OBSERVATIONS ON

# Some Aspects of Joint Diseases In Experimental and Clinical Cases In Bovines



THESIS

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## CERTIFICATE

Certified that Sri Krishna Pratap, U.P.College of Veterinary Science and Animal Husbandry, Mathura, a candidate for M.V.Sc. Final Examination of 1972 in SURGERY has been working under my supervision during the session and that the accompanying thesis entitled "OBSERVATIONS ON SOME ASPECTS OF JOINT DISEASES IN EXPERIMENTAL AND CLINICAL CASES OF BOVINES" which he is submitting is his genuine work.

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Dated April 28, 1972.

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Krishna Pratap

Mathura
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# C O N T E N T S

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## and

## Unit of measurements and values used

| Blood, synovia | Expressed in |
|---|---|
| Packed Cell Volume (PCV) | Volume per cent |
| Haemoglobin (jb) | Grams per 100 ml. |
| Erythrocytes (WBC) Total Count | Thousands per cubic mm. |
| Differential Leucocyte Count (DLC) | Per cent |
| L | Lymphocytes |
| M | Monocytes |
| P | Polymorpho-leucocytes |
| E | Eosinophils |
| B | Basophils |
| Total Protein | gm. per 100 ml. |
| Sugar (total reducing) | mg. per cent |
| Alkaline phosphatase (ALP) | Bodansky units/100 ml. |
| Di-potassium ethylene diamene tetra acetate (EDTA) | 2 mg./ml. |
| Temperature (T) | Fahrenheit |
| Pulse (P) | Per minute |
| Respiration (R) | Per minute |

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# INTRODUCTION

To achieve self sufficiency in food production for the teeming millions of Indian population; Green Revolution is the slogan of the day. As a result of this, besides intensive cultivation more and more of barren land is being brought under the plough. This has resulted in gradual disappearance of pastures and lessened production of feeds and fodder for our cattle population. Keeping in view the priority for growing food for human consumption, the scope for cattle fodder production is very limited and would remain so for years to come. We are, therefore, in shortage of 70 per cent concentrates and 50 per cent of roughages (Pant, 1961) for our cattle population.

Latest satistics reveal that the total bovine population of India is 229 millions which forms more than a quarter of total world bovine population. The male progeny of cattle provide the foundation stock of draught animals for the plough, bullock cart, for drawing water out of wells and for thrashing of harvested grains. Under ideal conditions the female bovine population should contribute to white revolution and the males in the green revolution but in practice in our country the picture is different. India can hardly sustain such enormous cattle population and there is already death of feeds and fodder.

In spite of industrialization and urbanization and latest trend of mechanisation in agricultural operations, there has been a steady increase in the number of working bullocks (6605150 in 1961 and 6972835 in 1966, according to news letter from

Directorate of Economics & Statistics, Ministry of Food and Agriculture, Community Development and Cooperative). This is obviously due to the fact that the average farmer does not have sufficient land and wealth to warrant the use of mechanical contrivance (tractor) for his agricultural operations. Besides this, another deterrent factor is fragmentation of holdings which is still very much in vogue in our country.

The facts mentioned above sufficiently justify the importance of cattle as the backbone of agricultural economy. Draught animals, in view of the nature of their work are more prone to diseases which are orthopedical in nature. Sprain, dislocation, arthritis, fracture, rupture of ligaments etc. are to name some of the conditions to which they are more prone. These conditions are usually crippling in nature and render the animal temporarily or permanently unfit for draught purposes. If not promptly attended to, correctly diagnosed and rationally treated, the physical incapacitation becomes usually permanent. Such crippled animals are definite liabilities of the owner and a burden on the available feeds and fodder which are already inadequate.

Unlike in foreign countries where physically crippled animals are sent to the slaughter house to salvage the carcass for human consumption, the condition in our country is entirely

different. On account of religious sentiments and legislative ban in most of the States, cow slaughter is prohibited. This means that the physically crippled animals would continue to be liability of and burden on the owner and feeds and fodder respectively.

Correct diagnosis at the opportune time and rational treatment therefore, appear to be the only way out of this embarrassing situation. Due to lack of knowledge and proper diagnostic facilities, orthopedic affections of draught animals are often inadequately and improperly treated. Perusal of literature on this pertinent aspect reveals that there is a paucity of indigenous literature.

In view of the importance of the problem and lack of adequate information, it has been considered worthwhile to undertake studies on arthritic conditions in cattle. Since experimental models provide a good scope to study the symptomatology, thread and bare and to evaluate different therapy the investigation includes besides clinical cases, induction of arthritic condition in buffalo calves with the help of potent bacterial cultures and study of different parameters of diagnostic importance suitable for a field veterinarian as well as a researcher. The organisms used in this study are those commonly reported in clinical cases.

The observations are recorded in this thesis.

# REVIEW OF LITERATURE

## REVIEW OF LITERATURE

Fisher (1923) reported .92 gm per cent total protein in the synovial fluidof ox. According to him RBCs vary between 12 to 4600 per cmm. He has further stated that trauma inflicted by the passage of the needle through the vascular synovial membrane accounts for some of the blood found. No importance can be attached to their enumeration in the synovial fluid in the arthritis.

Key (1928) commenting on the types of cells in synovial fluid observed that fluid obtained from normal joints of laboratory animals and of children contained the same type of cells and about the same number and proportions as did the synovial fluids of rabbits. R.B.Cs. were present in every fluid in about equal number to the total W.B.Cs.

Bauer et al. (1930) found of average of 112 white cells and 64 Red cells per cmm. in the astragalo-tibial joints fluid of young cattle. The count was somewhat higher in the carpometacarpal joints. 90-95 per cent of these cells were phagocytic and 85.5 per cent of all the nucleated cells were monocytes. The total protein nitrogen in fluids from normal joints of cattle was found to average 145.1 mg. per 100 ml. corresponding to a total protein of 0.91 gm. per cent. He observed high total protein in some of the fluids from rheumatic joints and low sugar concentration as a strong presumptive evidence of bacterial invasion of the fluid.

The viscosity of human synovial fluids varies between 4.2 to 32.5. This has been stated to be lower in joints aspirated twice within a space of few days.

Collins (1936) undertook cytological, chemical and bacteriological examination of joint fluids over a period of 12 months from cases of chromic arthritis of obscure etiology. He has emphasized the following distinguishing features of synovial lining cells.

(a) The tendency to a torpedo shaped nucleus most frequently encountered.

(b) The deeply stained nuclear membrane, regular nucleochromatin network and nuclear vacuole.

(c) The absence of sharply defined rim of cytoplasm and azurophilic cytoplasmic granules.

