RADIOGRAPHIC AND PATHOPHYSIOLOGICAL INVESTIGATION OF JOINT DISORDERS IN BOVINES

THESIS
SUBMITTED TO
THE ORISSA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY
BHUBANESWAR

IN PARTIAL FULFILMENT OF
THE REQUIREMENTS
FOR THE DEGREE OF

MASTER OF VETERINARY SCIENCE
IN
SURGERY

By
Ramaballabha Mahapatra
B. V. Sc & A. H. (Utkal)

DEPARTMENT OF SURGERY
ORISSA COLLEGE OF VETERINARY SCIENCE AND ANIMAL HUSBANDRY
BHUBANESWAR
1986

TO MY LATE FATHER

C E R T I F I C A T E

This is to certify that the thesis entitled "RADIOGRAPHIC AND PATHOPHYSIOLOGICAL INVESTIGATION OF JOINT DISORDERS IN BOVINES" submitted in partial fulfilment of the requirements for the degree of Master of Veterinary Science (Surgery) of the Orissa University of Agriculture and Technology, Bhubaneswar, is a faithful record of bonafide and original research work carried out by Ramaballabha Mahapatra under our guidance and supervision. No part of the thesis has been submitted for any degree or diploma earlier.

23.5.86.

(Dr. A.K.Ray)
Co-Advisor

23.5.'86

(Dr. A.K.Mitra)
Advisor

A C K N O W L E D G E M E N T S

The author expresses his deepest sense of reverence, gratitude and indebtedness to Dr.A.K.Mitra,Ph.D, Professor and Head, Department of Surgery for his precious advice, able guidance, incessant untiring supervision and constructive criticism throughout the course of this investigation and preparation of this manuscript.

He is extremely grateful to Dr.A.K.Ray,M.V.Sc, Reader of surgery Department for his valuable suggestions and timely help as and when required throughout the period of this work.

He is delighted in expressing his profound sense of gratitude and indebtedness to Dr. J.Mohanty, Ph.D former Professor and Head, Department of Surgery and now the Director, Animal Husbandry, Dairy and Veterinary services, Orissa for his intellectual advice, constructive criticism and instructive suggestions during the short period before joining his new assignment.

The author avails the opportunity of ventilating his profound obligation to Dr.S.C.Ojha, Ph.D,Ex-Reader in Surgery under whose intellectual thought and inspiring efforts the present study was modelled and initiated

before he left this College to join his new assignment, on promotion, at Gujrat. His keen interest and help at each step of this study are unforgetable.

The author gratefully acknowledges the benevolence of the Director, Animal Husbandry, Dairy and Veterinary services, Orissa for sponsoring him for this higher study.

The author has the pleasure of expressing his sincere obligation to his teachers of surgery Department, Dr.V.S.C.Bose, M.V.Sc. and Dr.S.Nayak, M.V.Sc. for their help and co-operation.

Grateful acknowledgements are due to Dr.S.N.Misra,Ph.D, Reader in Pharmacology, Dr.G.M.Patnaik, Ph.D, Reader in Pathology, Dr.L.N.Das, Ph.D, Reader and Head, Department of Anatomy, Dr.P.C.Dey, M.V.Sc., Director, Central clinic and Mr. M.K. Bal, M.Sc. Lecturer, Department of Statistics for their selfless help but for which the present work would have suffered a great set back.

The Co-operation and help of his postgraduate colleagues, Dr.T.Pathy and Major N. Mohanty are gratefully acknowledged. Particularly the assistance of Dr.T.Pathy are unforgettable. He is indeed a friend inneed.

The author is extremely grateful to his M.V.Sc,Part-I friends in general and to Dr.S.Basu in particular who has helped at each and every stepe during the course of this

investigation. The non-teaching staff of surgery Department deserve appreciation of the author.

Hearty thanks are also due to Mrs & Mr.V.Madhu for typing this script so nicely.

Last but not the least, the author expresses deepest appreciation to Gayatri, his wife, who inspite of her chronic illness not only took the entire responsibility of the family but was also the principal source of inspiration behind the successful completion of the present study. Pipa and Pilu, the beloved daughter and son of the author, compromised well with all odds and relieved the author from all domestic worries during the period of this study for which they deserve appreciation.

(Dr. Ramaballabha Mahapatra)

C O N T E N T S

L I S T O F T A B L E S

LIST OF FIGURES

LIST OF FIGURES

****

CHAPTER-I
INTRODUCTION

I N T R O D U C T I O N

Mechanisation in the field of agriculture in India is gaining pace yet most of our farmers still depend on bullocks. The government has launched a programme for white revolution to increase the socio-economic status of poor and marginal farmers. Hence much emphasis is being given to improve the genetic potential of our cattle population. Besides, cattle breeding and cattle development projects are in operation to upgrade the cattle resources. As a consequence of this people are now careful for the health cover of their cattle in order to get a better return from both milch and draught cattle.

The infusion of exotic breeds and upgrading programme has exposed the cattle to many other diseases. One of these is joint disorders which has posed a problem to farmers. They sustained irrepairable loss due to such impairment in the locomotion of their animals. Thus

it has now become a challenge to the veteri-narians to spare no stone unturned in order to formulate suitable diagnostic measures for early diagnosis and treatment of this malady.

The joint affection is judged by pain, swelling and lameness in cattle which restricts its mobility. The joint disorders may be due to fracture of carpal or tarsal bones or impaired formation of synovia.

The conventional methods of diagnosis is by history and physical examination of the affected joint. Such examination limitsfor accurate investigation of the structures of the joint located inside. Unless the structures are viewed, the physical examination alone provides inadequate information to accurately diagnose the condition of the joint.

In the present days sophisticated yet costly methods are being adopted not only to investigate the joints but also to operate on the affected portions. Arthroscopy is being done in foreign countries but it has its limitations due to prohibitive cost. The next

choice is by radiography but no standardised data is available about limb joints of cattle. Besides, radiographs of limb joints at various planes are necessary to document a precisely informative glossary.

Perusal of literatures revealed incomplete informations about the structures of joints of a living ruminant. It, thus, prompted the author to take up a research work to attempt the diagnosis of joint disorder in ruminants by radiography and observe the patho-physiological changes in affected cases. Since investigation of all the limb joints will not be possible in a limited period of time, the study has been concentrated on knee and hock joints. Moreover, the knee and the hock joints are more prone to affection and yet still more in exotic breeds of cattle.

* * * * * *

CHAPTER-II

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The disorders of knee and hock joints in ruminants was perused in available literature.

Anatomical Consideration

Both the knee and hock joints of bovine are synovial or diarthrodial joints composed of groups of bones and few other structures for convenience of mobility. (Getty, 1977).

The knee is a composite joint consisting of six bones, bound by radius above and metacarpus below, arranged in two rows. The proximal row consists of four bones- radial carpal, intermediate carpal, ulnar carpal and accessory carpal whereas the distal row has two bones only- the fused second and third carpal and the fourth carpal (Getty, 1977).

The blood supply to knee joint is mainly from the median artery. (Fig-I). It descends along the medial aspect of caudal surface of radius. It then passes through the carpal canal to the meta carpal region. The radial artery descends along the medio palmar aspect of carpus contributing to the dorsal carpal rete. The dorsal carpal branch arises from radial artery. It is strong and supplies the dorso medial aspect of the carpal joint.

The dorsal carpal rete is a network of delicate vessels on the dorsal aspect of carpus. From this network arises a small delicate vessel, the dorsal metacarpal artery which descends in the longitudinal groove on the dorsal surface of metacarpus.

Tibiotarsal or hock joint contains a group of short bones- the Ossa tarsi, bound above by tibial distal extremity and below by the metatarsus. In bovine these are five in number and arranged in two rows. The proximal row consists of the tibial tarsel bone and fibular tarsal bone. The fused second and third tarsals and the first tarsal are placed medially and laterally respectively in the distal row. The central and the fourth are fused to form one bone which is interposed between the two rows (Getty, 1977).

The blood supply to hock joint in bovines is mainly from the saphenous artery which is the most extensive branch of femoral artery (Fig-2). It arises within the middle two third of thigh and bifurcates to lateral and medial plantar arteries on the plantar aspect of tarsus (Mcleod,1958).

Incidence

The incidence of hygroma was reported by Bergman and Agren (1923) to be more common in herds having infectious abortions. Synovitis and rheumatic arthritis of hock in a bull was recorded by Kulkarni (1967). Subsequently Greenough et al (1972) have reported to have observed hydrarthrosis of tarsal and Carpal joints in cattle. They further recorded that bursitis of these two joints were more common in confined adult cattle. Ramakrishna (1975) has also recorded bilateral and unilateral chronic tarsal hydrarthrosis but with synovial effusions.

Aetiology

It has been observed by O'Connor (1950) and Frank (1959) that repeated trauma of knee and hock

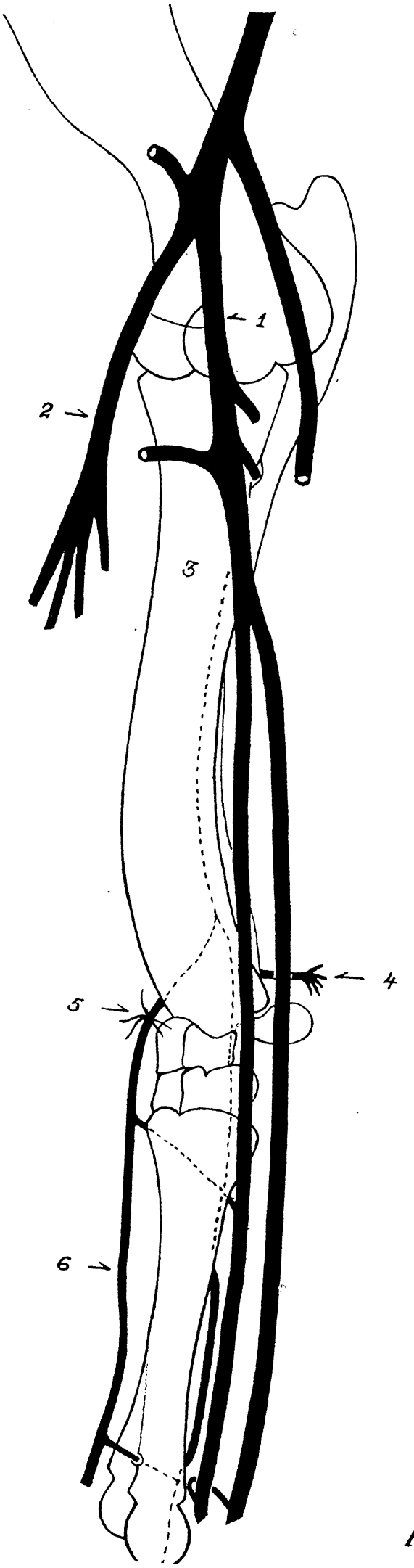

Fig. 1

Fig. 2

joints predisposed to capped knee and capped hock in cattle. In horses, according to Vanpelt (1969), tenosynovitis was found to be due to strain, pressure, trauma and friction. A group of workers (Coid and Vaughan, 1957; and Greenough et al, 1972) isolated Brucella organism in carpal hygroma of cattle. In the opinion of Ramakrishna (1975) pathological alterations of synovial fluid may cause disorders of joints.

Clinical features

The clinical manifestationsof joint disorders were found to be evidenced externally by tissue inflammation andswelling. (Frank, 1959; Greenough, 1972). They observed that the swelling or distension of the joints may be fibrous or fluctuating in nature. The affected animals exhibit lameness during movement. Similar observations in horses have also been reported by O'Connor (1950); Frank, (1959); Vanpelt, (1969); Adams (1974); and Rose, (1983).

Radiography

In routine clinical practice both plain and contrast radiographic techniques have been employed. Several workers considered radiography to be most

important for the diagnosis of joint diseases and suggested to perform this in combination with clinical examination (Vanpelt, 1965; Greenough et al, 1972; Adams, 1974; Veenendaal, et al,1981; Rose, 1983; and Suntun, 1984). On the contrary Pratap et al, (1977) were of the opinion that in early stage of arthritis radiography was of less importance whereas Orsini (1984) was of the view that radiography in Osteomyelitis and septic arthritis should not be accepted as the only diagnostic method.

There have been suggestions to conduct plain and contrast media radiography of joints using 50% diathrizoate sodium solution (Vanpelt, 1965), 70% W/V of Iothalmate (Veenendaal et al, 1981) and air (Dik, 1984).

