITERATURE

CHAPTER II

2. REVIEW OF LITERATURE

The literature on bacteriological and pathological examination of lymph nodes was reviewed. In view of limited literature on lymph node pathology in cattle, the relevant aspects of other species were also incorporated.

2.1 INCIDENCE:

Al-Sadi & Ridha (1994) conducted a pathological study on randomly obtained lymph nodes of bovine (76), ovine (103) and caprine (100) carcasses and the incidence was 22.3 percent, 15.3 percent and 19 percent respectively. Pathological lesions in mediastinal, hepatic, renal and mesenteric lymph nodes were observed and concluded that lymph nodes of apparently healthy cattle, sheep and goat could be the sites of significant pathological lesions and make the lymph nodes unfit for human consumption.

Maity *et al.* (2000) examined a total of 1187 lymph nodes of cattle in West Bengal and out of which 234 (19.7%) were found to be abnormal.

They reported pathological lesions in mesenteric 110 (47.01%) bronchial 89 (36.03%), supramammary 23 (9.83%) and prescapular 12 (5.13%) lymph nodes. The highest incidence of mesenteric lymph node involvement was postulated to be due to more involvement of gastrointestinal diseases as compared with other systemic diseases.

2.2 EDEMATOUS/ HYPERPLASIA OF LYMPH NODES

Misdorp and Wieger (1971) observed enlarged lymph nodes in fattened calves of abattoir. Histologically, the enlarged lymph nodes revealed hyperplasia of lymphoid tissue in cortex and eosinophils and plasma cell infiltration in the medulla. They did not observe any evidence of bacterial infection or of the administration of hormones.

Gibaly *et al* (1993) investigated histopathological changes in lymph nodes of cattle by producing *Brucella melitensis* infection experimentally. They recorded edema with hyperplasia of reticular cells and scattered lymphocytes in the center.

Al- Sadi and Ridha (1994) collected mediastinal, hepatic, renal and mesenteric lymph nodes from 103 ovine cases and recorded size, color and

consistency of each lymph node. Out of 103 ovine cases, 4 had reactive hyperplasia. In 2 ovine cases, lymphoid follicles were with large germinal centers and well defined margins surrounded by a mantle of small lymphocytes. They also observed the paracortical lymphoid hyperplasia, which was characterized by diffuse paracortical hyperplasia and attenuated germinal centers. Extensive paracortical areas in papillary fashion toward the hilar areas characterized medullary cord hyperplasia. The cords displayed a considerable number of small lymphocytes.

Deeb *et al* (1995) made histological study on extra genital lesions in naturally infected animals with *Brucella melitensis*. *Brucella melitensis* was isolated from udder and supramammary lymph glands. The supramammary lymph glands showed congestion and edema.

Day *et al* (1996) reported on clinical and pathological features of 31 dogs with a range of systemic illness and granulomatous lymphadenopathy associated with the presence of birefringence crystalline material in lymph nodes. The popliteal lymph nodes from 4 out of 5 control dogs had evidence of a degree of reactive change characterized by the presence of

secondary lymphoid follicles and dilatation of medullary sinuses with infiltration of macrophages.

Maity et al (2000) examined mesenteric, bronchial, supramammary and prescapular lymph nodes in cattle and observed enlargement of lymph nodes in 149 cases (63.68%). According to them the lymph nodes were pale, enlarged and edematous and soft in consistency. Histologically, they observed enlarged lymph nodes with reactive follicular hyperplasia characterized by increased number and size of follicles with large number of immature cells and macrophages.

2.3 HEMORRHAGIC LYMPHNODES :

The occurrence and etiology of hemorrhages in mesenteric lymph nodes of cattle at slaughter were studied by Kunst and Reuter (1994). They stated that red discoloration in mesenteric lymph nodes of cattle was associated with chronic inflammation (88%) and acute and sub acute enteritis (12%).

Maity et al (2000) observed hemorrhages in 23 cases out of 1187 lymph nodes of cattle. Lymph nodes were swollen with dark red to bright red color. Histopathologically hemorrhagic lymph nodes showed large

number of erythrocytes in sinuses. Congestion and extravasation of erythrocytes were found in some vessels.

2.4 LYMPHADENITIS

McKenzie and Donald (1979) conducted histopathological examination of materials received from cattle abattoirs that were suspected for Tuberculosis and found that *Corynebacterium equi* associated with caseous lymphadenitis and reported that the lesions occurred essentially in bronchial lymph nodes. He found that the lesions were well-encapsulated granulomatous containing yellowish caseous material centrally with foci of mineralisation. Microscopically, granulomas consisted of caseous necrosis with heavy neutrophilic infiltration.

Rogers *et al* (1980) conducted a study on the distribution of *Mycobacterium bovis* in Queensland cattle herds. The retro pharyngeal, mandibular, bronchial, mediastinal, mesenteric, prescapular, supramammary and hepatic lymph nodes were examined. Caseated necrosis and calcification were noticed with Langhan's type of giant cell infiltration. The tubercular organisms were isolated on cultural examination of (89%) mediastinal, bronchial and retro pharyngeal lymph nodes.

A retrospective study based on necropsy regarding the tuberculosis in cattle was made by Sharma *et al* (1985). A total number of 1268 carcasses of cattle above 6 months age were examined. Of which 168 exhibited gross lesions of tuberculosis. The lesions were confined to the lymph nodes associated with respiratory tract alone in 115 carcasses.

Jensen *et al* (1990) studied intestinal and pulmonary mycotic lymphadenitis in cattle. Among 4877 slaughtered cattle with tuberculosis like lesions in lymph nodes, 94 cases (1.9%) revealed fungal hyphae on histopathological examination. Affected lymph nodes were mesenteric in 84 cases (77%) and mediastinal in 7 cases (7.4 %). The lesions were found to be granulomatous and consisted of masses of necrotic tissue containing scattered foci of calcification. The inflammatory cells included were lymphocytes, plasma cells, epitholoid cells and giant cells. Hyphae were seen in necrotic areas and accompanied by giant cells. Mycotic lymphadenitis was caused by *Candida* and *Aspergillus*.

Zschock *et al* (1990) made a pathological and cultural study of the lymph nodes from the slaughtered cattle. Out of 194 samples from

suspected tubercular lymph nodes examined, the acid-fast bacteria were detected in 141 cases.

Al Sadi and Ridha (1994) noticed a case of caseous lymphadenitis in ovine mesenteric lymph nodes collected at an abattoir. The affected lymph nodes were grossly enlarged and converted into a single globoid lesion upon incision. The lesion consisted of greenish caseous material surrounded by a thick capsule. These changes were also visualized microscopically.

Al-Sadi and Ridha (1994) also found 2 advanced cases of bovine tuberculosis collected at an abattoir. The mediastinal and mesenteric lymph nodes were grossly enlarged, yellowish in color and hard in consistency. Grating sound was heard when nodes were incised. Microscopically, typical foci of granulomatous inflammation with a central admixture of necrotic material, epithelioid and Langhan's giant cells were observed. At periphery of the lesion lymphocytes, plasma cells and monocytes were noticed. Acid-fast bacilli were observed in the caseated necrotic material.

Out of a total of 234 abnormal lymph nodes, caseous lymphadenitis was found in 31(13.25%) in cattle by Maity *et al* 2000. Grossly lymph nodes were enlarged, hard and indurated with greenish white caseous mass. Sections of few lymph nodes showed presence of calcified mass that was surrounded by fibrous capsule. Microscopically, caseated lymph nodes depicted early caseation intermingled with lymphoblasts and lymphocytes. The presence of macrophages, epithelioid cells and Langhan's types of giant cells were predominantly found. The *Mycobacterium* species was identified from caseated lymph nodes.

Maity *et al.* (2000) observed 16 cases of pyogenic lymph nodes in cattle out of 1187 and were characterised by small to large abscesses and presence of pus in the medullary region with connective tissue encapsulation. In few cases, pus cells replaced the normal histological structures of the lymph nodes.

2.5 PARASITIC LYMPHADENITIS

Landsverk *et al* (1978) made a case study of emaciated adult cow with generalized enlargement of lymph nodes. Generalized lymphadenopathy with perilymphadenitis and depletion of lymphocytes and

histiocytes were observed. In histiocytes and vascular endothelial cells of lymph nodes, early stages of protozoan parasites were found. They reported that the protozoan was sarcocystis based.

Jose (1979) observed the presence of both asexual and sexual stages of *Eimeria* in mesenteric lymph nodes of 2 kids that were naturally infected. The mesenteric lymph nodes were enlarged. Histopathological study showed presence of immature and mature gametes and oocysts in cells of sub capsules, cortical and medullary sinuses, trabeculae and hiluses of mesenteric lymph nodes. The local aggregates of lymphocytes and plasma cells with sub mucosal edema were also seen.

Luckins and Gray (1979) made a pathological study regarding presence of *Trypanosomes* in lymph nodes of cattle and sheep infected with *T.congolense*. The prefemoral lymph nodes of 2 calves and a sheep infected with *T.congolense* were examined by them histologically. They concluded that the *Trypanosomes* could be detected in lymph gland juice as in blood stream. Histologically, parasites were found in the sub capsular sinuses of prefemoral lymph nodes of all the 3 animals. Large number of intact *Trypanosomes* were located in the sub scapular sinuses and in the

sinuses of trabecular and hilar region of node, but not observed in cortical or medullary lymphoid tissue of the nodes.

Irvin and Vander (1980) conducted ovine lymphoid survey in New Zealand. Histopathologically they observed calcified parasitic lesions with eosinophilic infiltration and hemosiderin accumulations in 500 samples.

Morrison *et al* (1982) studied the response of murine (mice) lymphoid system in a chronic infection due to *Trypanosoma congolense*. A significant proliferative response in lymph nodes occurred 3 weeks of infection and involved mainly the B-dependent follicular areas in which there were marked germinal center formation. This was associated with the appearance of large number of macrophages in the medullary cords and in lymph nodes sinuses. There was no obvious lymphoid depletion.

Bundza and Gardiner (1990) conducted a study between 1977 and 1989 on 12 cattle lymph nodes at slaughter. They found the migration of larval parasites in the mesenteric lymph nodes. The parasitic lesions were found in 9 cows, 2 steers and one heifer. Macroscopically all animals had green foci upto 5 mm in diameter in lymph nodes. Parasites were not found

in zones of eosinophils in serial sections of animals 1 and 2. Animals 3 to 12 had larval parasites in sections of mesenteric lymph nodes. Animal 3 had several filarial Nematodes of *Setaria sps* and 4 had *Chabertia sps* 5,6,7 *Esophagostomum radiatum Strongyloids Stephonofilaria stelesi* and *Setaria sps* were seen in 9, 10 and 11 animals respectively. All these surrounded by a zone of eosinophils showing chronic lymphadenitis.