Stone et al. (1950) treated 7 patients with rheumatoid arthritis with pituitary ACTH and synthetic cortisone acetate. In each case the symptoms improved after the injection of adequate amount of either of these materials. In contrast, pregnenolone acetate, de-oxycortone acetate and ascorbic acid, acetyl salicylic acid produced no relief. After injection of cortisone or ACTH were discontinued, the symptoms gradually returned.

Blair et al. (1954) observed that when a joint is repeatedly emptied neither the viscosity nor the quantity of effusion remains constant. They further stated that greater

the amount of effusion from any given joint the lower is the viscosity. Emptying of the joint altered both the quantity and quality of effusion.

Schleiter and Dietz (1957) reported on the use of procaine and hydrocortisone in acute and chronic aseptic arthritis and tendovaginitis in horsess Acute arthritis in 6 horses were cured by volar and planter injections of 8 ml. of 4 per cent procaine (3 cases) or by intra-articular injection of 8-20 ml. of 2-20 per cent procaine. They regarded these methods superior to many others against this condition. Further, 8 out of 10 horses with chronic or sub-acute arthritis or tendovaginitis were cured by 2 to 5 injections of 125 mg. of hydrocortisone given intra-articularly or into the tendon sheaths.

Dietz et al. (1959) treated brucella synovitis in cattle and synovitis in horses with nebacetin and hydrocortisone. They also reported 7 cures among 8 cases of infected synovitis and tendovaginitis in horses treated in the same way.

Dirksen and Bartling (1959) reported on hydrocortisone, fluorhydrocortisone and prednisolone in the treatment of diseases of joints and tendon sheaths in cattle. These corticosteroids were injected directly into the synovial cavity of inflammed joint or tandon sheath in 35 cattle, of which 21 were completely cured and 6 other improved.

One or two injections were sufficient for acute inflammation, 4 injections for chronic inflammation. The dosage schedule was 125 mg. for hydrocortisone, 25-100 mg. for prednisolone and 6-12 mg for flurocortisone.

Numans and Kersjes (1960) reported on use of corticotrophin and corticosteroids in large animals suffering from peritonitis, laminitis, tendovaginitis or arthritis. Satisfactory results have been reported in bursitis, excepting navicular disease. The response of arthritis in horses was better than arthritis in cattle.

Vaughan (1960) reported clinical features of 13 cases of osteo-arthritis in cattle. Gross thickening of the periarticular tissue was observed as a constant feature in cases involving the stifle joint. He remarked that the treatment of osteo-arthritis of the hip and stifle joints in cattle is out of question and further emphasized that on account of the intense pain the animals should be relieved of their suffering.

Lange (1961) undertook cytological studies of bovine synovial fluid and commented on its clinical application. The study involved 150 synovial fluid samples from healthy and diseased joints of slaughter cattle.

Miller (1961) referring to corticosteroids in equine practice observed as follows:-

"Steroids reduce inflammation, they do not heal the part, indeed healing is often retarded. Adequate dosages,

repeated at adequate interval must be used. Do not nullify the effects of anti-inflammatory steroids by simultaneously rekindling the flame with counter-irritation".

He used steroids to cure various conditions in equines including arthritis, periostitis, bursitis and tenosynovitis.

Shupe (1961) investigated causes and pathology of arthritis in cattle by studying the bones and joints of 379 dairy and beef cattle ranging in age from 1 day to 21 years. He observed that inflammatory arthritis may result from infective agents such as Brucella Erysepelas, staphylococcus, streptococcus, PPLO or pneumococcus organisms. The capsule of the joint is probably involved but at later stages more degenerative conditions (Osteo=arthritis) may be developed. The clinical symptoms observed were elevated body temperature, hot swollen joint, anorexia, suppressed rumination and pain. These symptoms were not present in degenerative arthritis characterised by degeneration of bone cartilage.

Derevynako (1962) studied synovial pressure and differences in the inflammatory processes in case of aseptic exudative arthritis in schoulder and hock joints of horses and cattle. The arthritis was induced by injecting 10 per cent sodium chloride solution into the joints. The increase in pressure reported was 140 to 160 mm (horse, 30-120 mm (ox) in the shoulder joint and 430-480 mm (horse), 80-280 mm. (ox) in hick joint, 48 hours post induction which decreased gradually thereafter.

Morgan et al. (1962) radiographically diagnosed multiple exhostosis in different bones and joints of horses. As a therapeutic measure, he also undertook arthrocentesis.

Rhodes (1962) gave radiographic demonstration of the manifestations of degenerative joint diseases in horse. He observed that degenerative joint diseases are characterised by soft tissue swelling or increased soft tissue density about an articulation, a decrease in the radiolucent joint space and exaggeration of the periarticular contours, intra-articular and peri-articular hypertrophic bone spurs, calcification of collateral ligament or joint capsule where these structures are attached to the periosteum and varying degree of ankylosis.

VanPelt (1962) giving an account of anatomy and physiology of articular structures of equines observed that the basic functions of synovia are lubrication, nourishment of articular cartilage as well as a control factor in the maintenance of normal electrolyte and non-electrolyte balance. He further considered synovia a plasma dialysate to which a nonsulphated mucopolysaccharide is added to render it viscous.

Van Pelt (lic.cit.) by employing contrast arthrography in equines demonstrated the confines and ramifications of carpal and fetlock lameness in horses by intra-articular injections of adenocorticosteroids or their synthetic analogues. In this connection he mentioned about different synovial sacs of the knee joint.

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as clear, pale yellow and free of flocculant material which does not clot on standing or on storage upto 48 hours or more at 4°C.

Van Pelt (loc.cit.) described arthrocentesis and injection of the bovine tarsus, for local relief of inflammatory conditions involving these joints. He remarked that "arthrocentesis serves not only as a means of relieving increased intraarticular pressure associated with the joint affections, but also as avenue by which therapeutic drugsmay be introduced to the joint cavity". He described the most accessive point of entry to the tibio-tarsal and proximal inter-tarsal articulation through the dorsomedial cul-de-sac of the tibio-tarsal synovial sac. A 26 gauge, ¼" needle was used to infiltrate anaesthesia at the site of puncture, whereas for arthrocentesis and intra-articular injection a 16 gauze, 2" needle was used. He cautioned against flexion of the limb during the performance of this procedure to avoid chance of injury to the articular cartilage by the needle point and also to minimise the possibility of needle breakage in joint cavity. As an alternative to dorsomedial cul-de-sac he advised penetration through distal end of the medial malleolus of the tibia.

Jubb and Kennedy (1963) studied arthritis and tendovaginitis in animals. They observed that pathways of direct spread of inflammation from bone to joint are seen

in connection with osteo-myelitis and that direct spread of infection from adjacent soft tissue to joint is uncommon except nacrobacillosis causing foot rot in cattle. The important causative agents causing arthritis in cattle have been found to be staphylococcus, E. coli, C. pyogenes.