Doughlas et al, (1971) did assessthat arthrography by air was of more assistance than contrast medium. They have also advocated to perform angiography by injecting water soluble organic Iodine in suitable blood vessels. The exploratory puncture and radiography in cases of carpal hygroma in cattle was advocated by Greenough et al,(1972

Doughlas et al, (1971) have further reported that a carefully positioned plain straight radiograph

of joints were of utmost importance. It was Rose, (1983), who has advocated that the views should preferably be antero-posterior, or Latero-medial and lateral oblique positions.

Clinical pathology of Synovial fluid

The synovial fluid has the following properties (Benett, 1956):

(i) Thixotrophy

(ii) Wetting of surface

(iii) Elasticity and instantaneous dilatancy at impact

and

(iv) good heat conductivity

and show changes due to alteration in synovial tissues and metabolism in joints in diseases (Coles, 1967). Thus the importance of systematic study of synovial fluid has been stressed by Vanpelt, (1974).

It was Frerichs, (1846) who first detected mucin in synovial fluid after mixing it with acetic acid. The synovial fluid maintains its viscosity due to presence of mucin, (Vanpelt and Conner, 1963_a) and is lubricant in its function (Perman and Cornelius, 1971).

The synovial fluid of stifle joint of normal cattle was found by Tyagi and Krishnamurthy, (1972) to be colourless or amber coloured with floculent material in some samples.

It was Ramakrishna (1975) who failed to observe any corelation between the volume and viscosity of synovial fluid in tarsal hydrarthrosis. Krishnamurthy and Tyagi (1977 and 1978) examined synovial fluid of cattle, buffaloes and camels and recorded normal mucin precipitate even though viscosity varied in each joint.

The normal synovial fluid is alkaline with pH ranging from 7.31 to 7.4 (Perman and Cornelius, 1971). It has been observed by some workers that once pH was disturbed it took twenty to thirty minutes to return to its normal level (Ropes and Bauer, 1953; Barnett, 1961 and Curtiss, 1964). Karatzias, (1982) determined not only pH but also specific gravity, protein and glucose content and cell count of synovial fluid in cattle.

Cytology

Cytological studies of synovial fluid of normal joints have been studied by many workers to estimate the

number and different cell types (Warren, et al, 1935; Davis, 1945; Gardner, 1950; Ropes and Bauer, 1953; Tyagi and Krishnamurthy, 1972 and Vanpelt, 1974).

It has been suggested by Ropes and Bauer,(1953); Ramakrishna, (1975) and Zaitsev, (1982) that the cytological picture of synovial fluid showed variation than normal.

Singh et al, (1982) have observed leueocytosis, Neutrophillia and Lymphaemia in synovial fluid of chlamydia induced arthritis in cows. A grossly purulent synovial fluid with high leucocyte count, low viscosity and immediate clotting of fibrin soon after withdrawal was reported by Orsini, (1984) when strepto- and Staphylo Coccus Organisms were isolated from joint effusions.

Biochemical characters

(1) Glucose:-

Variations in the concentration of glucose in synovial fluid and serum in contrast to other nonelectrolytes was observed by Ropes and Bauer(1953). These workers and Furey et al (1959) have stressed

these values to be of much significance for diagnosis of joint diseases.

The normal glucose concentration in synovial fluid is reported to be almost parellel with that of serum by most of the workers. (Curtiss, 1964; Vanpelt, 1974; Ramakrishna, 1975 and Bauer, 1982), whereas Perman and Cornelius (1971) observed the average glucose concentration of bovine synovial fluid to be slightly lower than that of serum. On the contrary, Vanpelt and Conner (1963_b) have reported to have observed high sugar levels in synovial fluid than blood and plasma in bulls, cows, and steers.

The determination of the difference in sugar levels of synovial fluid and blood for diagnostic purposes was emphasised by Curtiss (1964) and Vanpelt (1974).

Bauer, (1982) has observed, in degenerative joint diseases, that the synovial fluid glucose concentration equals that of plasma as in normal condition. However, in inflammatory joint diseases synovial glucose level drops to 60% and in aseptic arthritis it further drops to 40% of the plasma value.

(2) Total Protein

The total protein concentration of the synovial fluid from Knee joint and plasma of cattle was estimated by Bauer et al (1940) and Gardner (1950). They have recorded that the total protein in synovial fluid was lower than that of serum, whereas Ropes and Bauer,(1953) observed marked variation in total protein concentration of synovial fluid having significant relationship with the type, duration and severity of the joint disease.

Perman and Cornelius (1971) and Zaitsev (1982 Rose (1983) have recorded that the synovial protein increased significantly in pathological diseases of joints like severe infectious arthritis whereas Vanpelt, (1969) not only agreed with this but also has reported that the protein of synovial fluid increased more than serum protein in severe infectious joint diseases. Karatzias and Meermann (1982) have found that injection of oxytetracycline into joints of normal bulls caused an increase in synovial total protein.

According to reports of Tyagi and Krishnamurthy (1975) and Krishnamurthy and Tyagi (1977) the synovial total protein of normal stifle joints of cows were higher than both bullocks and buffaloes.

In human beings the synovial protein content was approximately one-third of that of serum (Curtiss,1964) or one-fourth of that of serum (Bauer, 1982).

(3) Sodium and Potassium

Bauer et al (1940) have stated that concentration of electrolytes occur in synovial fluid as per the Donnon equilibrium theory and sodium, potassium, calcium and Mangnesium are present in lower concentration than in serum. Identical opinions that electrolytes distribution in synovial fluid in general exist in accordance with the laws governing membrane equilibrium was stated by several workers, (Gardner, 1950; Hopes and Bauer, 1953;Barnett et al.1961; and Perman and Cornelius 1971).

According to Perman and Cornelius, (1971) the synovial sodium, Potassium, Calcium and Manganesium in cattle are slightly lower than its concentration

in serum while total inorganic phosphate is about the same in both synovia and serum.

The concentration of sodium and potassium of synovial fluid of stiffle joints in cattle and buffaloes were estimated by Krishnamurthy and Tyagi(1977) whereas Scholz et al (1983_a) have recorded the sodium and potassium content of stiffle and hock joints of cattle.

Difference in plasma sodium, potassium and calcium values in normal calves and those suffering from polyarthritis caused by C.pyogenes was not observed by Torres et al (1981). On the contrary, major elements of synovia in cattle with infected and non infected arthritis were estimated by Scholz et al (1983_b). The sodium and Potassium concentration of 26 cattle with noninfected arthritis were 3.8 and 120 mMol./L. respectively. The corresponding values in cattle with infected arthritis were 4.13 and 137 mMol./L. respectively.

(4) Uric Acid

Normally urea and uric acid occur in the fluid in a slight lower concentration than in serum (Barnett et al. 1961).

Exogenous or endogenous compounds not required by the body are eliminated unchanged or undergo metabolism and are then excreted. One of the best known species difference is the case of uric acid. Uric acid in man is excreted unchanged but in most other mammals is converted to allointoin (Clarke, 1981). The reason for this is that man lacks the enzyme uricase.

In terms of nitrogen allointoin forms 92.1%, uric acid 7.3% and purines 0.7% of elimination products in cattle (Dukes, 1933).

In comparison to normal animals, animals affected with upward fixation of patella showed a very slight rise in blood uric acid level as recorded by Tyagi and Murthy (1977) and Patro and Mohanty (1985).

Bacteriology

Boyd, Delez and Fitch (1930) have indicated that Brucella abortus was an associated aetiological factor in the development of carpal hygroma. Identical opinions were reported by Greenough et al(1972) They further suggested that investigation for

C.pyogenes should also be done. On the other hand O'Connor (1950) was of the view that carpal hygroma was rarely due to botreomycosis or tuberculosis.

In human beings, positive culture of strepto-,staphylo- and pneumococcus or E.Coli was isolated from snyovial fluid or arthritis cases by Ropes and Bauer (1953). Furey et al (1959) have suggested that frequent laboratory investigation should be done in case of infectious arthritis.

Curtiss (1964) and Vanpelt (1974) have stressed for both aerobic and anaerobic cultures of synovial fluid of suspected joint diseases. Rose (1983) was of the opinion that inhibitory product of synovial fluid may prevent the growth of bacteria and thus no growth can be marked on direct plating, whereas, Orsini (1984) has suggested that rapid identification of bacteria may be possible basing on short chain and total cellular fatty acid composition of the bacteria and their byproducts.

* * * * * * *

CHAPTER-III

MATERIALS AND METHODS

MATERIALS AND METHODS

The study has been done in six experimental cow calves and twelve clinical bovine cases with joint disorders.

The six calves were in the age group of 3 months to 3 years. All these calves were apparently healthy without having any sign of lameness. These animals were numbered from one to six and were quarantined for 2 days before they were utilised for experimental work. The age, sex, body weight and normal clinical status have been recorded in Table No.1.

The twelve clinical cases with various joint disorders were also subjected to the present investigation. A few of them were presented at the Central Clinic of Orissa Veterinary College for treatment and the rest of the animals were treated in and around Bhubaneswar city by field veterinarians. A detailed clinical examination revealed that seven cases were having knee

Table 1 -showing clinical status of experimental animals before experiments.

Sl.No.	Sex	Breed age	Body wt. (KG).	Temp. in (^{o}F)	Pulse rate per minute.	Resp.rate per minute
1.	M	Jersey 3 months	38	100.8	58	21
2.	F	Jersey 6 months	46	101.0	58	22
3.	M	Jersey 9 months	64	101.2	54	19
4.	M	Country breed 1½ years	48	101.4	52	20
5.	M	Country breed 2 years	54	102.2	48	18
6.	M	Country breed 2½ years	58	101.4	52	19

joint disorders and the other five were having hock joint disorders. Nine of these animals were previously treated by local veterinarians. The details about these clinical cases have been enlisted in Table No.2.

The history of the clinical cases includes duration of illness, sign of traumatic injury and details of previous treatment. Initially, the body weights of the animals were recorded. Then the animals were throughly examined during rest and movement. The affected joints were palpated to record the characteristics of the swellings, pain and inflammation. Samples of joint fluid were collected from distended joints by strict aseptic aspiration for laboratory analysis.

Collection and preservation of synovial fluid samples

The anterior surface of the knee joints and anteromedial surface of hock joints were subjected to surgical toilet. In the cases where joint capsule was distended, fluid was collected by puncturing at the most prominent portion of the swelling. The fluid oozed out spontaneously through the needle, whereas,

Table 2 showing details information of clinical cases.

Sl. No.	Breed	Approximate age (years)	Sex	Body weight (Kg)	Approximate duration in months	Joint involved	Type of flooring	Previously treated or not
1.	Jersey	6	F	352	1½	Left hock	Hard	No
2.	Jersey	4½	F	280	3	Left knee	Hard	Yes
3.	Jersey	5	F	245	1	Right knee	Hard	Yes
4.	Jersey	2½	F	160	½	Both knee	Ear then	Yes
5.	Country breed	5	F	160	2	Right hock	Earth en	Yes
6.	Country breed	3½	M	210	1½	Right hock	Ear then	Yes
7.	Jersey	3	F	190	1	Right hock	Hard	No
8.	Jersey	4½	F	210	1	Left knee	Hard	No
9.	Country breed	6	F	290	1	Left knee	Hard	Yes
10.	Country breed	5½	M	280	2	Left knee	Hard	Yes
11.	Country breed	5	M	270	2½	right hock	Hard	Yes
12.	Jersey	4	F	190	12	left knee (Traumatic)	Hard	Yes

in the cases where the joint capsule was not markedly distended, fluid was aspirated by a sterilised glass syringe. In the cases of disorders of knee joint, fluid from the radiocarpal and intercarpal joints were collected separately. A sterile 18 gauge, 10 cm long needle was employed for collection of fluid from the joints. In order to approach hock joint, a needle was passed at the anteromedial aspect of the hock over the most prominent portion of the joint capsule avoiding the saphenous vein. The joints were flexed to facilitate the collection of fluid as and when was necessary.

The synovial fluids were collected in sterile test tubes. Subsequently, a portion of each sample was transferred to one test tube without anticoagulant and some amount to another test tube containing Ethylene Diamino tetraacetic acid (EDTA). Thus, from each animal three samples were collected. The sample of the first tube was employed for bacteriological investigation. The tube containing sample without anticoagulant was subjected to observe the colour, consistency and clot formation. The results have been recorded immediately after collection. Further, the samples without anticoagulant were centrifuged at appropriate rotations

per minute for 30 minutes. The supernatant fluid was separated and preserved in the freezing chamber of a refrigerator for mucin precipitation test and estimation of levels of sodium and potassium. A portion of the raw fluid was kept for uric acid estimation. The samples collected with anticoagulant were used for estimating the differential count. A portion of the raw fluid was kept for total erythrocyte and total leucocyte count. Then the rest of the fluid were centrifuged. The supernatant fluid was separated and preserved for estimation of glucose and total protein. The sediment was utilised for differential leucocyte count.