Al-Sadi & Ridha (1994) conducted a pathological study on ovine lymph nodes and found nymphal *Lingatula* of mesenteric lymph nodes. The lymphal stage was well encapsulated.

Thiruthalinathan et al (1998) observed the enlargement of parotid lymphgland in all 4 calves with petichial hemorrhages in parotid lymphgland. Lymphgland smears showed presence of schizonts and piroplasms of *Theileria annulata*.

The infection rate of *Lingatula serrata* nymph in livers and mesenteric of 200 sheep were investigated by Shekarforoush and Arzani (2001) in Shiraz slaughter house. The mesenteric lymph nodes in 23 sheep

(11.5%) and in 6 livers (3%) were found infected by *Lingatula serrata* nymph.

2.6 PIGMENTATION OF LYMPHNODES

2.6.1 Carotinoid pigmentation

Ladds (1986) reported the deposition of orange carotinoid pigment in the lumbar lymph nodes. Similar pigmentation of the liver and hepatic lymph nodes has been attributed to ingestion of a toxin possibly of plant origin.

2.6.2 Hemosiderosis

Al-Sadi and Ridha (1994) observed hemosiderin in 2.9% cases out of 103 ovine and caprine cases and observed hemosiderin pigment as coarse brown granules in macrophages of the medullary areas of lymph nodes.

Day *et al* (1996) conducted a pathological study and electron microscopic analysis on 31 dogs in industrial area with a range of systemic illness and granulomatous lymphadenopathy associated with in lymph nodes. Twenty lymph nodes showed the presence of variable quantities of hemosiderin with in the macrophages of the medulla. In 4 lymph nodes the

hemosiderin was associated with sinus or parenchyma hemorrhages. In four lymph nodes there was evidence of hemorrhages without tissue hemosiderin deposition. One case was diagnosed cytologically. The stained smears revealed neutrophils, macrophages with intracellular birifringent crystals and some extra cellular crystalline fragments. In some lymph nodes hemosiderosis was associated with matrix background.

2.6.3 Melanosis

Al-Sadi and Ridha (1994) noticed presence of melanin pigment in one case (0.9%) out of 103 cases in sheep and goat. The melanin pigment appeared as fine rounded dark brown granules in the phagocytic cells with in medullary areas of ovine lymph nodes.

2.7 MINERAL DEPOSITION IN LYMPHNODES

Granulomatous lymphadenopathy was observed by Day *et al* (1996) in dogs reared in industrial area due to more amounts of silicon, copper, and calcium aluminum, with lesser amount of phosphorous, sodium, potassium, iron, magnesium, titanium, nickel and chromium. The mineral content was observed by Electron Microscopic analysis. All the lymph nodes showed different stages of histopathological changes.

2.8 NEOPLASIA OF LYMPHNODES

Singh *et al* (1980) made clinico pathological studies on lymph sarcoma in Indian Buffaloes. 192 debilitated adult buffaloes with enlarged superficial lymph nodes were procured after examination about 70,000 buffaloes. After a period of between 75 days and a year, under observation they were killed for postmortem examination and found lymph sarcoma in 50 cases. About 5000 buffalo carcasses were also examined at various abattoirs in the country. 1277 cases were suspected of lymphosarcoma on the basis of gross lesions. The tissues from 283 cases were examined histopathologically and they revealed lymphoarcoma lesions in 170 cases.

Valli *et al* (1981) studied the histocytology of lymphoid tumors in dog, cat and cow and made a retrospective study of lymphomas in 72 dogs, 81 cats and 90 cows. He found that out of 90 cows studied, 50 cases showed non-cleaved cell type lymphomas, 7 nodular non-cleaved cell type of tumors and one nodular cleaved cell type tumor.

Al -Sadi and Ridha (1994) conducted a pathological study on spleen and lymph nodes of 76 bovine, 103 ovine and 100 caprine carcasses. Out of which 2 cases of bovine lymphosarcoma were seen. The neoplasm was

multicentric involving all of the examined lymph nodes. Affected lymph nodes were swollen with firm consistency and of grayish white color. On cut section it was difficult to distinguish the cortex from the medulla. Microscopically obliteration of the cortex, medullary cords and sinusoids by neoplastic cells were noticed.

2.9 CYTOLOGICAL SMEAR EXAMINATION

Mills (1984) made a study regarding the diagnosis from lymph nodes by fine needle aspiration cytology from the enlarged lymph node of 62 animals (40 dogs 16 cats, 4 horses and 2 goats) over 6 years period. Concurrent histopathological examinations were performed on 34 out of 62 cases (18 dogs, 10 cats, 4 horses and 2 goats) either on lymph nodes surgically excised or at postmortem. Of 62 cases, 36 were diagnosed cytologically as lymphosarcoma, 7 as metabolic neoplasms, 3 as septic lymphadenitis, and 9 as reactive lymph node hyperplasia with possible hypersensitivity. Results of 34 histopathological sections were in agreement with cytology in 33 cases (97%).

Awan *et al* (1988) surveyed a total of 7300 cattle for Trypanosomiasis by thin and thick blood smear and lymph gland biopsy

smear examination during the dry and wet seasons in 1979 and 1980. 307 (4,2%) were positive. The prevalence ranged from 117 (3.11%) of 3758 in the dry season, and 190 (5.36%) of 3542 in the wet season. *Trypanosoma vivax* was the most common species. *T. congolense* and *T. brucei* were frequent.

Chapter III

***MATERIALS
AND
METHODS***

CHAPTER III

3. MATERIALS AND METHODS

3.1 SOURCE

To study the pathological and bacteriological examination of lymph nodes in cattle mesenteric, mediastinal/ bronchial, prescapular and precural lymph nodes were collected from different slaughterhouses in Chittoor District and surroundings. A total of 1892 cattle which were brought to slaughter were examined and collected 1396 lymph nodes showing gross lesions.

3.2 MODE OF COLLECTION

The lymph nodes along with capsule were collected and brought to the laboratory and stored at 4°C. The lymph nodes were incised aseptically and the swabs were collected and processed for isolation and identification of bacteria. The impression smears were also taken from the sections of lymph nodes for cytological and bacteriological examination. Subsequently the lymph nodes were stored in 10% buffered formalin for histopathological examination.

3.3 METHODS EMPLOYED

3.3.1 Bacterial isolation

Direct smear examination:

The impression smears collected from lymph nodes were stained with Zeihl Neilson's method of staining for the presence of acid-fast bacteria.

The swab materials were streaked on the blood agar and incubated at 37°C for 48 to 72 hours and recorded the colony morphology. Subsequently the organisms were inoculated for further characterization as described in Bergey's manual. (Buchanan et al 1974)

The following selective media were used for bacterial isolation

1. Macconky's agar
2. Eosin methylene blue agar
3. Potato dextrose agar medium
4. Brain heart infusion agar medium
5. Lowern stain Jenson medium
6. Nutrient agar

The bacteria were identified by using the following tests.

1. Coagulase test
2. Catalase test
3. Voges Pross Kause test was done by Barits method.
4. Indole test
5. Fermentation test

3.3.2 Cytological smear examination

The imprint films that were collected on slides were stained by Wright, Giemsa and Leishman's stain. The slides were examined under microscope and recorded the results.

3.3.3 Histopathological examination

The one half of each lymph node that was stored in 10% neutral buffered formalin was processed routinely for histopathological examination. Sections of 5 to 6 microns thickness were made and stained by Haematoxylin and Eosin. (Luna, 1968).

Chapter IV

RESULTS

CHAPTER IV

4. RESULTS

4.1 INCIDENCE

Among 1396 lymph nodes of cattle examined for any gross pathological lesions only 329 (23.56%) lymph nodes were found to be abnormal.

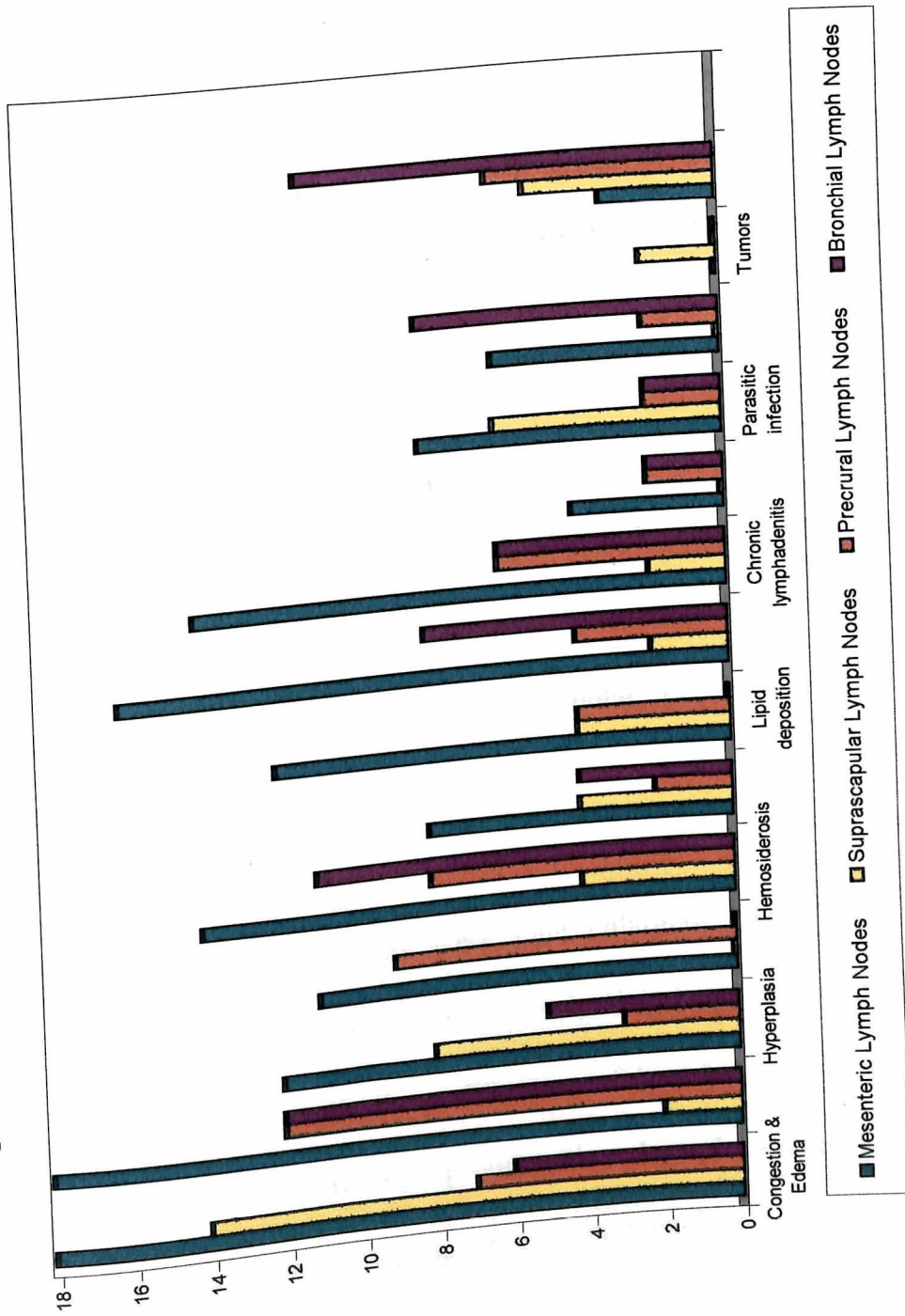
Various pathological lesions that were observed in lymph nodes were enlarged and edematous 45 (13.6%), hemorrhagic 39(11.9%), hemosiderosis 32 (9.7%), acute lymphadenitis 30 (9.12%), hyperplasia 28(8.51%), chronic lymphadenitis 28(8.51%), lymphoid depletion 25 (7.6%), plant pigment 20 (6.07%), lipid deposition 20 (6.07%), parasitic infection in 18 (5.47%), melanosis 18(5.47%) abscess 16 (4.86%), caseous lymphadenitis 8 (2.43%) and neoplastic conditions 2(0.6%)and were shown in table 1 and fig. 1

The detailed examination revealed higher incidence of enlargement and edematous lymph nodes followed by hemorrhagic, hemosiderosis and then acute lymphadenitis.