Sharp (1963) studied the effect of cortisol and certain synthetic steroids on the permeability of synovial membrane. He observed that certain steroids namely dexamethasone and prednisolone decreased permeability to about the same extent. Fluorohydrocortisone had no detectable effect.

Simmons and Johnston (1963) gave a good account of mycoplasma arthritis in calves. The physical symptoms noted were lameness, tendency to walk on toes, enlarged and tender joints. Tetracyclines injected systematically and also intra-articularly, relieved lameness in two calves but failed to destroy mycoplasm as was evident from isolation of the organism from the treated joints 5 months after treatment.

VanPelt (1963) reported on intra-synovial injection of methyl-prednisolone in the treatment of 23 joints in 14 cattle afflicted with a variety of inflammatory conditions in dose ranging between 40-90 mg. According to his observations, osteo-arthritis was the most frequently encountered condition (48 per cent) and the tibio-tarsal joint was most commonly affected (78 per cent). All injections were made intra-articularly and excellent immediate and sustained clinical

response was observed in high percentage of cases evidenced by relief from pain, elevation of inflammation, resolution of effusion and improvement in gait. Improvement was usually obvious within 24 hours.

Carne et al. (1964) commenting on lameness in beef cattle said that in great majority of cases lameness was due to some form of osteo-arthritis, which after a long period of chronic lameness terminated in complete crippling. They further reported that in adult animals the joints principally involved were hock and stifle and the pathological processes involved were essentially degenerative in nature.

Dozsa et al. (1964) diagnosed radiographically a case of bovine traumatic arthritis in a 2 year old Ayrshire heifer. Antibiotic pointment and oral sulphonamide were administered and ice packs employed locally worked but the lameness did not improve. Arthrocentesis in the standing animal was also performed.

Schlichting (1965) made observations on the effects of antibiotics injected into the carpal and tarsal joints of 23 Friesian cattle. The antibiotics were chlortetracycline, oxytetracycline, tetracycline, supracillin and veticillin. One carpal joint and one tarsal joints of each animal was studied and the other joints of the same animal served as control. The animals were slaughtered after 4-5 days. Intra-articular injections of 125 mg and 250 mg 2-5 per cent

chlortetracycline eye pintment caused acute local and systemic reaction whereas 210 mg. 3 per cent oxytetracycline suspension gave rise to medium to high grade local reaction. The addition of 6 mg. fluorohydrocortisone or 5 mg. dexamethasone-ester appeared to relieve pain but did not reduce the synovial reaction. 12.5 per cent tetracycline at dose of 250 mg. and 500 mg. in cows produced slightly inflammatory reaction, 10 ml. supracillin produced only slight reaction in the joint of 4 animals and was well tolerated. Veticillin caused only slight local reaction in the joints of 4 animals in dosages of 9,00,000 I.U. and 18,00,000 I.U. while supracillin was well tolerated in 2 joints of cattle. Tetracycline and veticillin are considered the bestpreparations for use in the arthritis and synivitis. Control experiments show that 10 ml of 5 per cent tutocaine caused only slight reaction within the joints and the same volume of 2 per cent novocain, 2 per cent histocaine and distilled water produced no reaction. Simple puncture of the joint caused no reaction.

Smith and Frame (1965) made observations on electron-microscopy of the free protein or the protein polysaccharides complex on bovine synovial fluid and found that mucin clot did not contain appreciable amount of free protein and hence could be regarded as identical to the hyaluronate protein complex.

Trussel (1965) studied clinical response to intra-synovial injection of flumethasone in the horses and found that cortico-steroids exert their favourable influence directly on the

synovial membrane lining the joints, tendon sheath or bursa. The effective concentration achieved by direct application to the affected part cannot be attained by any other known method.

VanPelt (1965) observed that adrenocorticoid steroids or their synthetic analogues, penicillin G. procaine (crystalline in aquous suspension), dihydrostreptomycin-sulphate and neomycin-sulphate may be injected singly or in combination for the treatment of infectious arthritis. He also suggested 1% solution of Hyexylcaine hydrochloride intra-articularly for differential diagnostic purpose and for immediate relief from pain.

VanPelt (1966) classified infectious arthritis in calves with respect to its duration and as primary and tertiary depending upon its mode of pathogenesis. Synovial fluid samples were subjected to bacteriological examination and alpha-haemolytic streptococcus species was isolated most frequently from the suppurative synovial effusion. It was further observed that most severe joint infections were produced by C. pyogenes alone or in combination with streptococcus fecalis. In acute cases no severe articular destruction was noticed.

Kottman et al. (1967) reported on intra-articular application of oxytetracyclin and tetracyclin in horses and cattle and observed that when 100 mg of tetracyclin were injected into the phalangeal joint cavities therapeutic amounts of antibiotics persisted for 24 hours. The injections

induced inflammatory response characterised by leucocytosis and neutrophilia and a raised level of total protein. The reaction was intense for 24-48 hours after injection and the synovial fluid returned to normal in 5-6 days. On the basis of this finding, they concluded that the use of such injection was contra-indicated.

Scholl (1967) studied osteo-arthrosis deformans of carpal joint in bullock and on post-mortem examination he found three types of lesions- (i) Transparency of the cartilage on the surface of the joint, (ii) Erosion with totalloss of cartilage, (iii) the gross and microscopic finding agreed with those described in literature but the microscopic lesions did not coincide with the gross lesions. He concluded that the development of the disease was primarily due to bone damage and that a number of factors (stress, nutritional or hormonal disorder of mineral metabolism as well as direct endocrine action on cartilage and bone matrix) might have played a part.

VanPelt (1967) giving an account of pathologic changes of joint diseases associated with malignant lymphoma compared the result of tests and examination of synovial fluid with those of blood and serum. Significant changes in the articular surface and cartilage, blood serum and synovial fluid were noticed.

Van Pelt (loc.cit.) made observations on intra-articular injection of 6 M.A.P.* into 20 joints of 13 horses affected with tarsal hydro-arthrosis. Clinical response manifested by reduced

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* 6-Alphamethyl, 17 alphahydroxy progesterone acetate

distension of synovial fluid toward normal was noticed. No correlation between dosages and duration of clinical benefits were observed. All joints were free of any radiographic evidence

Eisenmenger (1968) performed studies on the inflammatory synovial reaction following joint puncture or injection into the joint and reported on its diagnostic significance. The normal values of the cell count, differential cell pictures, viscosity and specific gravity of synovial fluid from hock joint were determined in 67 slaughtered horses. Joint puncture alone produced an increase in cell number and a shift in differential count. The specific gravity, viscosity were usually reduced. The reaction increased upto the 3rd day. Prednisolone injection caused a slight reaction.