Collection of serum

Five millilitres of blood was collected from the jugular vein of each animal in sterile test tubes. Serum from the blood was collected and was centrifuged. This was preserved for estimation of glucose and uric acid.

Plain and contrast arthrography was conducted in experimental animals in anteroposterior, posteroanterior, lateromedial, mediolateral and latero oblique positions using 57-72 KV and 14-32 MaS. The thickness of joints varied from 4.5 - 7.0 cms. in normal cases. In clinical

cases the radiographs were taken in anteroposterior, posteroanterior, lateromedial, and mediolateral views using 66-76 Kv and 15-22.5 MaS. The thickness ranged from 7-11 cms.

Contrast media was attempted with air, 5% paraffiniodine and conray (Iothalamate) 420 supplied by May and Baker Ltd. These media were injected into knee joint in the anterior surface by observing aseptic methods. In the cases of hock joint, the media were injected at the anteromedial aspect of the joint immediately over the most prominent portion of the joint capsule after maintaining conventional aseptic precautions. The media was injected in knee joints at two sites, (i) into the radiocarpal joint and (ii) into intercarpal joint, after aspirating out as much of synovial fluid as was possible. The media was injected in hock joint at one site after aspirating out the synovial fluid. The amount as dose of air was 10-20 ml and that of 5% paraffin-iodine was 5-10 ml in each joint. Radiographs were taken immediately after the media were injected. The dose of conray ranged from 10-20 ml according to the size of the joint. Immediately after conray was injected the animals were allowed a light walk for 3 minutes for even distribution of the media

following which radiographs were obtained.

Angiography was attempted in experimental animals in order to study the pattern of vascularity using conray as the contrast medium. Median artery was selected for injecting contrast media for the purpose. Median artery above the knee joint and 1½ inch below the elbow joint on medial aspect was exposed and conray-420 was injected in to it through a catheter. After a lapse of one minute radiographs of knee joint were taken. The dose of conray employed was 5 ml. A tourniquet was applied above the point of injection. The KV that was employed was 57, mas 26 as the thickness ranged from 5.5 to 6 cms. Plain radiography was performed in clinical cases to observe the changes.

Analysis of Synovial fluid

Immediately after collection of synovial fluid samples from each animal the quantity, appearance, viscosity and colour were recorded.

The pH of the samples were estimated with the help of British drug house, pH paper and were recorded.

The synovial samples, which were collected without anticoagulant, were centrifuged and the supernatant fluid was used to test the mucin precipitation quality according to the procedure recommended by Vanpelt and Conner, (1963_a). The quality of the precipitates were classified as advocated by Vanpelt,(1970) and are detailed below:-

Normal - Tight, ropy clumps in clear solution

Fair - Soft mass in a light turbid solution

Poor - Small friable mass in a turbid solution

very poor - Few flakes in a very turbid solution

According to Vanpelt, (1970) numerical values as stated below were assigned to each of the above for statistical purposes.

Category		Assigned value
Normal	..	4
Fair	..	3
Poor	..	2
Very poor	..	1

Bacteriological Investigations

The synovial fluid samples collected from

each animal for bacteriological study were cultured in nutrient broth of 1.3 percent and were incubated at 37°C for 24-48 hours. The microbial growths were carefully observed adhering to the suggestions by Cruick shank et al (1975).

Morphological Identification

The slides, prepared from cultures, showing positive growth were stained with Gram's stain and diagnosis was made basing on morphological and staining characters as per the opinions of Merchant and Packer,(1967).

Cytological study

The total leucocyte and total erythrocyte count of each sample were estimated from the synovial samples which were collected with anticoagulant . The fluid was diluted in a centrifuge tube with white blood corpuscle diluting fluid and in another tube with red blood corpuscle diluting fluid. The rate of dilution in both was 1 : 10 . These diluted samples were centrifuged. Supernatant fluids were discarded and the residue were examined for counting Leucocytes and ertythrocytes using haemocytometer.

Smears of synovial fluid, collected with anticoagulant were drawn immediately after collection on grease free clean microslides. The smears were fixed with methyl alcohol for 5 minutes and then stained with Giemsa stain of 1:10 dilution for 45 minutes. One hundred leucocytes were identified and counted for each samples.

Biochemical studies

Sodium and Potassium:

The supernatant fluids after centrifuging the synovial fluids collected without anticoagulant were utilised for estimation of levels of sodium and potassium, using the E.E.L. flame photometre (Wootton,1964).

Uric acid:

The uric acid values were estimated from the serum and synovial fluid samples collected without anticoagulant as per the procedure described in spectron-20 mannual, (1965), using the spectron-20 apparatus.

Glucose:

The supernatant fluid of the centrifuged synovial samples which were collected with anti-coagulant

were exposed to evaluate the concentration of glucose according to the procedures mentioned in spectronic-20 mannual (1965). The concentration of glucose of the respective serum samples were similarly estimated within two hours of its collection using spectron-20 apparatus.

Total Protein:

The supernatant fluids of the centrifuged synovial samples which were collected with anticoagulant were used for estimation of total protein as per the methods documented in spectron-20 mannual (1965) using bovine albumin as standard in the concentration of 0.5 grammes per 100 milliliter.

The mean values of each parameters were statistically analysed for analysis of variance basing on the principles of Snedecor and Cochran, (1967).

* * * * * * *

CHAPTER-IV
RESULTS

R E S U L T S

The twelve clinical cases which were investigated in this study had joint disorders like bursitis, arthritis and tenosynovitis. The details of the clinical cases relating to their age, sex, breed, body weight, joints affected and duration have been presented in Table -2.

History of clinical cases

According to the reports of the Owners, the duration of the joint affections varied from 15 days to twelve months. Nine animals were reported to have received previous treatment with tetracyclines, corticosteroids, aegipyrine, berenil intramuscularly and surgical treatment (Table-3). It was recorded that the rest of the animals did not receive any treatment except hot fomentation and application of counter irritants (Table-3). The flooring which was provided to nine animals were reported to be hard and were made of either stone or concrete, whereas, the rest of the animals were maintained on earthen flooring (Table-2).

Case No.	Joint affected	History: Duration	History: Previous treatment	Locations of swellings.	'Degree' of lameness	Signs of inflammation	Tenderness	consistency of swelling.	Effusion	Tentative diagnosis
1.	Left hock	1½ months	Not given	Medial, laternal and anterior aspect	Mild	Absent	Present	Soft	Present	Bursitis
2.	Left knee	3 months	Hosta costin H I/m.	Medial, laternal and anterior aspect.	Mild	Absent	Present	Soft	Present	Bursitis
3.	Right knee	1 month	Egypy rini and oxyste ctin I/m.	Medial, lateral and anterior aspect.	Mild	Mild	Present	Soft	Present	Arthritis
4.	Both knees	15 days	Berenil I/M.	All sides except anterior aspect	Moderate	Mild	Absent	Mild hard	Absent	Arthritis
5.	Right hock	2 months	Egypyrin I/M.	Lateral aspect	Mild	Absent	Present	Soft	Present	Bursitis.
6.	Right hock	1½ months	Oxysteelin and Hosta-cortin-H I/M.	Lateral aspect	Moderate	Present	Present	Soft	Present	Bursitis.
7.	Right hock	1 month	not given	Lateral and medial aspect	Severe	Present	Absent	Firm	Absent	Tenosynovitis
8.	Left knee	1 month	Not given	medial aspect	Moderate	Present	Absent	Firm	Absent	Tenosynovitis.

.../...

Table 3: Showing findings of Clinical examination of affected animals.

Case no	Joint affected	History: Duration.	History: previous treatment	Location of Swellings.	'Degree' of lameness	Signs of inflammation.	Tenderness	Consistency of swelling	Effusion	Tentative diagnosis.
9.	Left knee	1 month	Esgyprin I/m.	Medial aspect	Moderate	Present	Absent	Firm	Present	Bursitis
10.	Left knee	2 months	Oxystoclin and Hostacortin-H I/M.	Medial and lateral aspect	Moderate	Present	Present	Soft	Present	Arthritis
11.	Right hock	2½ months	Hostacortin-H I/m.	Medial and Lateral aspect	Moderate	Present	Present	Soft	Present	Arthritis.
12.	Left knee	12 months	Wound sutured and Dicrysticin I/m. with dressing.	All sides, leg bent backwards.	Walking on three legs.	Present	Absent	Firm	Present	Traumatic arthritis.

The animals had no history of receiving traumatic injury at the affected joint or naval ill except one case which had injury caused by feeding trough. This animal was treated both medicinally and surgically. Subsequently the animal gradually showed flexion of the knee joint and the limb did bend backwards (fig.4) resembling knuckling.

Clinical findings

The findings of clinical examination of each case have been summarised in Table-3. All the affected cases showed swelling of the joint. Arthritis of knee and hock joints were observed in five cases with swelling on all sides except posterior aspect of knee joint in one case and anterior aspect of knee joint in one case. In two out of these five cases, swelling was found in medial and lateral aspects, whereas,in one case the swelling was found all around the joint along with oozing. All these cases had inflammation varying from mild to moderate degrees. Amongst these five animals swellings were soft in three animals, moderately hard in one and hard in another. The lameness was found to be mild in one, and moderate in four out of these five animals. Effusion was observed

Fig - 3

Fig - 4

in all these five cases except in one animal. The swellings were palpated to be tender in all these animals except one case (Table-3).

Bursitis of hock was observed in three animals. The swelling was found to be on the medial, lateral and anterior aspect in one case (Fig-3) while in two other animals it was only on the lateral aspect. Mild lameness was recorded in two animals and moderate lameness in one out of these three animals. Inflammation was not observed in two cases but it was found to be moderate in one case. The bursitis developed within a periodd of 1½ to 2 months. Synovial effusions were present in all these three cases (Table-3). One did not receive any treatment while in another case it was treated with esgipyrine intramuscullarly and the remaining one was treated with Oxysteclin and Hostacortin-H intramuscularly.

Bursitis of knee jointswere observed in two cases affecting the left knee in both. The condition developed within 1 to 3 months inspite of treatment with Hostacortein-H and Esgipyrine (Table-3). Swelling was observed to be on medial and lateral side and slight swelling on anterior aspect in one case. In the

other one it was localised on the medial aspect only with moderate lameness. The sign of inflammation was absent in one with mild lameness but in the other inflammation and moderate lameness was present. The swelling was soft in one but was firm in the other animal. Effusion was present in both these cases.

Two animals were found to have tenosynovitis of right hock and left knee with firm swelling on lateral and medial aspects in one and only on medial aspect in the other case. The swelling app-eared within a period of one month in both the cases. Lameness was moderate in one case whereas it was severe in the other. Inflammation was present in both these cases. Treatment was not given to either of these cases.

Radiography

Plain and contrast radiographs of normal knee and hock joints of six experimental animals were obtained. An attempt to determine the standard exposure factors in case of local breeds was made. The details of these have been presented in Table-4.

Different views were tried for knee and hock joints. The KV and MaS were calculated according to the

Table-4: showing details of exposure factors employed in knee and hock joint radiography and angiography of normal and affected animals.

Group of animals	Animal No.	Age	Body wgt. in kg.	Joint	Thickness of joint in cms.	View	KV	Mas	Plain or contrast.	Remarks
Control	1	3 months	38	Rt. knee	(5	A.P.	63	16	Plain	Good
					(4.6	L.M.	63	14	Plain	Good
	2	6 months	46	Lt. knee	5	A.P.	63	14	contrast (air) 40cc	Poor
					4.8	L.M?	63	14	Plain	Good
					5	Oblique	63	16	Plain	Good
					5	P.A.	63	16	Plain	Good.
	3	9 months	64	Rt. knee	6.5	A.P.	72	18	Plain	Good
					6.5	L.M.	72	19.5	Plain	Good
	4	1½ years	48	Lt. knee	5.5	L.M.	63	16	Plain	Good
				Rt. knee	5.5	A.P.	66	18	Contrast with 5% Iodine paraffin 10cl	Poor
				Rt. knee	5.5	A.P.	69	16.5	contrast with 50 cc air.	Poor
	5	2 years	54	Rt. hock	6	A.P.	57	24	Plain	Good
					6	L.M.	57	26	Plain	Good
					6	M.L.	57	24	Plain	Good
					6	A.P.	57	32	Contrast with 50 cc air.	Poor

Table 4: showing details of exposure factors employed in knee and hock joint radiogfaphy and ax angiography of normal and affected animals.