Table 1 : INCIDENCE OF HISTOPATHOLOGICAL LESIONS OF DIFFERENT LYMPHNODES

Name of the Condition	Mesenteric Lymph Nodes	Suprascapular Lymph Nodes	Precurral Lymph Nodes	Bronchial Lymph Nodes	Total	%
Congestion & Edema	18	14	7	6	45	13.6
Hemorrhages	18	2	7	12	39	11.9
Hyperplasia	12	8	3	5	28	8.5
Plant pigment	11	-	9	-	20	6.07
Hemosiderosis	14	4	8	6	32	9.7
Melanin	8	4	2	4	18	5.47
Lipid deposition	12	4	4	-	20	6.07
Acute lymphadenitis	16	2	4	8	30	9.12
Chronic lymphadenitis	14	2	6	6	28	8.51
Caseous lymphadenitis	4	-	2	2	8	2.43
Parasitic infection	8	6	2	2	18	5.47
Abscess	6	-	2	8	16	4.86
Tumors	-	2	-	-	2	0.6
Lymphoid depletion	3	5	6	11	25	7.6
Total	144	53	62	70	329	

Fig. 1 : Graph showing histopathological lesions of lymph nodes



The present investigation also revealed different pathological involvement of different lymph nodes in cattle viz mesenteric 144 (47.3%), bronchial 70 (21.8%) precrural 62 (18.84%), and suprascapular 53 (16.1%) lymph nodes. Among prescapular, bronchial, precrural and mesenteric lymph nodes, the lesions were more in mesenteric lymph nodes followed by bronchial lymph nodes. The different types of pathological lesions encountered in different lymph nodes recorded in cattle were given in table I.

4.2 EDEMATOUS LYMPH NODES

Among 1396 lymph nodes observed, 44 lymph nodes (13.6%) found to be edematous (Table 1). The incidence of edematous lymph nodes was 18, 14, 7, and 6 cases in mesenteric, prescapular, precrural and bronchial lymph nodes respectively.

Grossly the lymph nodes were pale enlarged, edematous, soft in consistency and turgid. On cut section bulged out appearance was seen. (Fig 2,3 &4) Microscopically proliferation of lymphatic parenchyma and follicular hyperplasia were seen prominently. Lymph sinuses were filled with lymphocytes, immature lymphocytes, mononuclear cells, plasma cells

and neutrophils. From few lymph nodes *Pasteurella* sps, *Streptococci* , *Pseudomonas* and *E. coli* bacteria were isolated.(Table 2)

4.3 HEMORRHAGIC LYMPH NODE

Hemorrhages were found in 39 lymph nodes (11.9%) (Table .1) and the incidence of hemorrhages in lymph nodes was 18, 12,7 and 2 cases in mesenteric, bronchial, precrural and pre scapular respectively. Grossly lymph nodes were swollen and dark red colored on cut section. Hyperemic areas were seen focally (Fig. 6) in majority of the cases and diffusely (Fig.7) in few lymph nodes. Microscopically large number of erythrocytes in lymph sinuses and congestion of blood vessels was noticed in many areas (Fig .8&9). *Pasturella* sps, *Streptococci* sps and *E. coli* sps were isolated from these lymph nodes.

4.4 HYPERPLASTIC LYMPHNODES

Hyperplasia was noticed in 28 (8.5%) lymph nodes (Table1). The incidence was 12,8 ,5 and 3 cases in mesenteric, suprascapular , bronchial and pre crural lymph nodes respectively (Table .1)

Fig. 2. Enlarged and edematous prescapular Lymph node.

Fig. 3. Edematous prescapular lymph node on cut section

Fig. 4. Edematous bronchial lymph node on cut section.

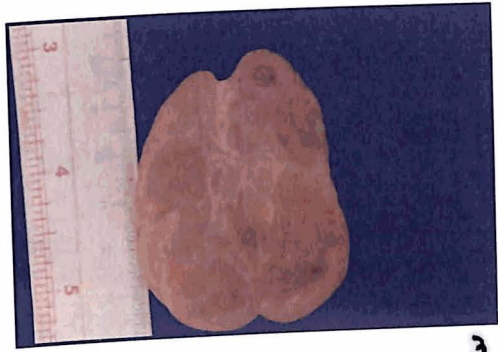
Fig. 5. Bronchial Lymph node:Edematous cortex H&E x70.

Fig. 6. Focal areas of Hyperemia in mesenteric lymph node.

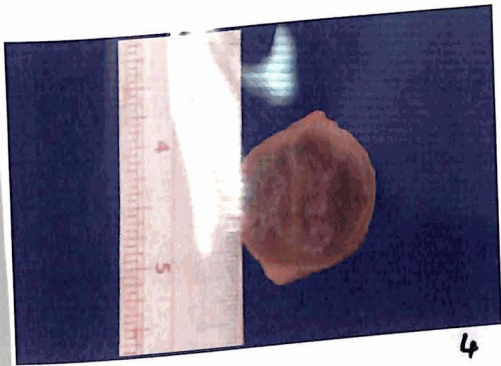
Fig. 7. Hemorrhagic bronchial lymph node on cut section.



2



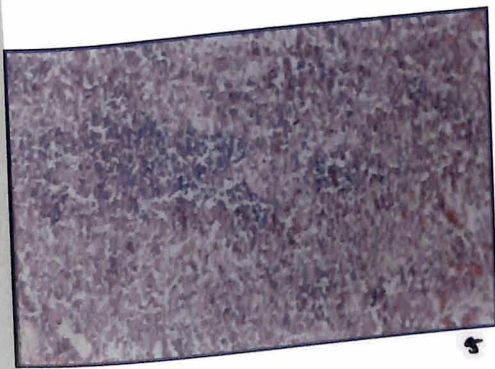
3



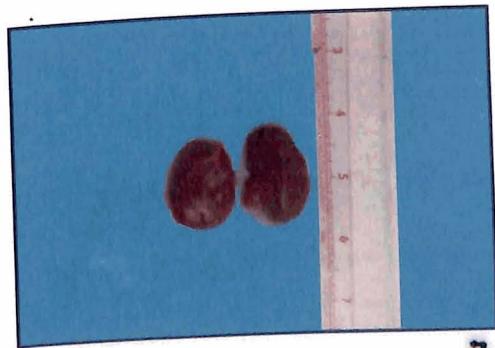
4



6



5



7

These lymph nodes were enlarged, gray in color, firm and hard in consistency. Follicles prominently noticed in most of the lymph nodes (Fig no 10&11).

Microscopically hyperplasia of the paracortical and medullary cord was noticed in majority of the cases. Few cases revealed follicular hyperplasia. Paracortical hyperplasia characterized by presence of more number of large lymphoid cells with prominent nuclei in paracortical area and attenuated germinal centers. In medullary cord hyperplasia, extension of paracortical area in papillary fashion towards hilar region was seen (Fig 12,13, &14). Follicular hyperplasia was characterized by increase in number and size of follicles in cortex. Medullary sinuses were displaced by more number of immature cells. The follicles were vary in size with well defined margins surrounded by a mantle of small lymphocytes.(Fig .15)

4.5 LIPIDOSIS

Out of 329 lymph nodes examined, lipid deposition was noticed in 20 lymph nodes (6.07%)(Table no .1)and the incidence was 12, 4, and 4 mesenteric, supra scapular and precrucial lymph nodes respectively. Grossly the fat deposition was seen as pale to dark white areas in lymphoid tissue

Fig. 8. Mesenteric lymph node: Large number of erythrocytes in cortex.
H&E x 70.

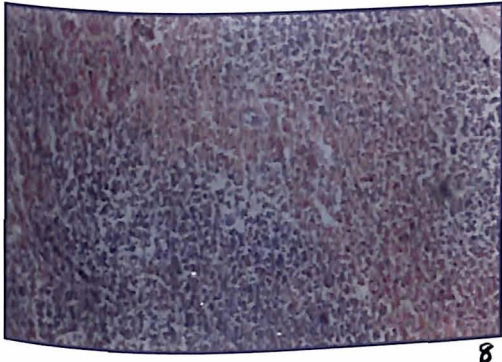
Fig. 9. Mesenteric lymph node: Massive distension of sinuses. H&E x 280.

Fig. 10. Enlarged grey colored hyperplastic lymph node with prominent
follicles and hemorrhages in pre scapular lymph nodes.

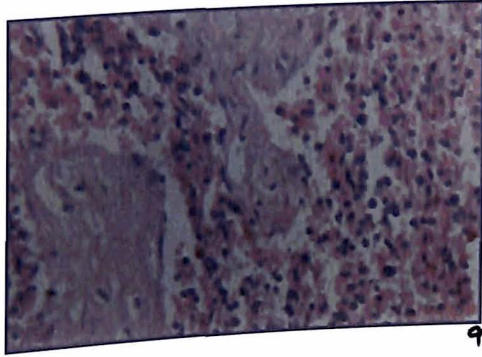
Fig. 11. Precurral lymph nodes Hyperplasia: Enlarged gray color lymph nodes
with prominence of follicles.

Fig. 12. Paracortical hyperplasia with large number of lymphoid cells.
H&E x 280.

Fig. 13. Medullary hyperplasia: Distension of sinuses with immature cells.
H&E X 70.