Morgan (1968) reported on radiographic diagnosis of bone and joint diseases in horses and observed that infective non-specific pyogenic arthritis in the early stage showed periarticular swelling, oedema of the joint capsule and increased width of joint space.

Spreull and Fraser (1968) described for extreme causes of arthritis where infection is due to pus forming bacteria arthrotomy and surgical drainage is necessary. The corticosteroid suppresses the animal response to infection. Therefore, the use of corticosteroid is contra-indicated while rest and good nursing are essential. According tothem the large weight bearing joints particularly the elbow, carpus, hip, stifle and hock joints are most commonly affected with degenerative arthritis. They further

stated that a chronic form of effusion may occur in tissues at site which are subject to repeated pressure and friction particularly at the knee and the elbow of horses and cattle. The repeated injury causes a sac like cavity to fill with viscous fluid and form a false bursa.

VanPelt (1968) evaluated the effects of intra-articular injection of synthetic steroids in tarsal hydrathrosis in cattle. The disease was diagnosed on the basis of anamnesis, clinical signs, arthrograph, synovial fluid analysis and bacteriological examinations of synovial effusions. The different agents tried were: Prednisolone-acetate (25 mg./cc.), 9 Fluoro-prednisolone acetate (2 mg./cc.), 6-Alpha-methyl prednisolone acetate (40 mg./cc.), 6-Alpha-methyl, 17 Alpha hydroxy-progesterone acetate (50 mg./cc.). Injection was made into the dorso-medial cul-de-sac of the tibiotarsal synovial sac via the aspirating needle after withdrawal of all available synovial fluid.He reported that a combination of 9-Fluoro-prednisolone acetate and 6-Alpha-methyl, 17-Alpha-Hydroxy-progesterone acetate in a 1:10 ratio was found most effective.

VanPelt (loc.cit.) reported on 2 cases of traumatic arthritis in cattle affected with bilateral posterior paresis. Self inflicted trauma occurred as the direct result of repeated attempts to change the position of hind limb or to stand. He further stated that the criteria for making a diagnosis of this condition are:

1. Trauma must be the result of a specific accident, severe enough to produce acute inflammation of the affected joint.

2. Traumatized joint must be the only one sign of inflammation.

3. The articular functions of joint should have been normal before the injury occurred.

4. Progressive articular changes may be demonstrated by arthrographs in 3 to 6 months time. Haematological changes were low haemoglobin content, low packed cell volume but the total leucocytic count was in the normal limits with an increase in the relative numbers of neutrophils.

VanPelt (loc.cit.) investigated synovial fluid changes produced by infectious arthritis in cattle. The volume of synovial effusions were in excess of normal. Their relative viscosity was reduced and mucinous precipitate quality was poor. Synovial fluid sugar level was 48 per cent less than that of blood sugar level. Alkaline phosphatase activity level were in excess of serum ALP activity level. The clinical manifestation ranged from arthralgia, in the absence of external signs of inflammation to arthritis with various degrees of inflammation. There was evidence of generalised bacteremia or toxemia in only 2 cattle. Palpation of the affected joint or joints revealed different degrees of hyperarthresthesia, arthrocele due to excessive synovial effusion and hyper-arthrothermia persistent arthrogryposis occurred in severe cases of infected arthritis. The colour of synovial fluid was various, i.e. pale amber to pale yellow, serosanguinious. The infectious synovial effusion clotted rapidly in the absence of anticoagulant and the viscosity was variable. The mean synovial alkaline phosphatase activity level $4.8 \pm 0.95$ sigma units per 1 ml. was significantly

higher than the serum ALP activity level.

VanPelt (loc.cit.) reported excessive transusative synovial effusion from tarsal hydrarthrosis in horse resembling normal synovial fluid but low protein concentration and higher leucocytic count. Serum synovial fluid sugar ration was 1:1; alkaline phosphatase activity levels were significantly higher in serum than in synovial fluid.

Liu et al. (1969) recorded a case of rheumatic arthritis in dog. Articular deformity, destruction of particular cartilage and atrophy of the juxta articular bone of the affected joints were observed radiographically.

Morgan (1969) made observation on radiological pathology and diagnosis of degenerative joint disease in stifle joint of dog. Radiographic changes seen were periarticular osteophytes, subchrondral bone sclerosis, attrition of subchondral bone, narrowing and collapse of joint space and subluxation or rotation of bone.

Riddle and Wheat (1969) investigated on the possible use of liquid silicone intra-articularly in horses for osteoarthritic joint signs of foreign body reaction were observed earliest at 72 hours and it became pronounced at 2 or 4 weeks. Silicone was found to be phagocytosed by the synovial microphages.

VanPelt (1969) observing on response of tarsal-hydrarthrosis in the horse to intra-articular injection of synthetic steroids remarked that tarsal hydrarthrosis being non-inflammatory

response to therapy was not dramatic. He further stated that in tarsal hydroarthritis, signs of pain, inflammation or lameness were not present. The treated cases required repetition of treatment which varied from 5-160 days.

VanPelt and Riley (1969) reported on clinico-pathological findings and therapy in septic arthritis in foals. They stated that arthrocentesis provided a means for immediate symptomatic relief and therapeutic benefit by removal of septic synovial effusion. They further advised that during the course of joint disease should antibiotic sensitivity determination reveal that one of the broadspectrum antibiotic is more effective than the antibiotic being used or should unequivocal evidence of clinical improvement not be present, therapy should be changed.

Azmal and Hayward (1970) observed that in dogs arthritis is characterised by primary changes of inflammatory nature in the synovial membrane whereas osteo-arthritis is primarily a degenerative change in the articular cartilage.

Riddle (1970) reported on healing of articular cartilage in the horse. Superficial and full thickness defects were superficially produced in the articular cartilage. The animals were euthanised at intervals. The study revealed that the superficial defects did not heal significantly after 8 months. He has also reviewed literature stating that injuries of articular cartilage did not heal with normal hyaline cartilage but mainly with fibrous tissue and fibro-cartilage.

VanPelt (1970) reported on the degenerative joint disease in the carpus and fetlock in cattle and stated that the signs of arthralgia as manifested by reluctance to put weight on the affected limb or limbs, transient to persistent arthrogryposis and lameness. Palpation of the joint revealed moderate peri-articular fibrosis and signs of pain where excessive digital pressure was applied. Radiograph revealed narrow intraarticular space, marginal osteophytes and increased density in subchondral bone.

VanPelt (loc.cit.) reported on infectious arthritis in cattle caused by C. pyogenes. The physical symptoms were visible distension of the joint capsule, peri-articular oedema and fibrosis, reluctance to bear weight on the affected limb and lameness, palpation revealed hypersensitivity and heat. The synovial effusion was turbid, yellow opaque and contained varying amount of floculant material, relative viscosity was reduced, alkaline phosphatase activity value was slightly in excess of the serum value.