Group of animals.	Animal No.	Age	Body wt in kg.	Joint	Thickness of joint in cms.	View	K.V.	Mas	Plain or contrast.	Remarks
Control	6	2½ years	58	Lt.knee	5.5	M.L. (flexed)	57	32	Plain	Fair
					5.5	M.L.	63	16	contrast with air 50 cc	Poor
					5.5	M.L.	70	20	contrast with air 60 cc	Poor
				Rt.knee	5.5	A.P.	69	18	contrast with 5% iodine lig.paraffin 10 cc.	Poor
					5.5	A.P.	72	18	contrast with 10% iodine liquid paraffin 10 cc.	Poor
Control	5	2 years	54	Rt.knee	6	A.P.	57	26	Angiography by injecting 10 cc conray into median artery.	Fair
					6	M.L.	57	26		
Affected.	1			Lt.hock	11	A.P.	72	19.5	Plain	Fair
	4			Lt. hock	7	A.P.	72	22.5	Plain	Fair
	12			Lt. hock	7	M.L.	72	15	Plain	Good

N.B. A.P. - Antero posterior P.A. Postero anterior
L.M. Latero medial M.L. Medio lateral.

thickness of the joints. In order to obtain a three dimensional visulisation a minimum of two exposures like antero posterior (Fig-5) and Latero-medial (Fig-6) were found to be most beneficial as it did expose the joint capsule, the joint space, the contours of the bones involved in the joints and their normal position. An Anterolateral oblique radiograph of knee joint (Fig.7) did not reveal individual bones and joint spaces. The structures were found to be overlapping. However a flexed view (Fig.8) of knee joint exposed the joint spaces and anticular surface to a better degree. The anteroposterior radiograph of hock exposed the joint fairly well (Fig-9).

Contrast radiographs were taken using air (Fig.10) and 5 percent Iodine paraffin (Fig.11) as the contrast media which did not give better exposure. Plain radiographs were found to be better.

Angiography was also tried to study the vascular pattern of knee joint which gave a fairly good exposure of the course of the median artery (Fig.12) and the dorsal carpal branch anastomosing on the dorsomedial aspect of carpal joint (Fig.13)

Fig. 5

Fig-6

Fig-7

Fig - 8

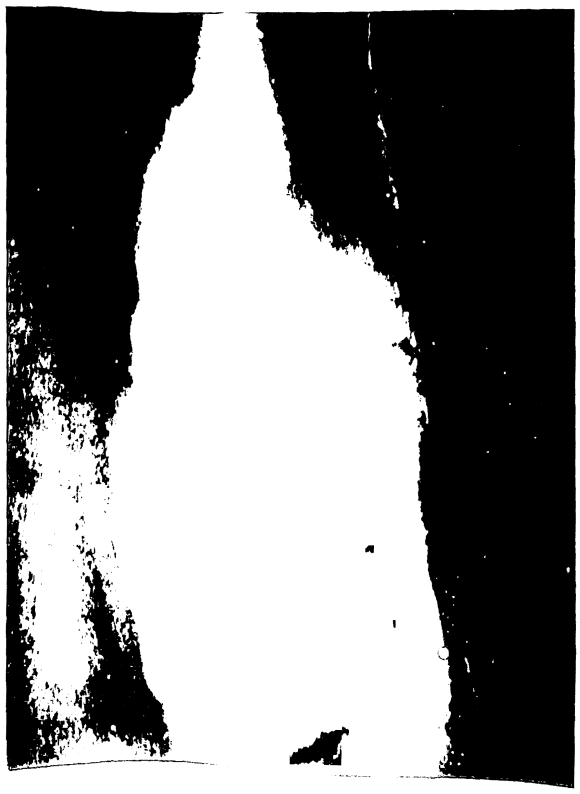

Fig - 9

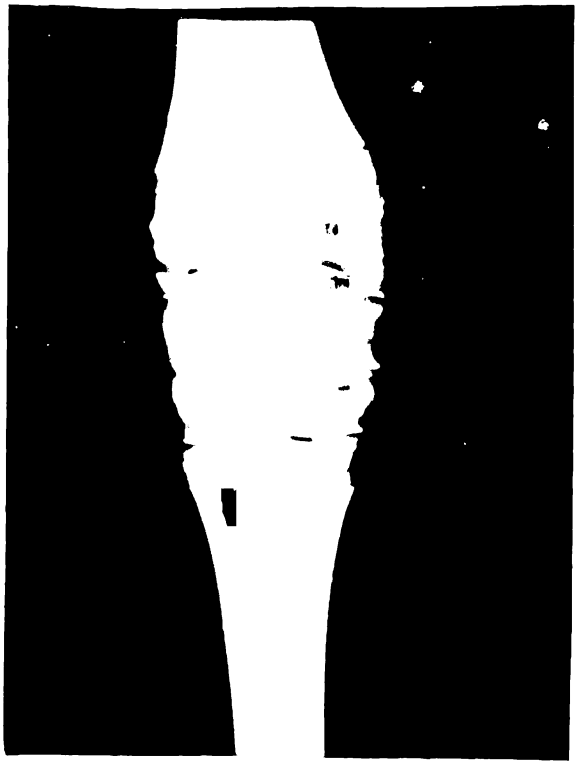

Fig. 10

Fig. 11

Plain radiography of three clinical cases presented at the clinic were taken. In one aseptic case a distinct swelling of the soft tissue was seen on radiography of left hock joint (Fig.14). There was no involvement of the joint capsule or the articulating bones suggesting it to be a case of tarsal false bursitis. Antero posterior view was found clear in this particular case.

It was seen that in one septic case (Fig 15) moderate soft tissue swelling was present on anteroposterior view. Bony proliferation or new bone grouth was not marked. This suggested that it was an early case of arthritis. Fracture was not observed and there was no reduction of joint space.

In another septic case mediálateral and posteroanterior radiographic views revealed the presence of abnormal new bony proliferations all round the joint and involving the bones. Soft tissue swelling was also observed in this case. In the radiograph obtained in the flexed position of the joint new bony proliferations were found to have encroached the carpal joint spaces (Fig.16). However, osteoarthritic changes were clear. This particular animal sustained a trumatic injury on the anterior surface of the knee joint a year back as was reported by the owner.

Fig - 12

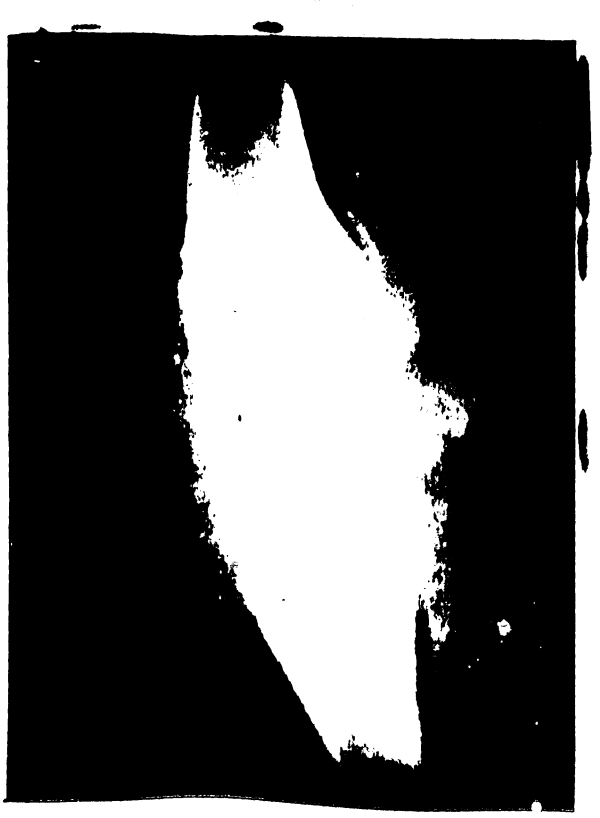

Fig - 13

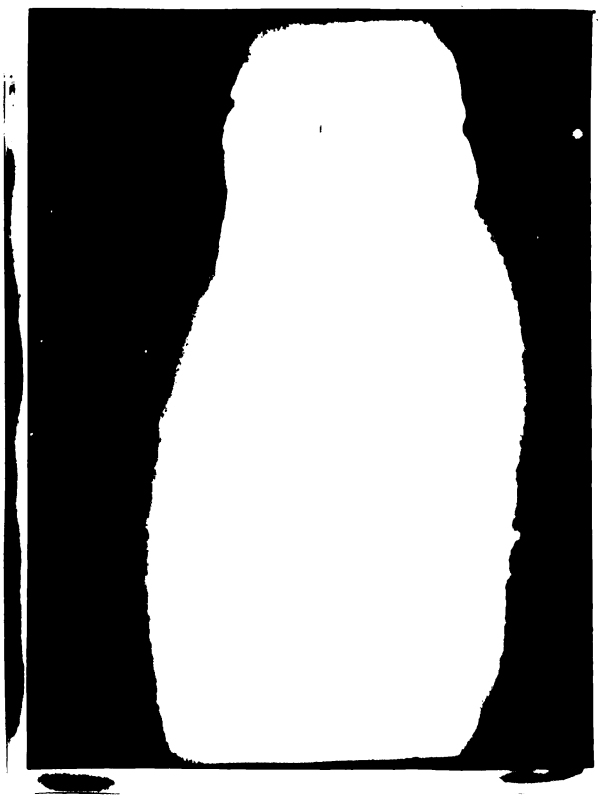

Fig - 14

Fig - 15

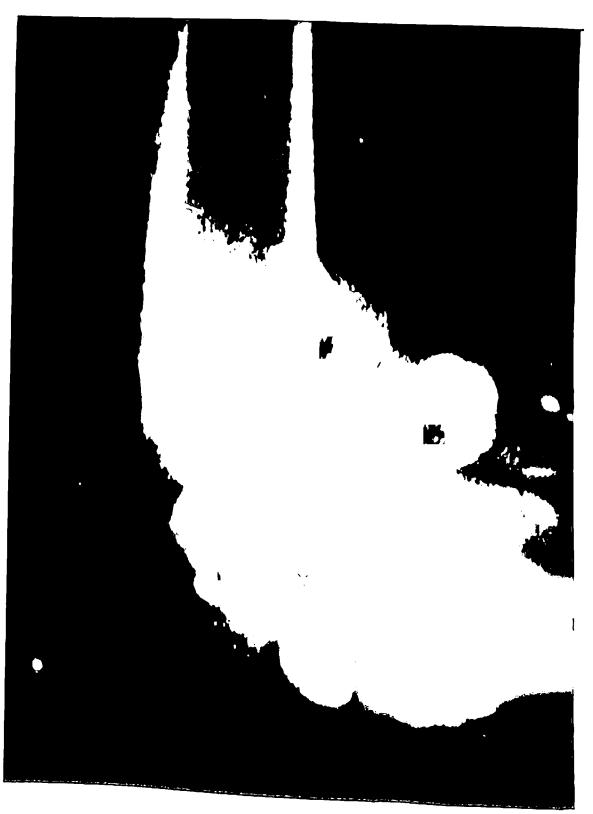

Fig - 16

Any corelation between age, body, weight and requirement of KV and MaS could not be established in the present study.

Synovial fluid analysis

a) Physical characters:-

The synovial effusions were classified as aseptic and septic according to bacterial culture results. Synovial samples from three affected animals did not show growth on nutrient both culture and hence were considered to be aseptic. The rest nine samples showed growth on culture and were considered to be septic. (Table.5). The findings of the physical characters of synovial fluids from the joints of healthy experimental animals and affected ones have been presented in Table-6. The physical characters include appearance, pH, volume, and mucin precipitation quality.

(i) Appearance:-

In the normal animals the effusions of all the six samples were found clear and colourless.

The synovial effusions of three cases which were accepted to be aseptic appeared

Table 5 showing results of bacteriological culture test of synovial fluids from affected joints.

Case no.	Culture Results	Organisms identified	Tentative diagnosis.
1.	No growth	-	Aseptic bursitis
2.	Positive	Staphylo coccus	Septic bursitis
3.	Positive	Staphylo coccus	Arthritis
4.	Positive	Staphylo coccus	Arthritis
5.	Positive	Klebsiella	Bursitis
6.	Positive	Staphylo-Coccus	Bursitis
7.	Positive	Staphylo coccus	Tenosynovitis
8.	Positive	Klebsiella	Tenosynovitis
9.	No growth	-	Aseptic bursitis
10.	No growth	-	Aseptic Arthritis
11.	Positive	Klebsiella	Arthritis
12.	Positive	Staphylo coccus	Septic arthritis.