8



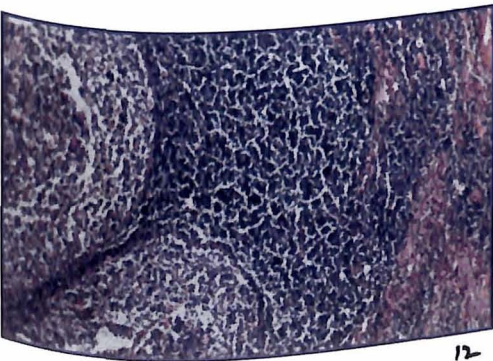
9



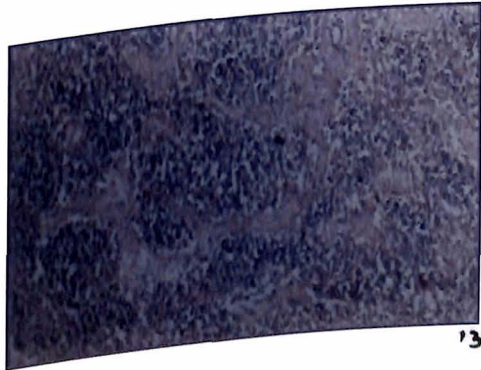
10



11



12



13

on cut section (Fig no.16). In some lymph nodes it was involved more extensively. Microscopically lipoid in nodal sinuses appeared as round empty spaces with distension of sinuses.(Fig.17) In some areas accumulation of foamy macrophages and giant cells were also noticed. Few lymph nodes revealed granulomatous changes characterized by presence of epitheloid cells and lymphocytes infiltration.

4.6 LYMPHADENITIS

4.6.1 Acute Lymphadenitis

Acute lymphadenitis was seen in 30 lymph nodes (9.12%) and the incidence was 12, 16, 8 and 2 cases in mesenteric , bronchial, precrural and prescapular lymph nodes respectively. Grossly lymph nodes were soft, enlarged, edematous and moist. The contents bulged out above the cut surface and hyperemic to a variable degree (Fig no 18&19). Microscopically prominence of small vessels, severe congestion and edema were noticed in cortical areas (Fig.20) Focal necrosis was also observed in certain areas. Lymph sinuses were filled with lymphocytes, mononuclear cells, plasma cells and neutrophils.(Fig.21). *Pasturella* and *E.coli* were isolated from some of these cases.

4.6.2 Caseous Lymphadenitis

Caseous lymphadenitis was found in 8 lymph nodes out of 329 lymph nodes (2.43%) and the incidence was 4,2 and 2 cases in mesenteric, bronchial and precrural respectively. (Table 3) These lymph nodes were grossly enlarged, hard, indurated and showed greenish white caseous mass. (Fig. 22) Some of them revealed calcified mass also. Microscopically caseated lymph nodes depicted caseation in center with presence of lymphoblasts, lymphocytes, macrophages, epitheloid cells and Langhan's giant cells. *Mycobacterium* were isolated from caseated lymph nodes.(Table 2)

4.6.3 Chronic lymphadenitis

Chronic lymphadenitis was noticed in 28 lymph nodes (8.5%) out of 329 lymph nodes (8.5%) examined and the incidence was more in mesenteric lymph nodes.(Table 1)

Grossly the infected lymph nodes were hard, firm, dry and indurated. (Fig. no.23). Microscopically there was marked proliferation of collagenous septa of the medulla. Microscopically the chronic lymphadenitis characterized by hyperplasia of reticulo endothelial cells and presence of

Fig. 14. Medullary hyperplasia: Distension of sinuses with macrophages, lymphocytes and plasma cells. H&E x 280.

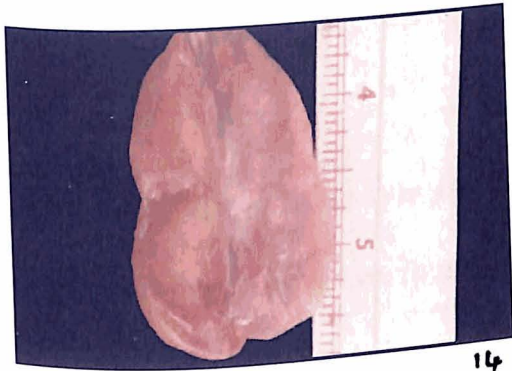
Fig. 15. Follicular hyperplasia. H&E x 280.

Fig. 16. Lipidosis: Dark white areas of lymphoid tissue on cut section in precruial lymph node

Fig. 17. Distension of sinuses with round and empty spaces. H&E x 280.

Fig. 18. Enlarged bronchial lymph node with hyperemia on cut section.

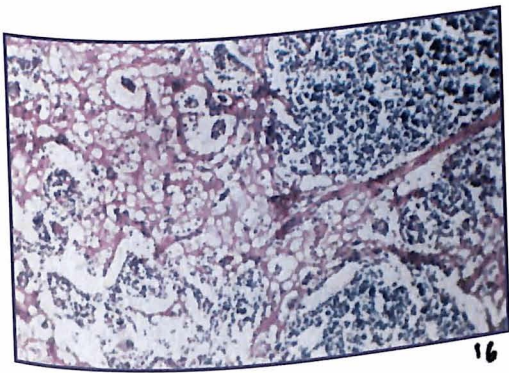
Fig. 19. Enlarged, edematous and moist appearance of prescapular lymph node.



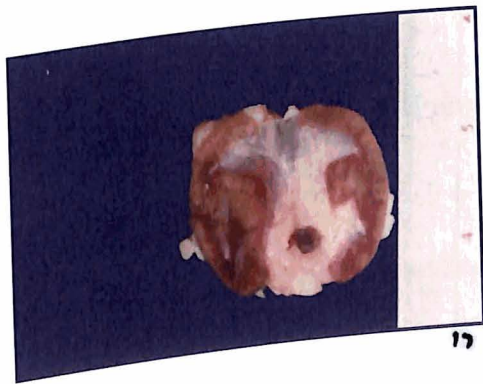
14



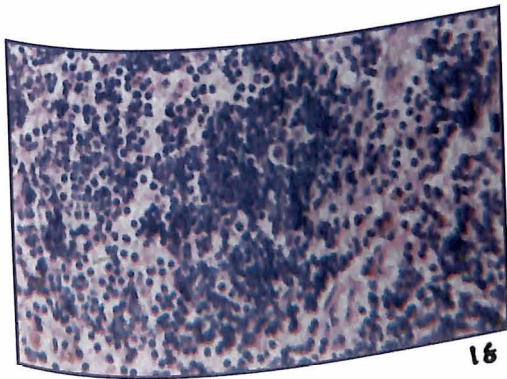
15



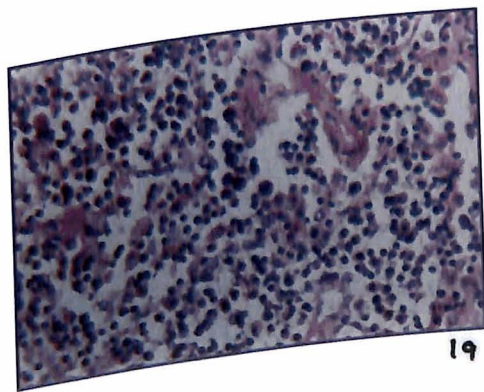
16



17



18



19

sinus catarrh in majority of the cases. Few cases showed severe cortical fibrosis.(Fig no. 24) In many places infiltration of epitheloid cells, plasma cells and histiocytes were found in medullary sinuses (Fig no. 25)

4.6.4 Suppurative lymphadenitis

Abscesses were found in 16 lymph nodes (4.86%) and the incidence was more in bronchial lymph nodes (Table 1) and the incidence was 8,6and 2 cases in bronchial, mesenteric and precrural lymph nodes respectively.

Grossly the lymph nodes were slightly enlarged, soft in consistency in majority of cases and with hard consistency in few cases. On cut section small to large abscesses were found. Some of the lymph nodes revealed presence of yellowish white gritty inspissated matrix with various degrees of capsular fibrosis. Microscopically severe necrosis of the cortex and medulla with severe infiltration of neutrophils was prominently observed. In majority of the cases, pus cells replaced the lymphoid tissue. In few cases in addition to above changes calcified material was also found. (Fig. 26)

Fig. 20 Prescapular lymph node showing congestion in cortical areas.
H&E x 280.

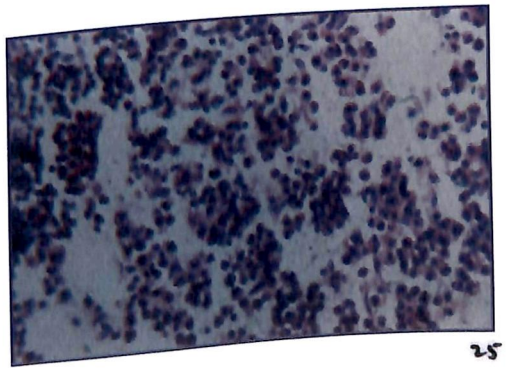
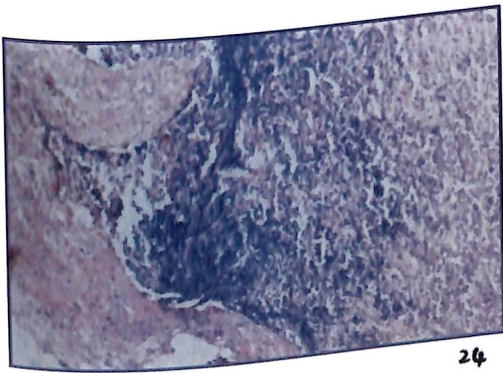
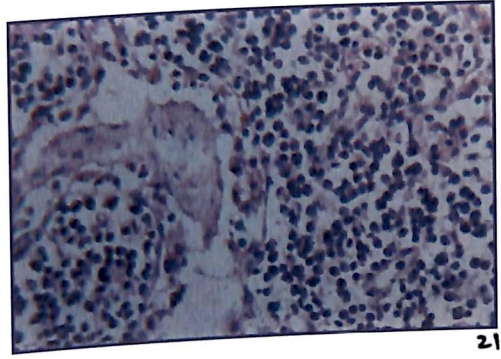
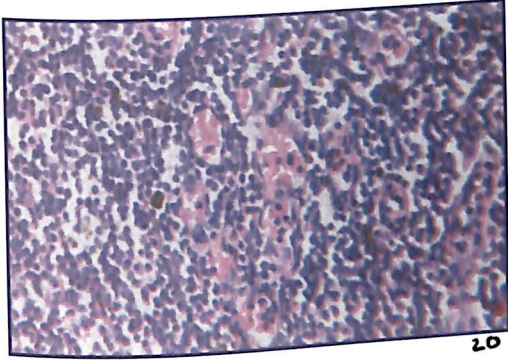
Fig. 21 Plasma cells and lymphocytes in lymphoid sinuses. H&E x 280.