VanPelt (loc.cit.) reported that arthrocentesis of affected stifle provided immediate symptomatic relief. They afvised that intra-articular cortosteroid preparations as well as antibiotic corticosteroids could also be conveniently combined with local preparations.

VanPelt (loc.cit.) used Betamethasone intra-articularly in degenerative joint disease, traumatic arthritis and in osteochondritia dissicans, after post-injection synovial analysis

showed that betamethasone preparations were well tolerated and proved to be beneficial as temporary, palliative, repeatable local adjunct in the management of non-inflammatory joint disease in horse.

Krantidev (1971) reported the values of alkaline phosphatase in buffaloes 1.77 to 4.957 Bodansky units/100 ml. of serum and total serum protein 7.342±0.266 gm./100 ml of serum.

Singh (1971) reported mycoplasma arthritis occurring most frequently in hock, stifle and elbow joints of cattle. The synovial fluid was opaque to straw coloured, serum alkaline phosphatase level was within the normalrange. Intra-articularly aquous chloramphenicol and systemic treatment with oxytetracycline and tyosin did not give an immediate response. Affected animals, however, recovered 2-3 weeks later without further treatment.

VanPelt (1971) showed the effect of alkaline phosphatase in vitro on the relative viscosity and mucinous precipitate quality of bovine synovial fluid. After incubation of 1 hour at 38°C, there was a minor increase in mean alkaline phosphatase activity value for both the treated and untreated control group of synovial fluid. There was significant ($r = -0.663$, $P < 0.05$) correlation between a high preincubation intrinsic alkaline phosphatase activity and reduced postincubation value in individual samples. The mean relative viscosity value for the treated group of sample was significant ($P < 0.10$).

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# SURGICAL ANATOMY

Fig.1 CARPAL JOINT

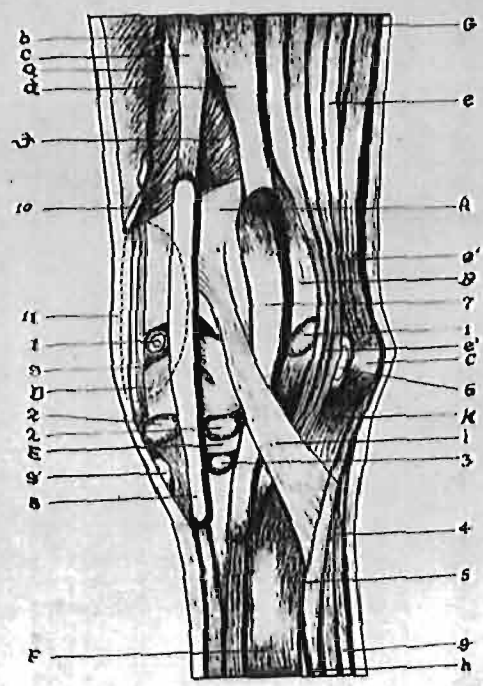
A. radius
B. stykoid process of the ulna
C. accessory carpal bone
D. radial carpal bone
E. fourth carpal bone
F. cannon bone (3rd and 4thmeta-carpals)

a. extensor carpi radialis muscle
b. medial digital extensor
c. common digital extnesor
d. lateral digital extensor
e. M. ulnaris lateralis
~~e~~x
e' its insertion on the metacarpus
e" its insertion on the accessory bone
f abductor pollicis longue
g tendon of the superficial portion of the superficial digital flexor
h tendon of the deep digital flexor
i lateral ligament of the carpal joint
k lateral, distal ligament of the accessory bone, concealing the 5th metacarpal bone

1,1,1 Capsule of the antebrachial-carpal joint
1' its volar dorsal pouch
2,2 capsule of the intercarpal joint
3 capsule of the carpo-metacarpal joint
4 bursa of the tendon of the superficial digital flexor
5 bursa of the tendon of the deep digital flexor
6 bursa of the lateral tendon of the ulnaris lateralis
7 tendon sheath of the lateral digital extensor
8 tendon sheath of the common and medial digital extensor
9,9' bursa under the tendon of the extensor carpi radialis
10 tendon sheath of the abductor pollicis longus
11,11 precarpal subcutaneous bursa, its extent shown by dotted line.

(From - HOECHST 'Topographical anatomical diagrams of injection technique in horses, cattle, dogs and cats").

# CARPAL JOINT




*Lateral View*

## SURGICAL ANATOMY

Since the present study involved only carpal joint and hock joint, it would be pertinent to restrict to the anatomical descriptions of these joints only.

CARPAL JOINT (Sisson, 1953 and I.C.A.R., 1964)

The carpal joint is quite commonly, but erroneously, termed as the knee joint, with which it has no comparison in the human anatomy. It is a composite joint and consists of three sets of articulations.

i. Radio-ulnar carpal articulation between the distal end of radius and ulna and the proximal row of the carpus (ginglymus though not typical).

ii. Intercarpal articulation between the two rows of carpus (ginglymus though not typical).

iii. Carpo-metacarpal articulation between the distal row of carpus and the proximal ends of metacarpal bones (arthrodia).

In addition, articulations are formed between adjacent bones of each carpal row (arthrodia).

The joint capsule may be regarded, so far as the fibrous part is considered, as being common to all three joints. It is attached close to the margin of the articular surface of the radius above, the metacarpus below, its deep face is also attache to a considerable extent to the carpal bones and to the small ligaments.

Fig. 2 HOCK JOINT

A medial view of the tarsus with the skin and superficial tissue removed

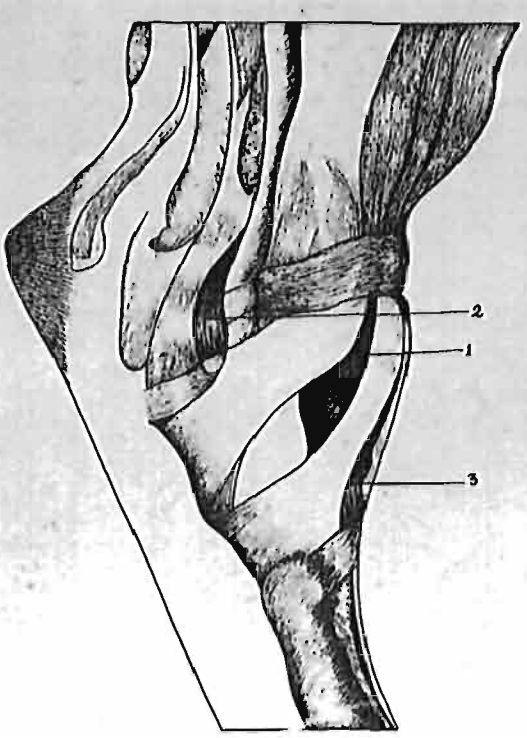
(1) Dorsomedial cul-de-sac projecting between the medial collateral ligament and the tendons of the peroneous tertius and medial branch of the tibialis anterior.