N.B. All the six control samples showed no growth on culture.

pale yellow in one and reddish clear in the other two samples. In the septic group of nine animals the fluids were turbid and pale yellow in two while it was light reddish and turbid in three other cases. In the rest four cases the fluid was clear and the colour varied from light yellow to reddish (Table-6).

(ii) Volume:

In the normal samples the volume ranged from 2 -4.5 millilitre, the mean being 3.4 ± 0.45 millilitre.

In the aseptic group the volume of synovial fluid varied from 6-6.5 millilitre with a mean of 30.6 ± 17.7 millilitre, while in the septic group the volume ranged from 4-14 millilitre with a mean of 8.1 +_ 1.36 millilitre (Table-6).

(iii) pH:

The pH of synovial fluid from the control group ranged from 7.6 to 8.2 with a mean of 7.93 +_ 0.09.

The pH of synovial fluid which were collected from the aseptic group varied from 6.6 to 7.2 with a mean of 6.86 ± 0.17 whereas,

the pH in the septic group ranged from 6.4 to 7.2 with a mean of 6.73 ± 0.09 (Table.6).

(iv) Mucin Precepitation test:

The test revealed that in all the six normal samples from control group there was normal clot formation but in the clinical cases the mucin precepitation quality varied from fair to very poor (Table.6).

In the aseptic group the mucin precipitation quality in one case was fair, in other two it was poor. Similarly in the septic group in two cases it was fair, but was very poor in another animal while in the rest of the six cases it was found to be poor in quality.

Thus, the mean assigned value of the normal samples was 4 whereas the average assigned values of the fluid samples of the aseptic and septic groups were 2.3 ± 0.33 and 2.1 ± 0.19 respectively.

(b) Bacteriological findings

The synovial fluid samples from all the six experimental animals and the twelve clinical cases

were subjected to bacterial culture test. The synovial cultures in nutirent broth on incubation at 37^{0}C for 24 to 48 hours revealed that all the samples from the joints of experimental control animals did not show any growth.

Out of the twelve clinical samples nine samples were found to be positive for bacterial growth while the remaining three were found negative even after 48 hours of incubation. (Table.5). The samples which were negative for bacterial growth were classified as aseptic and those in which growth occured were classified as septic group. Out of these positive samples staphylo coccus was identified in four, strepto coccus in two and Klebsiella in three cases. (Table.5).

(c) Cytological findings:-

Total erythrocyte count, total leucocyte count and differential leucocyte count of the synovial fluid samples from six normal and twelve affected joints were conducted and the findings have been presented in Table-7.

(i) Total erythrocyte count:-

The mean levels of total erythrocyte count (TEC)

Group	Case no.	'Appearance'	Amount of fluid collected in c.c.	pH	Mucin precipitation quality: Description	Mucin precipitation quality: Assigned value.	Synovial fluid collection site
Control	1	Clear and colourless	2	8.2	Normal	4	Left knee
	2	Clear and colourless	3	8.0	Normal	4	Right knee
	3	Clear and colourless	4	7.8	Normal	4	Right hock
	4	Clear and colourless	4.5	7.6	Normal	4	Right knee
	5	clear and colourless	3.5	7.8	Normal	4	Right knee
	6	clear and colourless	3.5	8.2	Normal	4	left hock.
	Average ± S.E.		3.4 ± 0.45	7.93 ± 0.09		4	
Aseptic	1	Pale yellow	65	6.6	Fair	3	Anterior medial aspect of left hock.
	9	Clear and reddish	6	7.2	Poor	2	Anterior aspect of left knee.
	10	Clear and reddish	21	6.8	Poor	2	Anterior aspect of left knee.
Average ± S.E.			30.6 ± 17.7	6.86 ± 0.17		2.3 ± 0.33	
Septic	1	Pale yellow slight turbid	6	6.8	fair	3	Anterior aspect of left knee.
	3.	Pale yellow slight turbid	4	6.8	Poor	2	Anterior aspect of right knee.
	4.	Reddish clear	4	7.0	Fair	3	Anterior aspect of right knee.
	5	Light yellow clear	6	6.8	Poor	2	Anterior aspect of right hock
	6.	Light yellow clear	12	6.6	Poor	2	Anterior aspect of right hock
	7.	Reddish turbid	14	7.2	Poor	2	Anterior aspect of right hock
	8.	Reddish turbid	14	6.4	Very poor	1	Anterior aspect of left knee
	11.	Light yellow clear	7	6.6	poor	2	Anterior medial aspect of right hock.
	12.	Reddish turbid	6	6.4	Poor	2	Anterior aspect of left knee
Average ± S.E.			8.1 ± 1.36	6.73 ± 0.09		2.10 ± 0.19	

Table 7 showing Result of cytological examination of Synovial fluids from normal and affected joints.

Parameters	Normal fluid Mean ± S.E.	Aseptic fluid Mean ± S.E.	Septic fluid Mean ± S.E.
Erythrocytes (Million/cmm.)	± 0.14 0.02 (6)	± 0.18 0.08 (3)	± 0.51 0.20 (9)
Leucocytes (per/cmm.)	± 1283.30 58.72 (6)	± 2011.60 719.93 (3)	± 8013.30 1602.53 (9)
Neutrophills %	± 30.30 4.23 (6)	± 6.0 1.53 (3)	± 57.60 8.16 (9)
Degenerated neutrophills %	± 8.30 1.41 (6)	± 17.60 2.20 (3)	± 13.40 3.24 (9)
Lymphocytes %	± 48.10 1.51 (6)	± 11.60 0.88 (3)	± 8.44 2.02 (9)
Degenerated Lymphocytes %	± 4.30 1.64 (6)	± 27.00 0.58 (3)	± 4.90 3.56 (9)
Unclassified degenerated cells %	± 4.30 0.84 (6)	± 28.30 0.67 (3)	± 11.20 1.97 (9)
Degenerated monocytes%	± 2.50 0.31	± 9.00 0.58	± 3.00 1.04
Eosino phills%	± 2.00 0.81	± 0.30 0.33	± 1.30 0.33

Figures in parentheses indicate number of joints studied.
S.E. Standard error.

in control, aseptic and septic groups were 0.14 ± 0.02 millions/cmm., 0.18 ± 0.08 millions/cmm and 0.51 ± 0.2 millions/cmms. respectively.

(Table 8). The highest T.E.C. recorded was 1.8 million/cmm in one septic case. The lowest was 0.06 millions/cmm in one aseptic case. In one case of the control group the T.E.C. was also 0.06 millions/cmm.(Table-7).

(ii)Total leucocyte count:-

In the control, aseptic and septic groups the mean total leucocyte count (TLC) were 1283.30 ± 58.72/cmm, 2011.60 ± 719.93/cmm and 8013.30 ± 1602.53/cmm. respectively. The septic fluid samples revealed marked leucocytosis as compared to aseptic fluids (Table-7).

(iii) Differential leucocyte count:

Lymphocytes with degenrated lymphocytes, neutrophills with degenerated ones, unclassified degenerated cells, degenerated monocytes and ecsinophills were observed on differential count, (Table-7).

The samples of normal control group showed a higher percentage of lymphocytes followed by

Table 8:- showing Result of biochemical analysis of serum and synovial fluid of knee and hock joints of normal and affected joints.

Parameters	Normal group Mean ± SE	Aseptic group Mean ± SE	Septic group Mean ± SE.
Serum glucose (Mg/100 ml)	44.00 ± 1.54 (6)	44.90 ± 0.87 (3)	47.30 ± 1.02 (9) NS
Synovial glucose (mg/100 ml.)	41.5 ± 0.78 (6)	11.80** ± 5.93 (3)	14.85** ± 5.08 (9)
Serum uric acid (mg/100 ml.)	0.82 ± 0.12 (6)	1.22 ± 0.27 (3)	1.20 ± 0.05 (9) NS
Synovial uric acid (mg/100ml.)	0.67 ± 0.10 (6)	1.30** ± 0.19 (3)	1.43 ** ± 0.11 (9)
Synovial total protein (gm%)	2.25 ± 0.11 (6)	7.40** ± 1.80 (3)	10.55** ± 1.02 (9)
Synovial sodium (mEq./L)	126.30 ± 11.84 (6)	129.30 ± 4.63 (3)	135.50 ± 2.05 (9) NS
Synovial Potassium (mEq./L.)	3.90 ± 0.31 (6)	3.90 ± 0.67 (3)	4.50 ± 0.31 (9) NS

Figures in parentheses indicate number of animals investigated

** indicates significance at 1% level.

NS. denotes not significant.

S.E. standard error.

neutrophills. The samples of aseptic group revealed a higher percentage of degenerated cells as compared to other two groups. It had the highest percentage of unclassified degenrated cells with 28.30 ± 0.67 % followed by degenerated lymphocytes with 27.00 ± 0.58% and degenerated nutrophills showing 17.60 ± 2.02%. In contrast the septic fluids showed the highest percentage of nutrophills as compared to other cells (Table 7)

(d) Biochemical findings:--

(i) Glucose:-

The serum and synovial glucose levels relating to six normal and twelve clinical animals were studied to note the differences. The findings have been incorporated in table -8.

The serum glucose and synovial glucose concentration of normal animals ranged from 39.4 to 48.6 mg/100 ml. and 39.4 to 42.8 mg/100 ml. respectively with a mean value of 44.00 ± 1.54mg/10

and 41.5 ± 0.78 mg/100 ml respectively. Thus the mean difference in this group between the serum glucose and synovial glucose concentration was found to be 2.50±0.82 mg./100 (Table 8).

The mean values of serum and synovial glucose levels in the aseptic group were 44.90 ± 0.87 mg./100ml. and 11.80± 5.93 mg/100ml respectively having a mean difference of 33.10 ± 5.86 mg./100 ml. (Table-8).

The mean values of serum and synovial glucose of the septic group of animals were 47.30 ± 1.02 mg/100 ml. and 14.55± 5.08 mg/100ml. respectively (Table-8) with a mean difference of 32.70 ± 4.95 mg./100 ml.

Synovial fluids collected from one case each of aseptic and septic group of animals did not reveal any glucose content.

The difference of serum glucose concentration between the normal, aseptic and septic groups was not statistically significant (Appendix-I).

In contrast, the synovial glucose concentrations of both aseptic and septic groups were significantly lower ($p < 0.01$) than the normal synovial glucose level although, the difference in synovial glucose concentrations of aseptic and septic groups

was not statistically significant (Appendix-II).

The difference between serum glucose and synovial glucose concentrations of the control group analysed by paired 't' test revealed that the variance was not statistically significant, whereas a similar test to asses the differences between the serum and synovial glucose concentration of affected animals was found to be highly ($P < 0.01$) significant. (Appendix III).

(ii) Total protein:

The synovial fluid samples collected from knee and hock joints of six normal control animals revealed a mean total protein concentration of 2.25 ± 0.11 gm. percent while in similar fluids from aseptic and septic groups the mean concentrations were 7.40 ± 1.80 gm. percent and 10.55 ± 1.02 gm. percent respectively. (Table-8).

The analysis of variance of synovial total protein of both aseptic and septic groups revealed that the increase in the concentration of total protein in the synovial fluids from

knee and hock joints of both the groups as compared to normal levels were highly ($P < 0.01$) significant. However, the difference in total protein concentrations of both aseptic and septic groups was not statistically significant (Appendix VII).

(iii) Uric acid:

Uric acid concentrations of both serum and synovial fluids from knee and hock joints of six normal and twelve clinical cases were estimated to study the differences.

The mean concentrations of serum and synovial uric acid of the control group were 0.82 ± 0.12 mg./100 ml. and 0.67 ± 0.10 mg./100 ml. respectively. (Table-8).

In the aseptic group the uric acid concentration in serum ranged from 0.9 to 1.65 mg./100ml. with a mean concentration of 1.22 ± 0.27 mg/100 ml. while in the same group the concentration of uric acid in synovial fluid ranged from 1.10 to 1.70 mg./100ml. with a mean of 1.30 ± 0.19 mg./100 ml.(Table.8). The uric acid concentration in serum and synovial fluid of septic group of animals had a

mean concentration of 1.20 ± 0.05 mg./100 ml. and 1.43 ± 0.11 mg./100 ml. respectively.

The analysis of variance revealed that the increase in the synovial uric acid concentration was found to be significantly (P < 0.01) higher than the normal synovial uric acid concentration (Appendix V) whereas, it was not statistically significant in serum of both aseptic and septic groups (Appendix IV) as compared to the normal concentration. However, the difference between the uric acid concentrations of both aseptic and septic groups were not statistically significant (Table 8).