Fig. 22 Enlarged and indurated bronchial lymph node with white caseous mass

Fig. 23 Dry and indurated appearance of prescapular lymph node on cut section

Fig. 24 Severe fibrosis in cortical areas of lymph nodes
H&E x 70.

Fig. 25 Infiltration of large number of plasma cells in medullary sinuses.
H&E x 280.

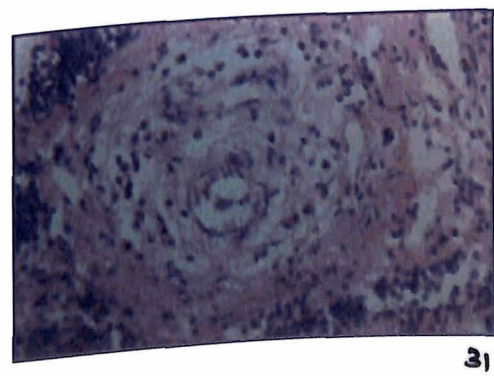
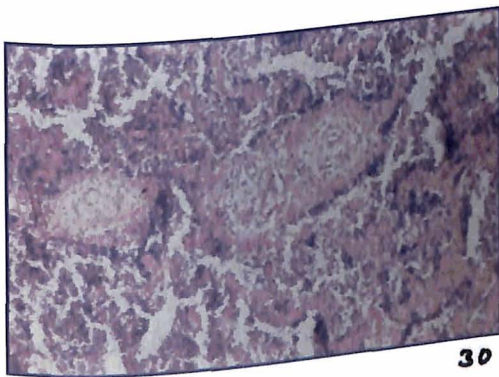
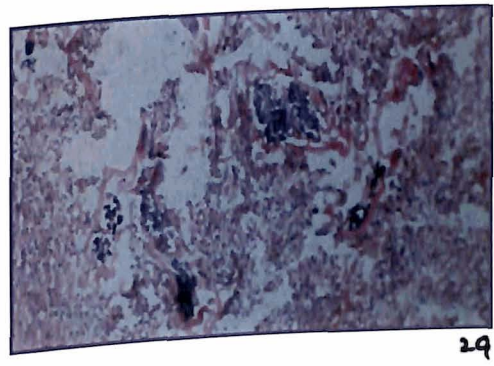
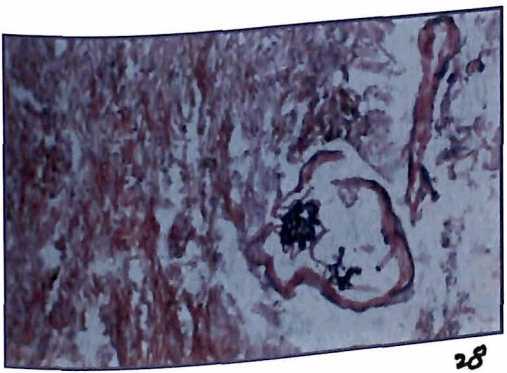
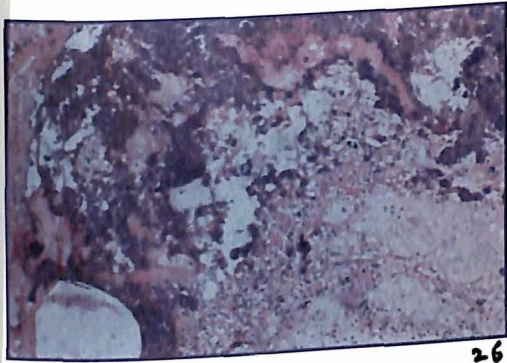


4.6.5 PARASITIC LYMPHADENITIS

Migrating larval parasites were found in 18 lymph nodes of cattle (5.4%) The incidence of parasitic infection was noticed in 8,6,2 and 2 percent in mesenteric, suprascapular, precrucial and bronchial lymph nodes respectively and the incidence was more in mesenteric lymph nodes (Table 1). The lymph nodes were enlarged, edematous and some were hard in consistency. The lesion was observed as green foci with gritty appearance. On cut section, lymph nodes showed migrating larvae of *Lingatula serrata* in some lymph nodes. (Fig 27)

Microscopically these lymph nodes showed chronic diffuse eosinophilic lymphadenitis. The pathological changes were in para cortex and were surrounded by inflammatory zone with giant cells. These lymph nodes revealed cut sections of larvae of *Lingatula serrata* parasites (Figure 28 and 29)in medullary sinuses and infiltration of mononuclear cells and extensive accumulation of eosinophils . And in few cases giant cells were also noticed. In few lymph nodes, severe arteriolitis with eosinophilic infiltration was also noticed (Fig no 30 and 31).

- Fig. 26 Severe necrosis and cellular infiltration with calcified areas in cortex and medulla . H&E x 70.
- Fig. 27 Enlarged and edematous mesenteric lymph node showing presence of *Lingatula serreta* larvae on cut section.
- Fig. 28 Presence of parasitic cut sections in medullary sinuses with cellular infiltration in. H&E x 70.
- Fig. 29 Presence of large number of parasitic cut sections in medullary sinuses H&E x70.
- Fig. 30 Section showing severe arteriolitis with infiltration of eosinophils in medulla H&E x 70.
- Fig. 31 Section showing severe arteriolitis with eosinophilic infiltration. H&E 280.



4.7 PIGMENTATIONS

4.7.1 Hemosiderosis

Thirty-two lymph nodes showed hemosiderosis pigment (11.25%). The incidence was 14,11,8 and 4 percent in mesenteric, bronchial, precrucial, and suprascapular lymph nodes respectively and it was more in mesenteric lymph nodes. Grossly it appeared as light brown in color (Fig no 32). Microscopically the hemosiderosis was apparent as coarse brown granules within reticular and sinusoidal macrophages of medullary areas (Fig 33&34).

4.7.2 Carotinoid pigment

Carotinoid pigment was seen in 20 lymph nodes (6.07%) and the incidence was 11 and 9 percent in mesenteric and precrucial lymph nodes.(Table 1)

Grossly dark plant pigmentations of medullary region were seen (Fig 35). Microscopically brown coloration of medullary sinuses was seen and it was found as normal non-inflammatory deposition. The pigment was intracellular in sinus macrophages (Fig.36) and no inflammatory reaction was seen in and around it.

Fig. 32 Hemosiderosis: Brownish discoloration of precrual lymph nodes.

Fig. 33 Hemosiderosis: Coarse brown granules in reticular and sinusoidal macrophages of cortex and medulla in. H&E x 70.

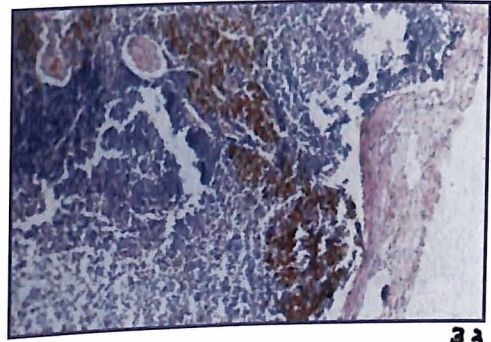
Fig. 34 Hemosiderosis: Coarse brown granules in reticular and sinusoidal macrophages of cortex and medulla. H&E x 280.

Fig. 35 Dark plant pigment in medullary areas of bronchial (top) and mesenteric lymph node (bottom).

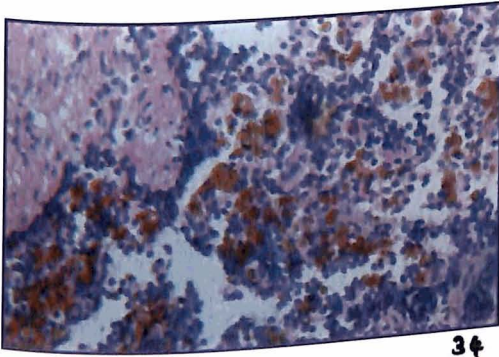
Fig. 36 Brown discoloration in medullary sinuses .H&E x70.



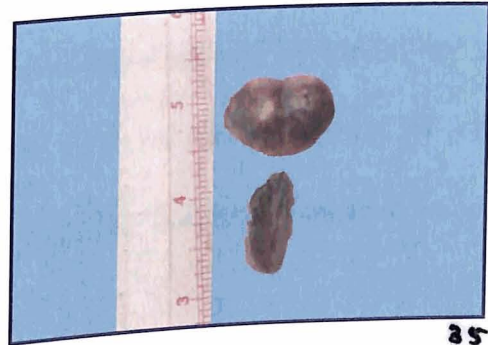
32



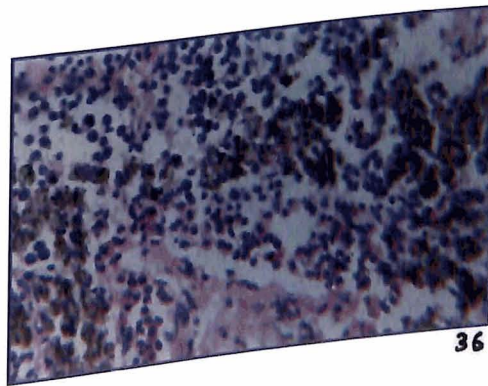
33



34



35



36

4.7.3 Melanin pigment

Melanin pigment was noticed in 18 lymph nodes (2.43%). The incidence of melanin was 5, in each mesenteric and 4 percent each in suprascapular, and bronchial lymph nodes respectively. The incidence was more prominent in mesenteric lymph nodes (Table 1).

Grossly these lymph nodes were dark black to brown in color (Figure.37&38), dry and hard in consistency. On cut section black-pigmented masses of varying shapes surrounded by a lighter zone were observed. Microscopically the pigment was confined to medullary sinuses in the form of irregular fine black granules in cytoplasm of enlarged reticular and macrophages (Figure 39). No bacterial isolates were found from these pigmented lymph nodes.

4.8 LYMPHOID DEPLETION

Lymphoid depletion was seen in 25 lymph nodes (7.6%) out of 329 lymph nodes and it was more pronounced in bronchial lymph nodes. The incidence of lymphoid depletion was 11,6,5 and 3 cases in bronchial, precruar, supra scapular and mesenteric lymph nodes respectively. Grossly most of the lymph nodes were pale in color (Figure no.40) and on cut

Fig. 37 Dark blackish-brownish diffuse discoloration of lymphoid tissue in precrural lymph node.

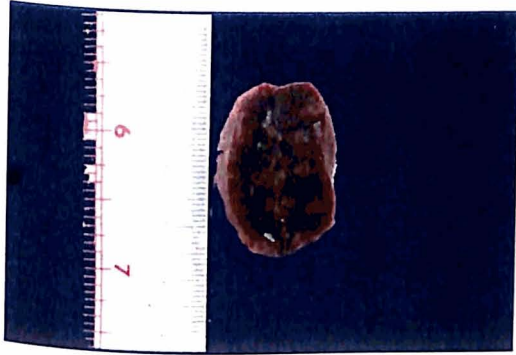
Fig. 38 Blackish-brownish discoloration in cortical areas of mesenteric lymph node.