(2) Medioplanter pouch is seen protruding between the tendons of the flexor digitalis longus and deep digital flexor.

(3) A small portion of the tibio-tarsal synovial sac extends distally between the tendons of the peroneous tertius and medial extensor

(From VanPelt, R.W. 1962; Arthrocentesis and injection of bovine tarsus. Vet. Med. 57 : 128).

# HOCK JOINT




Medial view

The carpal joint has three synovial membranes. The radio-ulnar carpal sac lubricates the radio-ulnar joint and that formed by the ulnar and the accessory carpal. The inter-carpal sac lubricates the inter-carpal joint and also the articulation between the bones of proximal and distal rows and communicate distally with the carpometacarpal sac. The carpometacarpal sac is very small and lubricates the carpo-metacarpal articulations and also covers the joint formed between the large and small metacarpal bones.

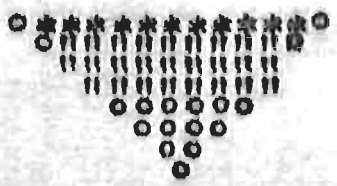
HOCK JOINT

The bovine tarsus is composed of five bones viz. tibial, fibular, first, and the fused central fourth, and the fused 2nd and 3rd tarsal bones. A trochlea on each end of tibial tarsal bone allows flexion of the hock joint at two points, i.e. at the fibio-tarsal and proximal intertarsal articulations. The tibio-tarsal and proximal intertarsal joints are ginglymus in nature although the mobility of the latter is considerably less than that of the former. The balance of tarsal articulations are of the arthrodial types and therefore, their movement is consideraly restricted.

The tarsus has a common fibrous capsule. However, portions of it may be composed of areolar or adipose connective tissue. The lining synovial membrane is divided into 4 synovial sacks, (i) the tibio tarsal, (ii) the proximal intertarsal, which encloses the articulations between the distal trochlea of

tibial tarsal, fibular tarsal and the fused central and fourth tarsal bones; (iii) the distal intertarsal sac which encompasses the articulation between the central tarsal, and the fused second and third tarsal bones, and (iv) the tarsometatarsal sac.

The tibiotarsal sac communicates posteriorly and laterally with the proximal intertarsal sac via the plantar and lateral surfaces of the tibial tarsal bones at its points of articulation with the fibular tarsal bone. There is also a minor avenue of communication with the proximal intertarsal sac at the medial abaxial surface of the proximal trochlea of the tibial tarsal bone and the lateral abaxial surface of the fibular tarsal bone just distal to its point of articulation with the lateral molleolus. Anteriorly, the tibiotarsal and proximal intertarsal synovial sacs are divided by the attachment of a common capsular wall that is attached along the articular margin of the distal trochlea of the tibial bone. Thus, intra-articular injection of the tibiotarsal synovial sac will not only provide therapy for the articulation of tibia and fibula with the tibial and fibular tarsal bones, but also the proximal intertarsal articulation involving the fused central and fourth tarsal bones.



# MATERIALS AND METHODS

## MATERIALS AND METHODS

Twelve calves aged between 1-½ and 2 years procured through contractor locally, provided materials for the study. The animals were kept on seven days pre-experimental observation period. They were housed in comfortable sheds and provided with bedding of dry leaves and paddy straws. Throughout the period of the study they were stall-fed. Balanced ration and clean drinking water were made available.

During the period of pre-experimental observation, temperature, pulse and respiration were daily recorded. Haemagological examination and synovial fluid analysis were also undertaken to preclude any infection.

The animals were randomly divided into three groups of four animals each.

After the period of pre-experimental observation and one day before the actual study, the selected joint was prepared by shaving with safety razor, scrubbing with soap and water, drying with sterile gauze swab and painting with tincture iodine. A protective bandage was applied over the joint and the animal returned to shed.

ARTHROCENTESIS- Carpal Joint

On the day of the experiment, the animal was given 50-75mg. of Largactil by intramuscular injection about 30 minutes earlier. The protective bandage was removed. With the help of 26" gauge ¼" needle 2 cc. Procaine hydrochloride is injected subcutaneously

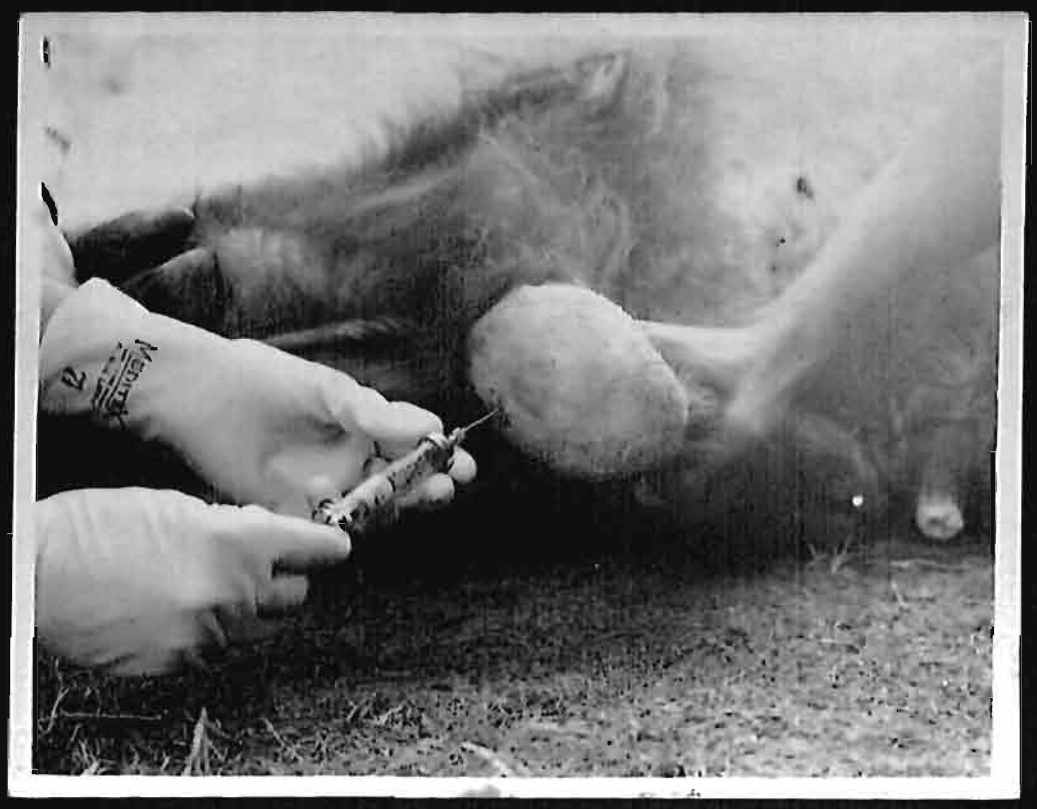


Fig. 3 Arthrocentesis of Carpal Joint

into small area of proposed site of an additional 2-4 cc. of anaesthetic solution is again infiltrated down to the fibrous joint capsule. While allowing time for the anaesthetic to attain its maximum depth of anaeathesia, the injection site was re-prepared by scrubbing with surgical soal and water. After the surgical scrub, the area is then dried with sterile sponges and painted with tincture of iodine which is allowed to dry.