Paired 't' test between the differences of serum and synovial uric acid concentrations of normal animals revealed the variance to be not signficant whereas the same test between the differences of serum and synovial uric acid concentrations of affected cases revealed a significantly (P< 0.01) higher concentration of uric acid in the synovial samples.(Appendix VI).

(iv) Sodium and Potassium:-

In the control group the mean values of

sodium and Potassium were 126.30 ± 11.84 MEq./L. and 3.30 ± 0.31 MEq./L. respectively. The mean sodium and potassium concentrations in the aseptic group were 129.30 ± 4.63 MEq/L and 3.90 ± 0.67 MEq./L. respectively while the mean corresponding values in the septic group were 135.50 ± 2.05 mEq./L. and 4.5 ± 0.31 MEq./L. respectively (Table-8).

The difference in synovial sodium and potassium concentrations of all the three groups were not statistically significant (Appendix VIII & IX) though the mean concentrationsof both sodium and potassium were higher in the septic group than the other two groups (Table-8).

* * * * * *

CHAPTER-V
DISCUSSION

D I S C U S S I O N

One of the fundamental characteristics of an animal is motion in which the joints are actively involved. The cartilage covering the articular surface in synovial joints is mainly, though not exclusively, of hyaline Variety. The articular cartilage is closely moulded and is adherent to the bony surfaces. The extent of the cartilage on a particular surface bears a close relation to the degree of movement of the part and prolongation of the cartilage covered surface are generally associated with an increased mobility in that direction. In young animals, prolonged exercise leads to an increase in thickness (Holmdahl and Ingelmark, 1948 and Sääf, 1950).

During movement of joint, the articular cartilagesundergo very slow wear and tear. Dry joint surface are readily eroded and reduction in viscosity

of synovial fluid by enzymatic means accelerates the wear and tear (Barnett et al., 1961).

The joint disorders like arthritis, bursitis and tenosynovitis are the common causes of lameness in cattle which not only reduces the value of the animals but also hinders the agricultural operations of farmers. This is of more occurence in cross bred animals. The causative agent, in all these cases, has not been established, as yet.

Bursa, though close to the joint, is not a joint structure. The synovial membrane lining the joint cavity and bursal cavity are considered to be identical (Bauer et al., 1940). This has been based more on assumption than on experimentation.

An attempt has thus been made in the present investigation to evaluate the alteration in synovial fluids of affected knees and hock joints in comparison tonormal joint fluids. In order to have a precise and accurate corelation, radiographs have been taken to arrive at a diagnosis in early stages of joint disorders.

Synovial fluid from joints was first observed

by Paracelsus as cited by Frerichs (1846). They have also stated that the fluid contained in the joint cavities, tendon sheaths and bursal mucosa generally resemble each other superficially. Till today no data was available to support this view.

Studies on clinical cases

Pathophysiologic studies of joint fluids from the affected knee and hock joints and radiography of these joints were performed in twelve clinical cases in the present investigation. Initially, it was planned to study all the joints of fore and hind limbs but subsequently, the project was limited to knee and hock joints only.

Out of twelve clinical cases five each had bursites and arthritis whereas two showed tenosynovitis (Table 3). In view of the less number of clinical cases, which were available, it was difficult to record the frequency of affection with respect to a particular joint disorder.

It was seen from Table-1 that jersey calves acquired more weight at lower age than country bred

calves at even higher age. It was evident from Table-2, that out of twelve clinical cases seven were of Jersey breed. Thus it revealed that exotic animals were more prone to joint disorders due to their heavier body weights. Further, the age of the animals ranged from 2½ years to 6 years and the body weights ranged from 160 kg to 352 kg. (Table 2). One jersey animal had less body weight with a joint disease about a year back. This cow was subsequently not properly looked after which resulted in emaciation.

So far as the age of the affected animals are concerned all the animals except three were more than four years of age. This finding agrees with the observations of Greenough et al.(1972). During the course of the present study it is presumed that higher body weight may have a significant role in the causation of joint disorders due to a stretching effect following pressure as was recorded by Barnett et al. (1961).

Traumatic injury at the left knee was reported in one case only. The rest of the animals

did not have history of trauma. It was reported that the condition developed spontaneously. This might be attributed to recurrent trauma due to hard flooring as has been opined by Greenough et al (1972).

The duration of the joint diseases varied from 15 days to one year. It was probable that after some symptomatic treatment there was a temporary relief. The owners mistook it to be a recovery but when there was recurrence with lameness and swelling of the joints the treatment became imperative.

Clinical findings:-

Swellings of the affected joints varied from each other relating to their location (Table 3). The consistency of the swellings varied from soft to firm.

Among the five cases of bursitis, the affection involving the hock joint was found in two cases and of knee joint in three cases. One case was not treated previously and aspiration of fluid was not performed. Hence, there was no sign of inflammation, though mild lameness was observed. The other four cases were treated after aspiration of accumulated fluid during

which, there was reputre or puncture of joint capsule. The introduction of foreign body into the joint cavity caused inflammation of the joint with mixture of bursal and synovial fluids leading to damage to the articular cartilage. Thus,there was mild to moderate lameness. Signs of inflammation was not seen in one case. The cause may be due to strict aseptic method adopted by the attending veterinarian during aspiration of the fluid so that the joint capsule was not punctured. There was lameness which might be due to the pressure exerted by the accumulated effusions. The swellings were soft to touch in four cases but was firm in one case which may be an acquired bursitis due to constant trauma by hard flooring as has been reported by Adams (1974) in case of horses. Chronic cystic forms of bursitis with soft consistency were seen in rest of the four cases which are the commonest in occurrence according to O'Connor (1950).

In the present investigation two cases of tenosynovitis were encountered which did not have effusion and inflammation. This was in contrast with the observations of Vanpelt (1969). He observed, in tenosynovities in horses, an excessive accumulation

of transudates without any sign of inflammation. This, he stressed, are the characteristics of tenosynovitis in horses. Such difference in the findings may be due to probable difference in the origin of the condition.

Five cases had varying duration of arthritis. In all these cases different degrees of lameness, soft tissue swellings, inflammation, tenderness and pain on flexion of the affected joints were observed. This was also the opinion of Rose (1983). The consistency of effusions in these ca es varied from soft to firm. All these cases were previously treated and fluid was aspirated through puncture of joint capsule. This might have caused damage to joint capsule and articular cartilage to varying degrees resulting in carpitis and subsequently lameness. In one case effusion was not observed as it was a fresh case of serous arthritis and aspiration wasnot tried by the attending Veterinarian. Consistency of the swelling was mildly hard suggesting swelling of periarticular tissue. One case had traumatic septic arthritis. The firm consistency was possibly due to fibrosis of periarticular tissues, thickening and fibrosis of damaged joint capsule accompanied by enlargement and proliferation of new bone growths surrounding the joint (Adams, 1974).

In cases of joint diseases the volume of synovial fluid increases in the presence of inflammation. This fluid is deficient in hyalurenate and reduces the lubricating action of synovia (Rooney, 1963).

Normal synovial fluid ddd not clot at room temperature. In case of injury to the joint, fibrinogen which is normally absent, enters the synovial fluid imparting it an ability to clot. The proportion of leucocytes increases which changes the colour of synovial fluid. The viscosity increases with low mucin production and destruction of hyaluronate resulting in reduced lubricant quality of the fluid. Such reduction in lubricant quality allows more friction between the surfaces. Increased friction, in turn, destroys the articular cartilage which covers the articular surface of the bone and the bone gets exposed. As subchondral surfaces become bare, marked eburnation occurs and arthritis results (Barnett et al, 1961). The delay in removal of the cause, which occured in the animals of the present study, might have further deteriorated the condition. The treatment was delayed in all these animals whi-ch resulted in joint disorders.

Radiography:-

The usefulness of radiography has been considered to be significant for diagnosis of carpal joint disorders (Greenough et al, 1972; Adams, 1974 and Llewellyn, 1979).

Rose (1983) has recommended the antero-posterior, lateromedial and latero oblique exposures to be the standard positions during radiography. He, however, stressed that the anteroposterior view is the best for studying the articular changes. In the present study, plain radiographs and contrast radiographs using air and 5 percent paraffin Iodine as contrast media were performed. Plain radiographs exposed the contours of the bones, joint space and normal positions of the bones. It was found that the effect of contrast media did not have any excellence over plain radiography. Doughlas and Williamson (1971) have reported that pneumoarthrography seldom revealed more than that was demonstrated by a carefully positioned straight radiography. Dik (1984) has also stated that the diagnostic value of negative (air) arthrograms were poor.

In the present investigation, the antero posterior,

latero medial,posteroanterior and oblique views of the joints clearly exposed the joint structures. However, the antero posterior and lateromedial radiographic views of the joints were found to be suitable for accurate diagnosis. Rose (1983) did recommend that the anteroposterior view alone was better for evaluation of articular change which, in the present study, was found to be inadequate.

It has been observed in the clinical cases of bursitis that when the distension of the bursal sac was appreciably large, both lateromedial and anteroposterior views provided a proper exposure of the distended bursa.

The inflammation of the tendon sheath which was observed on radiography of tenosynovitis justified that the radiography is a valuable aid for differential diagnosis of this condition.

In one case of initial stage of arthritis mild degree of soft tissue swelling was observed without any change in the bone or joint space. This agreed with the observations of Pratap et al. (1977) who have

opined that during early stage of arthritis, radiography is of less importance than physical symptomatology. It was found that when the radiographical findings were corelated with the pathophysiological findings the diagnosis was accurate in this case. Vanpelt (1965) and Suntun (1984) also held the same opinion. A plain radiograph of the knee joint of one animal suffering from traumatic arthritis revealed a reduction in joint space with extensive bony proliferation around the joint. Fibrous thickening of the joint capsule and surrounding soft tissue together with the irregular contours of the bones of joint were also marked in the radiograph. The findings were similar with the observations of Rose (1983). He stated that though soft tissue swelling may be the only significant finding initially, in long standing cases a decrease in the joint space may be identified.

Angiography of knee joint was conducted in the present study in normal healthy animals. It revealed the vascular pattern of knee joint. The results can be compared with angiographs of affected joints wherein the vascular network may differ than normal joints.

Analysis of Synovial Fluid:-

(i) Physical characters:-

The tarsal and carpal synovial samples collected from six control animals were found to be clear and colourless which was also the observations of Ropes et al. (1939), and Tyagi and Krishnamurthy (1972). The synovial samples from both septic and aseptic groups of animals varied in colour from pale yellow to light reddish and in appearance clear to turbid (Table-6) in transparency, Ropes and Bauer (1953) recorded similar observations in majority of samples of human synovial fluid affected with bursitis. Lack of marked difference in the colour and appearance of the synovial fluid samples of septic and aseptic joints in the present study confirmed that bacterial infection probably had no effect on the colour and consistency. (Merkens et al, 1984), Slight variations which were observed were due to damage to synovial cells (Barnett et al., 1961).

The volume of synovial fluids collected from tarsal and carpal joints of twelve clinical cases varied remarkably. This was attributed to the fact

that the nature of the conditions varied from cystic to fibrous forms. Identical findings were also reported by O'conner (1950).

Perman and cornelius (1971) reported the normal synovial fluid to be weakly alkaline with pH ranging between 7.31 to 7.40. They also stated that the change in pH is closely related to etiology and severity of the affection. The mean pH of the synovial samples of control group of animals of this experiment was 7.93 ± 0.09 and was, thus, slightly more alkaline than the observations of Perman and Cornelius (1971). On the contrary, the mean pH level of septic and aseptic groups were more acidic. The mean levels of pH of synovial fluid of septic and aseptic groups of animals were recorded to be 6.73 ± 0.09 and 6.86 ± 0.17 respectively. The variation of pH of septic and aseptic groups was not statistically significant but the synovial fluid of aseptic group of animals had higher pH level as compared to that of the septic group. The lesser level of pH of aseptic fluids than that of control group may be due to inflammation whereas, the lower pH level in the septic group was due to bacterial infection.

In the present investigation, the quality of clot formation in the mucin precipitation test of the twelve clinical cases varied from very poor to fair with a mean assigned value of 2.1 ± 0.19 as against 4 in normal joint fluids. This low value was indicative of a great reduction in the four vital properties of synovial fluids like Thixotrophy, wetting of surface, elasticity and instantaneous dilatancy at impact and good heat conductivity as enumerated by Bauer et al. (1940), Ropes and Bauer(1953), Barnett (1956), Furey et al(1959) and Vanpelt and Conner(1963). In addition to this, the low level also indicated a great reduction in the lubricating quality which is one of the functions of the fluid (Perman and cornelius,1971). Contrary to the present findings, Ramkrishna (1975) did not observe any change in the mucin precipitation test during similar investigation of bullocks affected with joint disorders.