Fig. 39 Blackish irregular granular pigment in medullary sinuses in . H&E x 280.

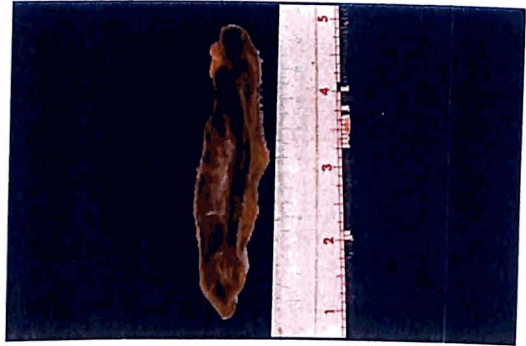
Fig. 40 Precrural lymph node showing pale appearance and severe atrophy of lymphoid follicles.

Fig. 41 Severe depletion of lymphoid follicles and atrophy of cortex. H&E x 280

Fig. 42 Swollen and firm prescapular lymph node with elevated areas in cortical portion.



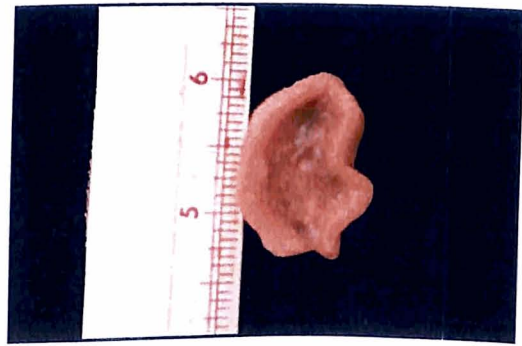
37



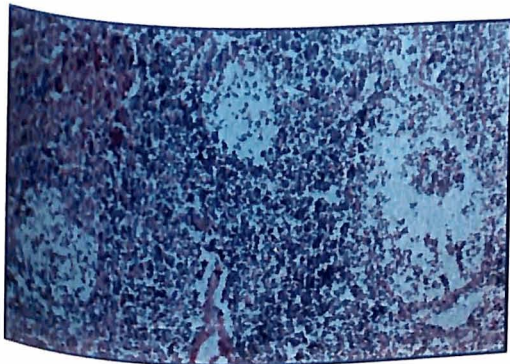
38



39



40



41



42

Table 2 : BACTERIOLOGICAL ISOLATION

Name of the Bacteria	Mesenteric Lymph Nodes		Suprascapular Lymph Nodes		Precrural Lymph Nodes		Bronchial Lymph Nodes	
	Examined	Positives	Examined	Positives	Examined	Positives	Examined	Positives
<i>E.coli</i>	6	3	5	4	3	1	4	1
Pseudomonos	4	3	2	1	1	-	1	-
Staphylococci	7	4	4	3	8	5	2	1
Streptococci	3	2	1	-	3	1	1	-
Pasteurella	21	16	5	4	9	8	6	4
Mycobacteria	6	4	2	-	3	1	1	-
Total	47	32	19	12	27	16	15	5

section the lymph nodes were grayish white in color. Microscopically severe lymphoid depletion in follicles was noticed. In addition to this atrophy of the cortex was also noticed (Fig.41).

4.9 NEOPLASTIC CHANGES

Two lymph nodes (0.06%) showed lymphoma changes. The neoplastic lymph nodes were swollen, firm and grayish white in appearance. On cut section demarcation between medulla and cortex was observed.(Fig.42). Microscopically cortex and medulla showed neoplastic cells in medullary cords and sinusoids.

4.10 CYTOLOGICAL SMEARS

Cytological smears were collected aseptically from 329 lymph nodes and abnormal changes were found in 191 cases.

4.10.1 Mast cells

Mast cells were observed in abundant in 11 impression smears. The incidence was 4,4,2 and 1 cases in mesenteric, bronchial, suprascapular and pre crural lymph nodes respectively(Table2). The incidence was more in mesenteric lymph nodes. These cells were larger in size, polymorphic,

spherical with large and numerous metachromatic granules and were seen constantly in lymphadenitis cases. (Fig.43)

4.10.2 Neutrophils

The lymph nodes having suppuration showed abundant neutrophils in 12 cytological smears. The incidence was 6,4 and 2 cases in bronchial, mesenteric, and pre crural respectively. The incidence was more in bronchial lymph nodes. These neutrophils exhibited degenerative changes in the nucleus like karyolysis and karyorrhexis. Bacteria also observed in the cytoplasm of some of the neutrophils.

4.10.3 Eosinophils

Eosinophils were found in abundant in 32 cytological smears. The incidence was 13, 12, 4, and 3 cases in bronchial, mesenteric, pre crural, and suprascapular lymph nodes respectively. The incidence was more in bronchial lymph nodes. The cytoplasm contains specific eosinophilic granules and bifurcated nucleus.(Figure.44) Majority of parasitic lymphadenitis cases revealed presence of eosinophils.

4.10.4 Bipolars

Bipolars were found in abundantly in the (35) lymph nodes (Fig. 45)

It was mostly noticed in acute lymphadenitis.

4.10.5 Lymphoblasts

Lymphoblasts were found in 14 cytological smears. The incidence was 4, 4, 3 and 3 cases in supra scapular, precrural, mesenteric and bronchial respectively. Nuclear chromatin was fine and diffuse. Nucleoli were also visible. These were larger in size than lymphocytes and possessed a broad or narrow rim of cytoplasm. These cells were found in enlarged of lymph nodes.

4.10.6 Plasma cells

Plasma cells were found in abundant in 29 lymph nodes impression smears. The incidence was 13,11,3 and 2 cases in mesenteric, bronchial, precrural and suprascapular lymph nodes respectively. The incidence was more in mesenteric lymph nodes. The nucleus was placed eccentrically (Fig. 47). The cytoplasm was basophilic and the peri nuclear area was present. Plasma cells were prominently seen in lymph nodes enlargement and chronic lymphadenitis cases.

4.10.7 Fibroblasts

Fibroblasts were found in 5 lymph nodes. Most of the cases of Chronic Lymphadenitis revealed fibroblasts in cytological smears (Fig. 48).

4.10.8 Macrophages (Epiheloid cells)

Macrophages were found in 28 impression smears. The incidence was 10, 8, 6 and 4 cases in precrural, suprascapular, mesenteric and bronchial lymph nodes respectively. The incidence was more in bronchial lymph nodes. These cells contained cellular debris with abundant cytoplasm (Fig. 49). Macrophages were observed in cases of chronic lymphadenitis and lymphoid hyperplasia.

4.10.9 Parasites

Parasites like *Microfilaria* sps, (Figure. 50) *Oncocerca armillata*, (Fig. 51&52), ova of *Lingatula serrata* and *Setaria* sps etc., were found in 12 lymph nodes impression smears. The incidence was 7, 2, 2 and 1 case in mesenteric suprascapular, bronchial, and precrural lymph nodes respectively. Parasites in cytological smears were observed in parasitic lymphadenitis. *Theileria* was found in 8 impression smears.

Fig. 43 Cytological smear showing presence of mast cells with meta chromatic granules. Leishman x 700.

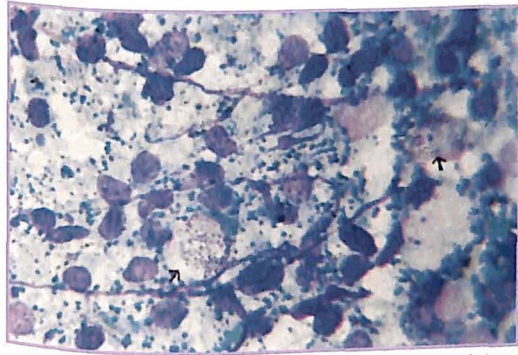
Fig. 44 Cytological smear showing presence of eosinophils. Leishman x 700.

Fig. 45 Bipolar organisms in cytological smear. Leishman stain. X700.

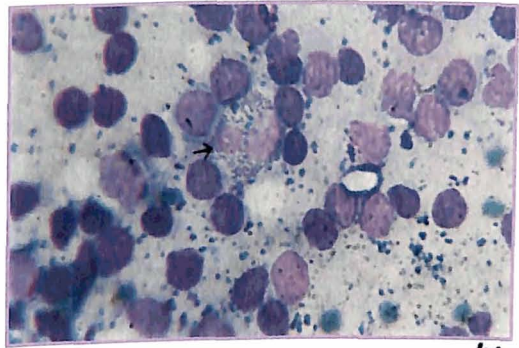
Fig. 46 Lymphoblasts in cytological smear. Leishman stain. X700.

Fig. 47 Plasma cells in cytological smear. Leishman stain. X700.

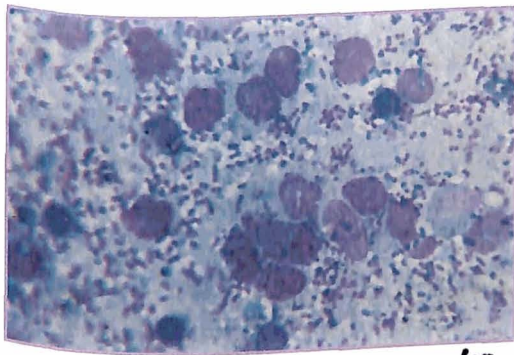
Fig. 48 Cytological smear showing the presence of more number of fibroblasts. Leishman stain. X700.