VanPelt (1960-1962) described the site of injection located on dorso-medial surface and Berge and Westheus (1965) advocated dorso-lateral surface of the carpus. Both the sites were suitable to gain entry into the synovial sac but the dorsolateral aspect was easier to approach and advantageous as there was less chances of disturbance by the animal during collection of fluid. The site was easily palpable as depression with the limb flexed, a needle is insertedhorizontally 2-3 cm. deep in the dorsolateral part of the carpus between the tendon of common digital extensor and common extensor carpi-radialis (Fig. 3).

Hock Joint

Preliminary preparations as for carpal joint. The method described by VanPelt (1962) was adopted which runs as follows:-

The most accessible point of entry to the tibiotarsal and indirectly the proximal intertarsal articulations, is through the dorsomedial cul-de-sac of the tibiotarsal synovial sac (Fig. 4). However, the anteriomedial aspect of the tarsus is closely clipped and cleaned with 70 per cent ethyl alcohol

Fig. 4 Site of Arthrocentesis of Hock Joint

to remove hair clippings, sebaceous debris and exfoliated epidermis prior to injection of local anaesthetic using a 26 gauge ½" needle, a small area of the proposed site of needle puncture is subcutaneously infiltrated with one to two cc. of 2 per cent solution of xylocaine. An additional 3.5 cc. of the anaesthetic solution is then infiltrated down to the fibrous capsule. This will anaesthetize the branches of the cephanous nerve that supply sensation to the medial surface of the hock. While allowing time for anaesthetic to attain its maximum depth of anaesthesia, the site is prepared by scrubbing with soap and water for five minutes. After the surgical scrub, the area is then dried with sterile sponges and painted with tincture iodine which is allowed to dry.

If the dorso-medial cul-ce-sac is not approachable due to any obvious reasons, the site for the insertion of the needle is readily palpated at the distal end of the medial malleolus of tibia employing a 16 gauge 2" needle the point of the skin entry is made just distal to the medial malleolus and medial to the cephanous vein. The needle is then directed in a medio-lateral horizontal direction in order to arrive at a point approximately to the midway in the concavity that lies between the sagittal ridges of the proximal trochlea of the tibial tarsal bone. At this time a few drops of synovia will usually appear at the hub of the needle when 10 cc glass syringe is attached to it for aspiration of synovia.

Potent cultures of 3 different species of organisms namely Staph. aureus, E. coli and C. pyogenes were used in saline suspension intra-articularly to induce infection as per details given below:

| | | |
|---|---|---|
| GROUP I | Staph.aureus | Knee joint (two animals)<br>Hock joint (two animals) |
| Group II | C. pyogenes | Knee joint (two animals)<br>Hock joint (two animals) |
| Group III | E. coli | Knee joint (two animals)<br>Hock joint (two animals) |

Infection was introduced into one joint of each animal so that the corresponding joint of the same animal served as control for purpose of comparison of physical symptoms like swelling, warmth, pain, reaction to forced flexion and extension and stance at rest and during progression.

The following studies were undertaken:-

1. Pre- and post-infection temperature, pulse, respiration and haematology.
2. Post-infection physical symptoms upto 10th day.
3. Pre- and post-infection synovial fluid analysis consisting of physical appearance, pH, viscosity, total RBC and WBC content, total sugar content, total protein and alkaline phosphatase.
4. Radiological examination of the joint in selected cases on the 11th post-infection day.
5. Intra-articular therapy on twelfth post-infection day.
6. Post-mortem examination in 6 randomly selected animals after the period of 20 days observation.

Method of collection of synovial fluid for analysis and for introduction of infection

Synovial samples were collected for analysis two days before introducing the infection and also on the third and seventh post-infection days. Samples of synovia were obtained by arthrocentesis of the carpal and tarsal joints after the essential preliminary preparation of the site as already stated earlier.

Synovia was aspirated with dried syringe and needle and transferred into 4 sterile dried test tubes numbered 1-4 for various examinations and estimations. Sample No.1 was collected in test tube containing EDTA to effect a concentration of 2 mg. per ml. of synovia for determination of pH, TLC and RBC count. Sample No.2 was collected in a dried centrifuge tube for determination of alkaline phosphatase, total protein and relative viscosity. Sample No.3 was collected into a small test tube containing sodium fluoride for determination of sugar content. Sample No.4 was collected in small sterile test tube for bacteriological examination.

Sample No.2 was centrifuged at 3000 r.p.m. for 45 minutes to obtain synovial fluid free of cellular material and debris. The supernatant was withdrawn with a sterile pipette into another sterile test tube for determination of ALP, total protein and relative viscosity. For introduction of infection into the joint, first arthrocentesis was performed as already described

and 2 ml of synovial fluid withdrawn. Following this, 2 ml of bacterial suspension in normal saline contained in a sterile syringe was introduced through the same needle into the joint.

Temperature, pulse, respiration and haematology

The temperature, pulse and respiration of each animal were checked every day in the morning and evening and the daily average recorded.

Haematological study consisted of RBC and WBC counts, DLC and PCV and haemoglobin determination. Pre-infection haematological examination was undertaken 3 days before the introduction of infection whereas post-infection haematological examination was done on 3rd and 7th post-infection days.

Collection of blood

Blood samples were collected from the jugular vein of the animals in the morning. Each time about 10 ml. of blood was withdrawn with sterile, clean and dry needle and syringe and transferred into 3 sterile dry test tubes numbered 1 to 3. The first test tube contained dried dipotassium ethylene-diamenetetraacetate (EDTA) to effect a concentration of 2 mg. per ml of blood for normal haematology. The second test tube (10 cc. centrifuge tube) contained 5 cc. of blood sample for separation of serum. The third test tube contained sodium fluoride (10 mg. per ml. of blood) as anticoagulant for estimation of blood sugar.

Method of blood examination

The following methods were employed in the examination of blood samples.

1. Differential leucocyte count- For staining and examination of blood smears, grease free slides were used. Blood smears were prepared out of sample from the tube containing EDTA. These smears were then dried and stained with Leishman and further processed conventionally for differential leucocyte count. 300 corpuscles were counted in each smear and the average recorded.