(ii) Bacteriological findings:-

Out of twelve clinical synovial samples investigated in this study, nine revealed bacterial growth on culture while growth was not observed in the rest of the three samples. Out of the nine positive

samples four had staphylococci species, two had streptococci species and three had Klebsiella species. These findings agreed with the observations of Ropes and Bauer (1953). Orsini (1984) considered Staphylo cocci and Klebsiella tobe common contaminants. Furey et al. (1959) and Rose (1983) have opined that it is difficult to get a bacterial culture from synovial fluid and hence the negative findings may not exclude infectious arthritis. The duration of affection ranged from 15 days to one year in the clinical cases. Further, the antibiotics and antirheumatic treatments must have affected the bacteriological findings.

(iii) Cytological findings:-

In the present study, total erythrocyte count was done to aid in diagnosiswhich was stressed by Ropes and Bauer (1953) and Furey et al (1959) . A higher erythrocyte count was observed in the Synovial fluids from the septic group having a mean value of 0.51 millions/cmm. as compared to 0.18 ± 0.08 millions/cmm. in aseptic group and 0.14 ± 0.02 millions/cmm. in control groups (Table 7).

There is no statistical difference between the erythrocyte counts of aseptic and control groups. The higher count in the septic group may be attributed to damage to blood vessels during aspiration of fluid from the affected joints as was reported by Gardner (1950). Such elevated levels of erythrocyte count were also observed by Ramakrishna (1975), and Zaitsev (1982) in the pathological effusions of synovial cavity.

Total leucocyte count of normal fluid samples in the present study had a mean value of 1283.30 ± 58.72/cmm. The mean leucocyte count recorded in the aseptic group was 2011.60± 719.93/cmm. and that in the septic group was 8013.30 ± 1602.53/cmm. Both the aseptic and septic fluids had higher leucocyte count than the normal fluid and the leucocyte count of the septic samples was the highest which was considered to be a constant feature by many previous workers (Gardner, 1950; Singh et al., 1983 and Orsini, 1984). Many workers had emphasized on the importance of total leucocyte count in joint disorders (Warren et al, 1935; Hopes and Bauer, 1953; Furey et al, 1959) and Ramakrishna, 1975). Variations in the total leucocyte

count of synovial samples may occur due to samples mixed with blood during collection (Gardner, 1950) or due to presence of pyogenic organisms like strepto-and Staphylococci in synovial effusions (Orsini, 1984; and Singh et al, 1983). The septic samples, in the present study, were blood tinged at the time of collection and most of these samples had strepto-and staphylo cocci infections which accounted for the elevated level of total leucocyte count.

Differential leucocyte count of the normal fluids, in the present investigation, showed a higher lymphocyte level with a mean of 48.10 ± 1.51%. Though the mean value does not agree with the values recorded by Tyagi and Krishnamurty (1972)and Ramakrishna (1975) it was established that there is a higher level of lymphocytes. The observation of the degenerated cells, however, did not signify any special situation except the effect of routine wear and tear. Higher mean percentage of neutrophills in the pathological fluids of the present study was the effect of inflammation. Ramakrishna (1975) and Zaitsev (1982) recorded much lower percentages of neutrophills. Similarly, wide variations in respect of monocytes and lymphocytes were also observed which were in accordance with the

observation of Ramakrishna (1975) and Zaitsev (1982). In the present study a remarkable percentage of unclassified degenerated cells were recorded in both septic and ~~x~~ aseptic fluids and a much lesser percentage of such cells were also recorded in normal fluids which was not found to be reported by any worker.

(iv) Biochemical findings:-

(a) Glucose:-

The synovial and serum glucose levels of normal animals were recorded to be 41.5 ± 0.78 mg/100ml. and 44.00 ± 1.54 mg./100 ml. respectively and are not statistically significant (Appendix III). Such findings were also reported by Curtiss (1964); Vanpelt (1974) and Ramakrishna (1975). Slightly lesser amount of glucose in normal synovial fluid than serum as recorded in the present study agreed with the observations of Barnett et al(1961) and Perman and Cornelius (1971). The normal synovial fluid contains the same nonelectrolytic constituents as serum and generally the distribution ratios in the two fluids approximate to unity. Glucose, however, occupies an anomalous position. Its concentration in normal synovial fluid

is considerably lower than in serum (Barnett *et al.*, 1961) . They considered the lesser level of glucose in synovial fluid was due to its utilisation by joint tissues.

Remarkable decrease in the synovial glucose level in clinical cases as compared to that in their serum was observed in the present study (Table 8) which was statistically ($P < 0.01$) significant (Appendix III). This was the sepcific effect of inflammation which rendered the synovial membrane impermeable to glucose. Vanpelt (1974) had also observed that depending on the increase in inflammation in ad-ult horses the synovial glucose Concentration dropped below the simultaneous serum glucose level and even might be zero.

In the present Study, significant difference was not found between glucose levels of serum and synovial fluid in aseptic and s eptic groups. The concentrations of glucose of synovial fluids recorded were 11.80 $\pm$ 5.93 mg./100 ml. in aseptic group and 14.55 $\pm$ 5.08 mg./100ml. in septic

group. This was in agreement with the findings of Bauer (1982) who had observed a fall of glucose level in synovial fluid upto 60 percent in inflammatory joint diseases and in aseptic arthritis it further dropped to 40 per cent of the plasma value.

Negative synovial glucose content in one case of aseptic group and one case of septic group were in accordance with the findings of Ropes and Bauer (1963) and Vanpelt (1974), who have opined that such condition may occur depending on the magnitude of inflammation.

(b) Uric acid:--

The concentration of uric acid in blood serum were 0.82 ± 0.12 mg./100ml. in normal animals, 1.22 ± 0.27 mg./100ml. in aseptic group and 1.20 ± 0.05 mg./100ml. in septic group (Table 8). The variation was not significant (Appendix IV). Higher serum uric acid level in affected cases was in accordance with the findings of Tyagi and Murthy, (1977) and Patra and Mohanty (1985).

In clinical and normal groups the synovial uric acid concentrations were 0.67 ± 0.10mg/100ml. in normal, 1.30 ± 0.19 mg./100 ml. in aseptic and 1.43 ± 0.11 mg./100ml. in septic group (Table 8). The uric acid concentrations in blood and synovial fluid of normal control group were 0.82 ± 0.12mg./10 and 0.67 ± 0.10mg./100ml. respectively which were not statistically significant as per paired 't' test (Appendix VI). This agreed with the observations of Barnett et al. (1961) who have also observed that urea and uric acid occur in the fluid in a slightly lower concentration than in serum.

The uric acid concentrations in synovial fluid were statistically ($P < 0.01$) significant (Appendix V) whereas, it was not significant in serum. However, there was no significant difference in syno-vial uric acid concentration between aseptic and septic groups (Table 8).

Uric acid excretion showed a remarkable species difference. It is excreted in man unchange-d because man lacks the enzyme uricase(clarke,et al. 1931) but in most mammals it is converted to

allointoin. Dukes, (1933) (cited by Patro and Mohanty, 1985) had observed that when nucleo protein digestion is impaired, uric acid tends to be deposited as granules or powder on specific joint articular surfaces causing dysfunction of joint movement. Laurence and Benett (1980) have stated that actively phagocytic leucocytes produce lactic acid and this promotes urate crystallisation as urates are less soluble in acid medium. More crystallisation causes more inflammation and more phagocytosis with more lactic acid production. Thus a self propagating, self stimulating vicious cycle occurs. This vicious cycle promotes uric acid deposition on joint surface causing joint disorders and can be estimated from synovial fluid.

(c) Total protein:--

In the present study the normal synovial total protein was found to be 2.25 ± 0.11 gm./100ml. which was slightly higher than the findings of Tyagi and Krishnamurthy (1974) and Ram Krishna (1975). Marked variations in the total protein concentrations

of synovial fluid were observed by Curtiss (1964) and Bauer (1982). Taking these observations into consideration the slight change observed in the present study in the control group was considered physiologically normal.

In the aseptic and septic groups the mean values of synovial total protein were recorded to be 7.40 ± 1.80 gm. per cent and 10.55 ± 1.02 gm. per cent (Table 8) respectively, which was significantly higher and was also statistically ($P < 0.01$) significant (Appendix VII). This agreed with the findings of Ropes and Bauer (1953); Perman and Cornelius (1971) and Vanpelt (1974). Perman and Cornelius (1971) also observed that in traumatic and degenerative joint disorders total synovial protein content may become doubled or even three fold in severe infectious arthritis. Similarly, Vanpelt (1974) also observed that the level of synovial total protein in cases of severe acute infectious arthritis may be raised even to the protein level of serum.

(d) Sodium and Potassium--

The mean sodium and Potassium concentrations in the normal synovial fluid of the control group

in the present study were recorded to be 126.30 ± 11.84 Eq./L. and 3.90 ± 0.31m Eq./L. respectively. The findings agreed with the observations of Scholz et al. (1983) who reported that the sodium and potassium levels were 124 m Mol./L. and 3.90 m Mol/L. respectively.

The mean level of sodium in synovial fluid of aseptic and septic groups were 129.3 ±4.63m Eq./L. and 135.50 ± 2.05 m Eq./L. respectively (Table 8). This increase was not statistically significant (Appendix VIII).

The mean synovial Potassium values in aseptic and septic fluids were 3.90 ± 0.67 m Eq./L. and 4.50 ± 0.31 m Eq./L. respectively. Analysis of variance showed this increase to be not significant statistically (Appendix IX).

The sodium level of the septic and aseptic fluids were higher than the control normal fluids. The potassium level of aseptic and control groups were the same whereas, its level in the septic group was higher. The sodium and potassium level of septic group is higher than the aseptic group. This agreed with the findings of Scholz et al. (1983b)

who observed higher synovial sodium and potassium concentration in infected arthritis cases than non infected ones. In the infected group of clinical cases investigated in this study the synovial sodium was 135.50 m Eq./L. where as the findings of Scholz (1983b) was 137 m. Mol./L. Similarly the Potassium value which was recorded in this study was 4.50 m Eq./L. and that of Scholz (1983b) was 4.13 m. Mol./L. In the non infected group of clinical cases the Sodium and Potassium levels were 129.3 and 3.9 m Eq;/L. and the findings of Scholz et al (1983b) were 120 m. Mol./L. and 3.8m Mol./L. respectively.

The distribution of electrlytes in synovial fluid in general is in accordance with the laws governing the membrane equillibrium (Gardner, 1950; Ropes and Bauer, 1953; Barnett et al. 1961 and Berman and Cornelius, 1971). Taking the above facts in to consideration the slight insignificant variations in the synovial sodium and Potassium levels in aseptic and septic groups may be attributed to variations in the permeability of synovial membrane in the clinical cases of the present study.

CHAPTER-VI
SUMMARY

S U M M A R Y

Twelve cases of knee and hock joint disorders in bovines were investigated with an attempt for early and accurate diagnosis. Radiography with pathophysiological examination of joint fluids were found inevitable for accurate diagnosis. Radiography of anteroposterior and Lateromedial views together provided a better visualisation of the joint structures. Plain radiographs were observed to be more demonstrative thank arthrography with air or lodine liquid paraffin as contrast media. Angiography of knee joint revealed the vascular pattern.

Leucocytosis was observed in all pathological joint effusions. Significant drop in glucose level and significant rise in total protein and uric acid level of pathological synovial fluid was observed. On the contrary the sodium and potassium levels of affected joint fluids did not show any variation.

****

BIBLIOGRAPHY

B I B L I O G R A P H Y

Adams, D.R.(1974). Lameness in horses. 3rd. Ed. Lea and Febiger, Philadelphia.

Barnett, C.H.(1957). Wear and tear in joints. An experimental study. J.Bones and joint Surg., 38:567-575.

Barnett, C.H. Davis, D.V. and Macconaill, M.A.(1961). Synovial joints, Their structure and mechanics. Ist Ed. William clowes and sons Ltd., London and Baceles.

Bauer, W. Ropes, M.W. and Waine, H. (1940). The Physiology of articular structures. Physioll. Rev., 20:272-312 cited by Barnett. C.H.; Davis. D.V.and Macc Conaill. M.A.(1961).

Bauer, J.D.(1982). Clinical laboratory methods, 9th.Ed. The C.V.Mobsy Company, London.

Berge, E. and Westhues, M.(1966). Veterinary operative surgery, Ist English Ed., Medical book Company,Copenhagen.