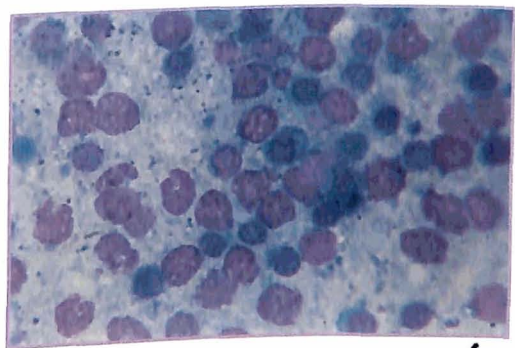
43



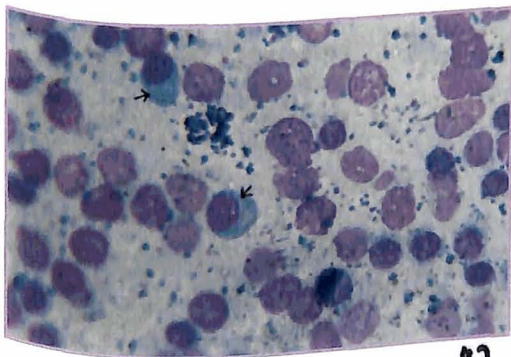
44



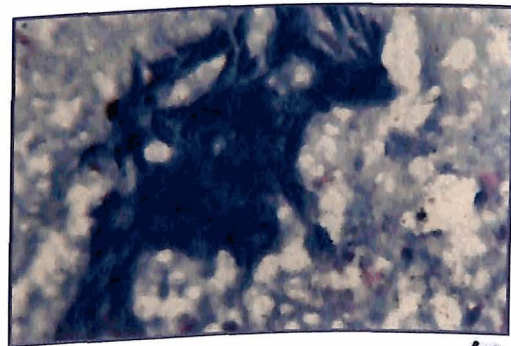
45



46



47



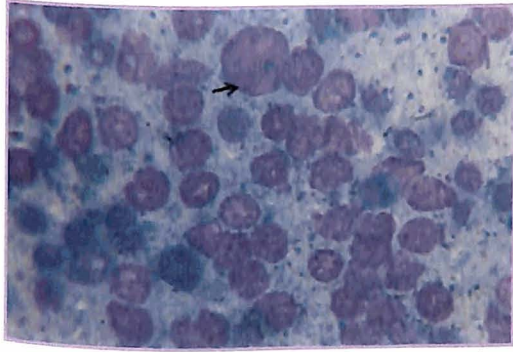
48

Fig. 49 Epitheloid cells in cytological smear. Leishman stain. X700.

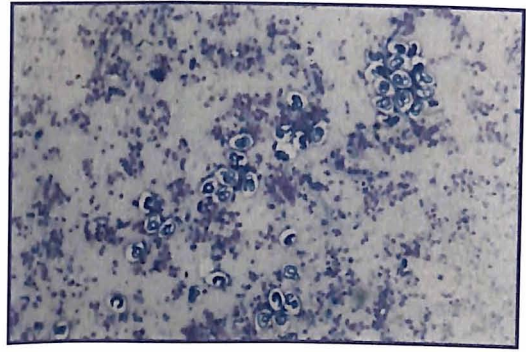
Fig. 50 Microfilarial organism in cytological smear. Leishman stain. X700.

Fig. 51 Cytological smear showing larvae of *Oncocerca armillata*.
Leishman stain. X280.

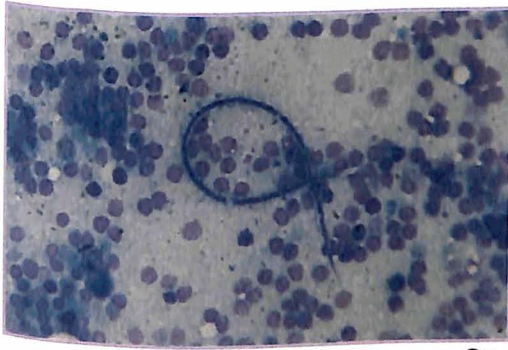
Fig. 52 Presence of *Oncocerca* larvae in cytological smear.
Leishman stain. X700.



49



51



50



52

Table 3 : CYTOLOGICAL SMEAR EXAMINATION RESULTS OF DIFFERENT LYMPHNODES

Name of the Cells	Mesenteric Lymph Nodes	Suprascapular Lymph Nodes	Precurral Lymph Nodes	Bronchial Lymph Nodes	Total
Bipolars	18	10	8	9	35
Macrophages	6	8	10	14	38
Lymphoblasts	3	4	4	3	14
Epitheloid cells	4	2	3	1	10
Neutrophils	4	-	2	6	12
Eosinophils	12	3	4	13	32
Parasitic larvae	7	2	1	2	12
Theileria	1	3	2	2	8
Mast Cell	4	2	1	4	11
Plasma Cell	10	2	3	9	24
Fibroblasts	3	-	-	2	5
Total	72	36	38	45	191

Chapter V

DISCUSSION

CHAPTER V

5. DISCUSSION

Lymphnodes are filters of the body system. They arrest entry of infections locally through phagocytic mechanism. Therefore the lymphnodes are always under stress due to attack of infectious or non-infectious agents throughout life. The study of pathology of lymphnode is therefore undertaken. The biopsy techniques often help in determination of function of lymphnode *in situ*.

Among 1396 lymph nodes of cattle examined, 329 (23.56%) lymph nodes found to be abnormal. Maity *et al.* (2000) examined 1187 lymph nodes of cattle in West Bengal and found 234 (19.7%) abnormal lymph nodes.

The present investigation revealed the involvement of different regional lymph nodes in cattle. The lesions were noticed in higher frequency in mesenteric lymph nodes (43.77%) followed by bronchial lymph nodes (21.28%) and it was in accordance with Maity *et al.* (2000) who reported the pathological involvement of mesenteric and bronchial

lymph nodes of cattle as 43.1% and 38.03% respectively. The highest incidence of mesenteric lymph nodes followed by bronchial lymph nodes may be due to more involvement of gastro intestinal diseases as compared with other systemic diseases.

Higher incidence of edema and enlargement of lymph nodes 45(13.6%) followed by hemorrhagic 39(11.9%) and hemosiderosis 32 (9.7%) were found on pathological examination. *Pasturella*, *E. coli*, *Salmonella* and *Staphylococcus*, were isolated from edematous enlarged lymph nodes. Maity *et al.* (2000) reported the incidence of enlargement and edematous lymph nodes as 63.68% and opined that it may be due to antigenic stimulations as earliest findings in infections. Ladds (1986) stated that local or generalized enlargement of lymph nodes might be due to impairment of lymph flow.

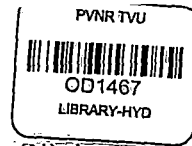
Hemorrhages were found in 39 lymph nodes (11.9%). Similar changes were also reported by Jannings (1970), Jubb *et al.* (1985) and Neiberle and Cohirs (1996). Maity *et.al.* (2000) reported that 23 lymph nodes (9.83%) were hemorrhagic, swollen darkened and hyperemic grossly. Large number of red blood cells that were found in the lymph sinuses of lymph nodes

probably due to considerable amount of blood accompanying the incoming lymph suggested the presence of septicemic diseases. Hemorrhages might have developed from endothelial injury that resulting from toxins liberated by the infectious agents.

Hyperplasia was noticed in 28 lymph nodes and majority of lymph nodes showed medullary hyperplasia. But few cases revealed follicular hyperplasia. Prominent expansion of medullary cords by plasmocytes is a feature of prolonged antigenic stimulation such as chronic infection or neoplasia (Jubbet.al 1985). Vyas (2003) opined that hyperplasia occurs because of presentation of blood born lymphocytes to the lymph born antigens. The inter action of B.cells with antigen and Tells mainly present in deep cortex results in proliferation of B cells. Lymph node hyperplasia may occur as general phenomena or as a local presence of chronic enteritis. Al-Sadi and Ridha (1994) reported 4 cases of reactive hyperplasia of ovine lymph node and concluded that reactive hyperplasia of lymph node was common in sheep and goat. It could be caused by a variety of stimuli. (Rywlin 1985).

ANGRAU Central Library
Hyderabad

D7299
1 10 1985



Focal lipid deposition was noticed in 20 lymph nodes grossly and in some lymph nodes it was involved more extensively. Ladds (1986) reported that lipid storage in bovine lymph nodes is a frequent occurrence in meat inspection and may be physiological or traumatic in causation.

Caseous lymphadenitis was found in 8 (2.43%) lymph nodes. *Mycobacteria* were isolated in 5 cases. Al-Sadi and Ridha (1994) observed caseous lymphadenitis in one case as an accidental finding in slaughtered animal. Where as higher incidence (13.25%) was noticed by Maity et.al (2000) and *Mycobacterium* sps was also identified.

Suppurative lymphadenitis was found in 16 lymph nodes. Grossly small to large sized abscess and microscopically necrosis and neutrophilic infiltration were noticed. This might be due to *Staphylococcus* and *Pasteurella* sps. infections as these were isolated upon bacteriological examination. Involvement of these lymph nodes could be due to drainage from primary sites. These observations are in concurrence with Ladds (1986) who observed lymph node abscess in cattle and stated that it results from infection with mere frequent pyogenic organisms such as *Corynebacterium pyogenous*, *Staphylococcus aureus* and *Pasteurella* sps. in

a cow. Maity *et al* (2000) opined that abscess develops when the inflammation originated from pyogenic organisms like *Staphylococcus aureus*. In contrary Al-Sadi and Ridha (1994) recorded tuberculosis involvement of mediastinal and mesenteric lymph nodes.

In animals these reactions have been following prolonged antigenic stimulation, immunization and in chronic immune stimulation associated with localized diseases (Jubb *et al.* 1985). Misdorp and Wieger (1971) studied lymph nodes of fat calves and revealed that hyperplasia of lymphoid tissue in cortex was with out any evidence of bacterial infection nor hormonal administration.

Most of the lymph nodes showed scarring of cortex. Extensive sclerosis may be due to out come of chronic inflammation. Vyas (2003) stated that prolonged infections of lymph nodes result into chronic lymphadenitis

Parasitic lymphadenitis was found in 18 lymph nodes. These lymph nodes showed cut sections of larval stages of *Lingatula serrata* with severe eosinophilic infiltration. The pentastomid *Lingatula serrata* is very

common in the viscera of various mammals and rarely in man. Animals act as intermediate host and usually become infected by ingesting material contaminated material (Soulsby 1982). The same was opined by Al-Sadi and Ridha in (1994). According to life cycle of *Lingatula serrata* mesentric lymph nodes are first infected and then the parasites migrates to other organs such as liver etc. Sherkov(1976), and Shakarfoursh etal (2003) reported that the prevalence rate of infection in liver was lower than that of mesenteric lymph nodes in sheep.

Hemosiderosis was found in 32 lymph nodes (11.24%) out of 329 lymph nodes that were examined. The pigment was found as coarse brown granules within reticular and sinusoidal macrophages in medullary areas. Al-Sadi and Ridha (1994) investigated and observed that hemosiderosis in 2.9% of lymph nodes out of 103 cases and observed hemosiderin pigment as coarse brown granules in macrophages of medullary areas. Hemosiderin is the commonest endogenous pigmentation noticed in the lymph nodes draining the areas of hemorrhages and it shows hemosiderin in reticular and sinusoidal macrophages (Vyas 2003). Ladds (1986) stated that hemosiderin pigment follow hemorrhages. Day and Pearson (1996) also found hemosiderosis in 20 lymph nodes out of 30 lymph nodes examined on electron microprobe analysis in 31 dogs of industrial areas.

Twenty lymph nodes showed the presence of carotinoid pigment and were most pronounced in mesenteric lymph nodes. Ladds (1986) reported that deposition of orange carotinoid pigment observed in lumbar lymph node and presumed to migrate from corpora lutea of the ovary or alimentary tract. Similar pigmentation of the liver and hepatic lymph nodes has been attributed to ingestion of a toxin possibly of plant origin.