Bergman, A.M. and Agren, E.(1923) skand.Vet.Tidskr.,13:181. cited by Cold, C.R. and Vaughan, L.C.(1957).

Booth, V.H. (1938). The specificity of Xanthene oxidase. Biochem. J.32:494.

Boyd., W.L; Delez, A.L. and Fitch, C.P. (1930). Cornell Vet.20:263. cited by Coid. C.R. and Vaughan, L.C.(1957).

Carlson, W.D. and Gillette, E.L. (1967). Veterinary Radiology. 2nd Ed. Lea. and Febiger, Philadelphia.

Clarke, M.L.; Harvey, D.G. and Humphreys, D.J. (1981). Veterinary Toxicology. 2nd.Ed. Bailliere Tindall, London.

Coid, C.R. and Vaughan L.C. (1957). Incidence of Carpal hygroma in dairy cattle infected with Br. abortus and maintained in an isolation compound. J.Comp. Path. 67:53-56.

Coles. E.H.(1967). Veterinary clinical pathology. W.B.Sounders Company, Philadelphia.

Cruickshank, R.; Duguid, J.P.; Marmion, B.P., and Swain, R.H.A.(1975) . Medical Microbiology. 12th.Ed.Vol-II. Churchill Livingstone, Edinburg.

Cultip, R.C. and Cheville, N.F.(1973).Structure of Synovial membrane of sheep. Am. J.Vet.Res., 34:45-50.

Curtiss, P.H. (1964). Changes produced in the Synovial membrane and synovial fluid by disease. J.Bone and Joint surg. 46-A: 873-887.

Davis, D.V.(1945). The cell content of synovial fluid. J.Anat., 79:66.73. Cited by Barnett, C.H.; Davis, D.V. and Macconaill, M.A.(1961).

Dik, K.J. (1984). Vet.Radiology. 25(2):93-96. (En.13ref.).Dep. Radiol. Vet.Fac. Univ.Yalelaan.

Doughlas,S.W. and Williamson.(1972). Principle of Veterinary Radiology. 2nd.Ed. Bailliere Tindall, U.S.A. The Williams and Wilkin Co. Baltimore.

Dukes, H.H. (1955). The physiology of domestic animals. 7th Ed.Cornell University Press. U.S.A.

Frank, E.R.(1959). Veterinary Surgery. 6th Ed. Burgers publishing Company, Minnesota.

Frerichs, F.T. (1846) "Synovia". In Wagner's Handwoerterbuch der physiologie.3,463. Braunschweig; Vieweg. Quoted by Barnett,C.H.; Davis. D.V. and Macconaill, M.A.(1961).

Furey, J.G.; Clark, W.S. and Brine, K.L. (1959). The practical importance of synovial fluid analysis J.Bone and Joint Surg.41-A:167-174.

Gardner, E.(1950). Physiology of movable joints. Physiol. Rev., 30:159-160.

Getty, R.(1977). Sisson and Grossman's The anatomy of domestic animals. 5th Ed. Macmillan Company of India Ltd, Delhi.

Greenough, P.R.; Maccallum, F.J. and Weaver, A.D.(1972). Lameness in Cattle. Ist Ed.Oliver and Boyd, Edinburg.

Holmdahl, D.E. and Ingelmark, B.E.(1948). Acta anat.6:309-375. cited by Barnett, C.H.Davis. D.V. and Macconaill. M.A. (1961).

Jubb, K.V.F. and Kennedy, P.C.(1970). Pathology of domestic animals. Vol-I., 2nd Ed., Academic Press, Newyork.

Karatzias, H. and Meermann, A.(1982). Diagnosis and therapy of joint diseases in cattle. Deutsche Tierarztlicha Wochen Schrift,82:439-441. (Abs.Vet.Bull. 53:4032)

Krishnamurthy, D. and Tyagi, R.P.S.(1977). Characteristics of synovial fluid and blood sera of cattle, Buffaloes and camels in health and when affected with upward fixation of patella. Indian vet. J., 54:995-1004.

Kulkarni, R.S.(1967). Successful treatment of synovial with rheumatic arthritis. Indian Vet.J.44:806-807.

Laurence, D.R. and Bennett, P.N.(1980). Clinical Pharmacology. 5th Ed.ELBS reprinted 1982. Churchill Livingstone, Hongkong.

Llewellynn, H.R.(1979). Equine vet. J., 11:90, cited by Veenendaal, J.C.Van; speirs. V.C. and Harrison, I. (1981).

Mcleod, W.M.(1958). Bovine anatomy. Burgess Publishing Company, Minneapolis-15, Minnesota.

Merchant, I.A. and Packer,R.A.(1967). Veterinary Bacteriology and Virology. 7th Ed.The Lowa State University Press, Lowa, U.S.A.

Merkens, H.W., Dieten, J.S.M.M. Van and Kersjes, A.W.(1984) Infectious (Septic) arthritis of the distal intertarsal and tarsometatarsal joints in cattle. Vet. Rec., 114:212-213.

O'conner, J.J. (1950). Dollars Veterinary Surgery, 4th Ed. Bailliere Tindall and Co. London.

Orsini, J.A. (1984). Strategies for treatment of bone and joint infections. J.Am.Vet.med.ASS., 185:1190-1193.

Patro, B.N. and Mohanty, J.(1985). Studies on recurrence, complications and possible etiology of sub-luxation of patella in cattle. Indian Vet.J.62:684-690.

Perman, V. and Cornelius, C.E.(1971). Synovial fluid in clinical biochemistry of domestic animals. Vol.II.(Eds. Kaneko, J.J. and Cornelius, C.E.) 2nd Ed.Academic Press, Newyork and London.

Pratap. K., Das, S.C. and Angelo, S.J. (1977). Haematological, radiological and symptomatological aspects of arthritis in buffalo calves. Indian Vet. J., 54:298-303.

Ramakrishna, O. (1975). Chronic tarsal hydrarthrosis in bullocks. Indian Vet. J., 52:571-579.

Ropes, M.W., Barnett, G.A. and Bauer, W.(1939). The origin and nature of Synovial fluid. J.Clin. Invest.18:351.

Ropes, M.W. and Bauer, W.(1953). Synovial fluid changes in joint diseases. Harvard university Press. Cambridge, Massachusetts.

Rooney, J.R.(1963). Equine medicine and surgery. Santabarbara, California. Veterinary Publication. Inc.

Rose, R.J. (1983). The diagnosis and treatment of arthritis in horses. Newzealand Vet.Jour., 31:13-15.

Saaf, J.(1950). Effect of exercise on adult articular cartilage. Acta Orthop.Scand, Suppl. 77-86. cited by Barnett, C.H; Davis.D. and Macconaill, M.A.(1961).

Schols. H; Karatsias, H. and Stober, M (1983a). Mineral concentrations in synovial (stifle and hock) of cattle with healthy joints. Zentralblatt fur veterinarmedizin, A-30:348-354. (Abst.Vet. Bull.53:6814).

Scholz. H;Keratzias, H. and Stober, in (1983)..Content of major elements in synovia of cattle with infected and uninfected arthritis. Zentralblatt fur veterianarmedizin. A-30:355-362.(Abst.Vet.Bull.,53-6915.

Singh,S.D.; Parihar, N.S. and Charan, K.(1983) Haematological and biochemical studies on chlamydia induced arthritis in calves, Indian Vet.J.60:690-597.

Snedecor, G.W. and Cochran, W.G.(1967). Statistical methods. 6th Ed., The Lowa State University Press, Lowa.

Suntun, M.Ven (1984). Radiographical diagnosis of degenerative joint diseases in horses, Comparison of radiographical and pathological findings. Inaugural dissertation. Fachbereich,Veterianarmedizin der Freien Univ.Barlin. (Abst. Vet. Bull, 54-11:951 (1984).

Torres, J.; Mayari, R.; Martinez, A. and Denis, M.(1981). Relationship between magnesium (and other minerals in blood plasma) and Polyarthritis in new born calves. Revistadesalud Animal.,3:13-20 (Abst.Vet. Bull., 52:3332)

Tyagi. R.P.S. and Krishnamurthy, D (1972 studies on stifle synovial fluid of bovines. I.Arthrocentesis technique and physiological examination of synovia in normal buffaloe calves. Indian Vet.J., 49:1257-1261.

Tyagi, R.P.S. and Krishnamurthy, D.(1974). The pattern of total protein and protein fractions in synovial fluid and serum of normal and affected (Subluxation of patella) bovines. Indian Vet.J., 51:156-158.

Vanpelt, R.W. and Conner, G.H. (1963_a)-Synovial fluid from the normal bovine tarsus. II. Relative viscosity and quality of mucopolysaccharides. Am.J.Vet.Res., 24:537-543.

Vanpelt, R.W. and Conner, G.H. (1963b). Synovial fluid from normal bovine tarsus. III. Blood, plasma and synovial fluid sugars, Am.J.Vet.Res., 24:735-741.

Vanpelt, R.W.(1969). Tenosynovitis in horses. J.Am.Vet. Med.Ass.; 154:1022-1032.

Vanpelt, R.W.(1973). Idiopathetic tarsitis in postparturient dairy cows; Clinico-pathologic findings and treatment J.Am.vet. Med.Ass., 162:284-290.

Vanpelt, R.W.(1974). Interpretation of synovial fluid finding in the horses. J.Am.vet.Med.Ass., 165:91-95.

Veenendaal, J.C.Van; Soeirs, V.C. and Harrison,I(1981). Treatment of hygromata in horses. Australian Vet.Jour., 57:513-514.

Warren,C.F. Barnett, G.A. and Bauer, W.(1935). The significance in cellular variations occuring in normal synovial fluid. Am.J.Path., 11-953-967. Quoted by Barnett, G.H.; Davis, D.V. and Mac.Conaill, M.A.(1961).

Wootton, I.D. (1964). Micro-analysis in Medical biochemistry. 4th Ed. J. and A. Churchill Ltd. London.

Zaitsev, E.A.(1982).Changes in synovial fluid of bulls with joint diseases. Veterinariya, Moscow (6):56 (R.V.) (Abst.Vet.Bull:52:7120).

APPENDIX

Appendix I

Analysis of variance of Serum Glucose

Normal versus affected.

Source	DF	SS	MS	F
Treatment	2	41.78	20.89	2.06 (NS*)
Error	15	151.82	10.12	
Total	17	193.60		

NS* - Not significant.

Appendix II

Analysis of variance of synovial glucose Normal versus affected.

Source	DF	SS	MS	F
Treatment	2	2380.69	1440.34	10.44**
Error	15	2068.64	137.91	
Total	17	4949.33		

** Significant at 1% level (P < 0.01)

CD (Critical difference) 20.41

Appendix III

Analysis of variance by paired 't' test between Serum glucose and synovial glucose.

Group of animal	Mean of serum glucose	Mean of synovial glucose	Mean difference	Value of 'T'
Control	44.0	41.5	2.5	2.1 NS
Affected	46.75	13.90	32.85	8.482**

** Indicates significant at 1% level (P/ 0.01)

NS denoted not significant.

Appendix IV

Analysis of variance of serum uric acid

Normal versus affected.

Source	DF	SS	MS	F
Treatment	2	0.60	0.30	0.5 NS
Error	15	0.93	0.602	
Total	17	1.53		

N.S. = Not significant.

Appendix V

Analysis of variance of synovial uric acid

Normal versus affected.

Source	DF	SS	MS	F
Treatment	2	2.64	1.320	13.6**
Error	15	1.46	0.097	
Total	17	4.10		

** Significant at 1% level

CD. (Critical difference) 1.70

Appendix VI.

Analysis of variance by paired 'T' test between serum uric acid and synovial uric acid.

Group of animals	Mean serum uric acid	Mean synovial uric acid	Mean difference	value of 'T'
Control	0.82	0.67	0.145	3.79**
Affected	1.205	1.413	0.24	

** Indicates significance at 1% level

NB denotes not significant.

Appendix VII.

Analysis of variance of synovial total protein Normal versus affected.

Source	DF	SS	MS	F
Treatment	2	248.40	124.20	19.88**
Error	15	94.13	6.27	
Total	17	342.53		

** Significant at 1% level.

CD - 4.36

Appendix VIII

Analysis of variance of synovial sodium

Normal versus affected.

Source	DF	SS	MS	F
Treatment	2	316.48	158.24	3.0 (NS)
Error	15	788.85	52.59	
Total	17	1105.33		

NS - Denotes not significant.

Appendix IX.

Analysis of variance of synovial potassium

Normal versus affected.

Source	DF	SS	MS	F
Treatment	2	1.56	0.78	1.2(NS)
Error	15	9.83	0.65	
Total	17	11.39		

NS. Denotes not significant.