Melanin pigment was noticed in 18 lymph nodes and this pigment was confined to medullary sinuses. Al-Sadi and Ridha (1994) reported melanosis in sheep and goat.

Twenty-five lymph nodes revealed lymphoid depletion. The gross and histopathological changes were in accordance with Maity *et al.* (2000). The epithelioid cell and giant cells were products of reticulo endothelial cells and proliferation suggesting the plasmocytic activation against foreign bodies.

Tumors were found in two lymph nodes. Singh et al (1980) reported clinical pathological studies on lymph sarcoma in Indian buffaloes and noticed lymphosarcoma in 170 cases.

Variable cytology was observed depending on pathological conditions. On cytological examination of enlarged hyperplastic lymph nodes and chronic lymphadenitis cases revealed the presence of macrophages, lymphoblasts cells and plasma cells. Lymphoid hyperplasia usually characterized by presence of small lymphocytes and plasma cells (Mary et al 1987). Vyas (2003) observed presence of macrophages, lymphoblasts, and plasma cells in chronic lymphadenitis. More number of neutrophils were observed in addition to normal population of lymphocytes in chronic suppurative lymphadenitis. In acute lymphadenitis, few cases revealed presence of bipolars in cytological smears.

Parasitic lymphadenitis cases revealed presence eosinophils and presence of several numbers of larval stages of *Microfilaria* in mesenteric lymph nodes. Eosinophils were also observed in cases of *Lingatula serrta* case that was observed grossly and on cut sections microscopically.

LIBRARY C.V.Sc
HYDERABAD-30
ACC. No. OD 1467
Date 25/10/18

ANGRAU Central Library
HYDERABAD-500 030.
ACC. No. D.7299
Date 05.01.04

Two cases of lymphosarcoma smears revealed presence of more number of lymphoblasts. Mary et. al (1987) stated that primary neoplasia is characterized by lymphoblasts, variable number of small lymphocytes, macrophages and few plasma cells. In few cases in addition to lymphoblasts "Koch's blue bodies" were noticed in larger lymphocytes and Macrophages and it was in accordance with (Soulsby 1982). Some of the chronic lymphadenitis cases revealed presence of mast cells.

Based on the present findings it was felt that a potential population of cattle had been suffering from various disease processes that affected the lymph nodes. Further it was speculated that the overall immune status of such a group of cattle might have been disordered. Thus the present work highlighted the importance of studies involving lymphnodes of pathology. The fine needle technique biopsy in relation to clinical immunopathology shall be the areas of further research.

Chapter VI

SUMMARY

CHAPTER - VI

SUMMARY

In the present investigation 1892 cattle carcasses were examined routinely in slaughter houses in Chittoor District and surroundings of Andhra Pradesh. The regional lymph nodes like bronchial, mesenteric, suprascapular and prescapular were examined for any gross pathological lesions. Only 329 (23.56%) lymph nodes were found to be abnormal.

The present investigation revealed the different pathological involvement of different regional lymph node in cattle viz mesenteric 144 (43.77%), bronchial 70 (21.28%), precural 62 (18.8%) and supra scapular 53 (16.1%) affected pathologically. Among different regional lymph nodes the lesions were more in mesenteric lymph nodes followed by bronchial lymph nodes.

Higher incidence of enlargement and edematous lymph node followed by hemorrhagic, hemosiderosis and acute lymphadenitis were noticed. The various pathological lesions that were observed in lymph nodes were enlarged, edematous 45 (13.6%), hemorrhagic 39(11.9%),

hemosiderosis 32 (11.25%), plant pigment 20 (6.07%), melanosis 8(2.43%) lipid depositions 20 (6.07%), acute lymphadenitis 30 (9.12%), parasitic infections in 18 (5.4%), abscess 16(4.86%), lymphoid depletion 25 (7.6%), caseous lymphadenitis 8 (2.43%) and chronic lymphadenitis 28(8.51%).

The cytological smear examinations revealed 191 cases of abnormalities out of total 329 lymph node impression smears examined. Cytological smears revealed macrophages in 38 cases, eosinophils in 32 cases, plasma cells in 24 cases, bipolars in 35 cases parasitic larvae in 12 cases, lymphoblast in 14 cases, epitheloid cells in 48 cases, neutrophils in 12 cases, mast cells in 11 cases, theileria in 8 cases, filarial worms in 8 cases and fibroblasts 5 cases.

Out of 108 lymph nodes examined 65 cases showed positive for bacterial isolates. In 8 , 4, 13, 3, 32 and 5 cases *E.coli*, *Pseudomonas*, *Staphylococci*, *Streptococci*, *Pasteurella* and *Mycobacterium* were isolated respectively.

LITERATURE CITED

LITERATURE CITED

- Al-Sadi, H.I and Ridha, A.M 1994 Comparative pathology of spleen and lymph nodes of apparently normal cattle, sheep and goats at the time of normal slaughters. *Small Ruminant Research* 14: 167-174.
- Awan Maq , Maiga S, Bouare s, 1988 Bovine Trypanosomiasis in Niger Vally of Republic of Mali; Occurrance and seasonal variation, *Bulletin of Animal Health and Production in Africa* 36; 4, 330-333.
- Buchanan R Engine and Gibbons N E 1974 *Bergey's manual of Determinative Bacteriology*, 8 th edition, Waverly press ,INC.
- Bundza A and Gardiner G H 1990 Larval Parasites in lymph nodes of slaughter cattle. *Journal of comparative pathology* 103 : 233-236.
- Day M J, Pearson G R, Lucke V M, Lane S J, and Sparks RSJ 1996 Lesions Associated with Mineral Deposition in the Lymph node and Lung of the Dog , *Vety pathology* 33; 29-42.
- Deeb S, Shalaby A A, Hosein H I, and E I Gendy 1995 *Egyptian Journal of Comparative Pathology and Clinical Pathology* 7;2; 291-299.

- Gibaly S M, Sergany M E, Ibrahim S I Handy M E R and Montaser AMA 1993 Histopathological changes and Immune response of *Brucella melitensis* infection in Cattle .proceedings of the second scientific Congress Egyptian Society for Cattle Diseases volume 2; 211-222.
- Irvin Woucten M and Vander 1980 Ovine lymphatic survey New Zealand Vety Journal 28(3) 36.
- Jannings A R 1970 Animal Pathology, 1st edn., pp. 10-14. Balliere Tindall & Casell, London.
- Jensen H E Schonheyder H and Jorgen sen J B 1990 Internal and pulmonary Mycotic lymphadenitis in cattle Journal of Comparative Pathology 1990, 102; page no.354.
- Jones T C and Hunt R D 1983 Veterinary Pathology. Lea and Febiger, Philadelphia, pp. 626-627, 648-661and 1338-1349.
- Jose D Lima 1979 Development of *Eimeria* species in Mesenteric Lymph nodes of Goats. The Journal of Parasitology 65,no 6, 976 -978.
- Jubb K V F, Kennedy P C and Palmer N 1985 Pathology of Domestic Animals, 3rd end., Vol. 3,pp. 181-188, Academic Press, London.

Mary Anna Thrall D V M M S 1987 Cytology of Lymphoid Tissue,
Vol.9 51-58.

Mckenzie R A and Beverly A Donald 1979 Lymphadenitis in cattle
associated with *corynebacterium equi*: A problem in Bovine
Tuberculosis Diagnosis. Journal of Comparative pathology
Vol 89, 31-37.

Mills J N 1984 Diagnosis from Lymph node fine aspiration cytology ,
Australian Vety Practitioner , 14 (1) Vety Bulletin 1984, Vol 54,
no 6909.

Misdorp W and Wieger K 1971, Enlarged lymph nodes in fattened
calves in Netherlands differential diagnosis from Lymphatic
Leucosis . Vety Bulletin 5080.

Morrison H I, Max Murray and Hinson C A 1982 The response of
Murine Lymphoid system to a chronic infection with
Trypanosoma congolense. The Lymph nodes., Thymus and
liver. Journal of pathology Vol 138, 273-288.

Nieberle and Cohrs 1996 Textbook of the Special Pathological Anatomy
of Domestic animals, 1st edn. Pp. 73-93. Pergamon Press,
London.

- Rogers R J, Donald B A and Schultz K 1980 The distribution of Mycobacterium of *Mycobacterium bovis* in Queens land cattle herds with observation on the laboratory Diagnosis of Tuberculosis. Australian Veterinary Journal, Vol 56, 542-546.
- Rywlin A M 1985 Hemopoitic system, Reticulo Endothelial system spleen, Lymph nodes Bone marrow and blood, Anderson's Pathology pp 1257-1325.
- Sharma A K, Vanamayya P R and Parihar N S 1985 Tuberculosis in cattle: A retrospective study based on necropsy. Indian J.Vet. Pathol., 9: 14-18.
- Shekarforoush S S, Razayi S M, Izadi M 2003 Prevelence of *Lingiatula serrata* nymph in sheep in Shiraz, Iran. Journal of Veterinary Parasitology, 17(1) 2003: 67-68.
- Shekarforoush S S and Arzani P 2001 The study of prevalence rate of *Linguatula serrata* nymph in liver of sheep, goat and cattle in shahre-kord, Iran. Iranian J. Vet. Res., 2:57-62.
- Sherkov S N and Rabie Y E 1976 Survey of *Linguatula serrata* in domestic animals in Jordan. Eryp. J. Vet. Sci., 13:89-97.
- Singh B, Singh K P, Parihar N S, Bansal M P and Singh C M 1980. Clinical pathological studies on Lymphosarcoma in Indian Buffaloes. Vety Bulletin 1980, Vol 50, no 4.

Soulsby E J C 1982 Helminthes and Protozoa of Domesticated Animals,
pp 511-520.

Thiruthalinathan R, Rajavelu G and Anandan R 1998 Vector Potentiality
of *Hyaloma Marginatum isaaci* in the transmission of
Theileria annulata. Cheiron 27; 1-2 10-12 8 ref.

Valli V E, Mc Scsherry B J, Dunham B M, Jacobes R M and Lumsden J
H 1981 Histocytology of Lymphoid Tumors in the dog, Cat
and cow, Veterinary Pathology 18; 494-512.

Vyas U K 2003 An Introduction to theory and Practice of Vety
Pathology, page no 102-104.

Zschock M, Palatzky R and Eskens U 1990 Tubercular Lymph nodes
culturing results for slaughter cattle for the years 1985-1989,
Flieschwirtschaft 1990, 70: 3, 285-286.

LIBRARY C.V.Sc
HYDERABAD-30
ACC No. OD 1467
Date: 25/10/05

ANGRAU Central Library
HYDERABAD-500 030.
ACC. No. D.7299
Date: 05.01.2005