2. Enumerating the total leucocyte count- Blood collected on EDTA was drawn into leucocyte diluting pipette upto the standard mark and diluted with diluting fluid upto the 11th mark. The contents of the pipette were mixed by rolling it between palms gently. The number of cells counted in the 4 corner squares of the improved Neubauer ruling chamber were multiplied by fifty for estimation of leucocytes per cmm. of blood.

3. Enumerating total erythrocyte count- Bllod was drawn into the erythrocyte diluting pipette upto the 0.5 mark and the pipette filled with diluting fluid upto the 101 mark. The contents were mixed as in WBC count. The number of cells counted in the five small squares of the improved Neubauer ruling chamber was multiplied by 10,000 to obtain total erythrocyte count per cmm. of blood.

4. Determining the Packed Cell Volume (PCV)- The PCV was determined with the help of Wintrobes haematocrit tube.

One ml of blood was pipetted into the tube which was then centrifuged at 3000 r.p.m. for half an hour. The PCV was noted in percentage.

5. Estimation of Haemoglobin (Hb)- Hb was determined in grams per 100 ml. of blood by Sahli's standard haemoglobinometer. A measured quantity of blood was transferred into the haemoglobinometer tube and treated with N/10 hydrochloric acid and the resulting colour was compared with the standard.

Chemical Estimations in Blood

SUGAR- Total blood sugar content was determined by the method of Hagedorn and Jensen (1923).

In a dried test tube, pipette one ml of 0.1 N NaOH and 5 ml. of 0.45 per cent zinc sulphate solution. A gelatinous precipitate of zinc-hydroxide forms 0.1 ml of blood from a capillary pipette is introduced into the test tube and the pipette washed out twice with the contents and blown empty. Put the test tube in a boiling water bath for 3 minutes; filter with a funnel of 3 to 4 cm. diameter, prepared witha small filter of washed, moistened, tightly pressed cotton, into a test tube and washed the funnel and filter with two 3 ml. portions of water. Add 2 ml. of alkaline potassium ferricyanide solution and heat in a boiling water bath for

15 minutes. Cool and add 3 ml. of iodide-sulphate solution and 2 ml of 3 per cent acetic acid solution. Titrate with 0.005 N sodium thiosulphate solutiong using as an indicator 2 drops of 1 per cent solution of soluble starch in saturated sodium chloride solution.

Calculation- Determine the blank obtained by carrying through the whole determination but without addition of blood. The sugar present in blood sample is calculated as follows:-

The thio-sulphate burette reading was substracted from the ferricyanide added in the sample. This value is x (ml. of ferricyanide reduced by the sugar present in 0.1 ml. of blood sample).

Because 2 ml of ferricyanide is reduced by 0.385 mg. of sugar, therefore, mg. per cent of sugar

$$= .385 \times \frac{X}{2.0} \times 1000$$

Estimation of total serum protein

The estimation was performed by direct Nesslerisation as described by Hawk et al. (1954)

Procedure- 1:50 dilution of serum was prepared and 1 ml. of it was digested in a micro-Kjeldahl flask with 1 ml. of 1:1 sulphuric acid. One drop of per sulphate solution was added as catalyst. After complete digestion

the material was transferred to a 50 ml. test tube by washing the micro-Kjeldahl flask with distilled water. The test tube was cooled by placing in iced water and then 15 ml. of Nessler's reagent were added and the volume was made to 50 ml. with cold distilled water. At the same time standard solution was prepared taking 3 ml. of standard ammonium sulphate solution into another 50 ml. test tube and 15 ml. of Nessler's reagent was added and the volume made to 50 ml. with cold distilled water. Density of the solution was measured in E.E.L. colorimeter.

Calculation-

$$\text{Total Nitrogen in g.} = \frac{\text{Reading of unknown}}{\text{Reading of Standard}} \times .15 \times \frac{100}{0.02 \times 1000}$$

$$\text{Total Protein in g/100 ml of serum} = \text{Total Nitrogen} \times 6.25$$

ESTIMATION OF ALKALINE PHOSPHATASE (ALP)

Estimation of ALP activity was performed as per details given below:

In a test tube 9 ml. of alkaline phosphatase substrate was taken and put in incubator at 37°C for 5 minutes and then added 1 ml. of serum and mixed the content well. The test tube was then put in the incubator at 37°C for 60 minutes. After that 2 ml. of 30 per cent trichlor-acetic acid was added and thoroughly mixed by inverting the test tube with the help of thumb while a gelatinous precipitate appeared

after 2 minutes following which filtration was done using Whatman's No.1 filter paper.

In 60 minutes incubation period blank and control were prepared. For control, 9 ml. of ALP substrate were taken in a test tube to which 2 ml. of 30 per cent trichlor acetic acid was added besides 1 ml. of serum. The contents were well mixed filtered and labelled as control.

For blank 9 ml. of ALP substrate, 1 ml. distilled water and 2 ml. of 30 per cent trichlor acetic acid were taken in test tube, mixed well and labelled as blank.

In the other test tube 8 ml. of the corresponding filtrate was pipetted to which was added 1 ml. of molybdate reagent, mixed and again added 0.4 ml. aminonaphthol sulphuric acid reagent and 0.6 ml. of distilled water to make the volume 10 ml. The solution was left for 6 minutes. In the Bausch and Lomb spectronic 20 colorimeter, 100 per cent transmittance with blank at wave length 700 mμ was set. The blank was replaced with unknown and control and the ALP units were read in Bodansky units per 100 ml. of serum.

Physical symptoms-

Observation of physical symptoms in connection with the infected joint commenced from the date following introduction of infection. The points observed were swelling by visual examination as well as palpation, warmth by palpation and by comparison with the health joint, pain by

applying digital pressure and limitation of movement by undertaking forced flexion and extension. Besides these, the animal was also observed during standing and also during movement to study the stance.

Analysis of Synovia

Synovial analysis was done both in pre- and post-infection periods.

1. pH - The pH of freshly collected synovia was determined by putting a drop of it on a strip of pH paper (BDH) and matching with the standard colour index. The reading was noted for record.

2. Physical appearance- The physical appearance of synovia was examined visually and the colour noted. The colour varied in different sample. Besides colour, presence or absence of flocculent material was also looked for and noted for record.

3. Viscosity- The viscosity of synovia was determined by viscosimeter following the method of Hawk et al. (1954).

The apparatus is kept in a constant temperature water bath (37°C) during the determination. Test with water first. By means of pipette introduce 2 cc. of distilled water into bulb E, blow at F and force the liquid above mark C. The fluid column should still reach to bulb E. Allow it to flow back and note the time with a stop watch for the meniscus

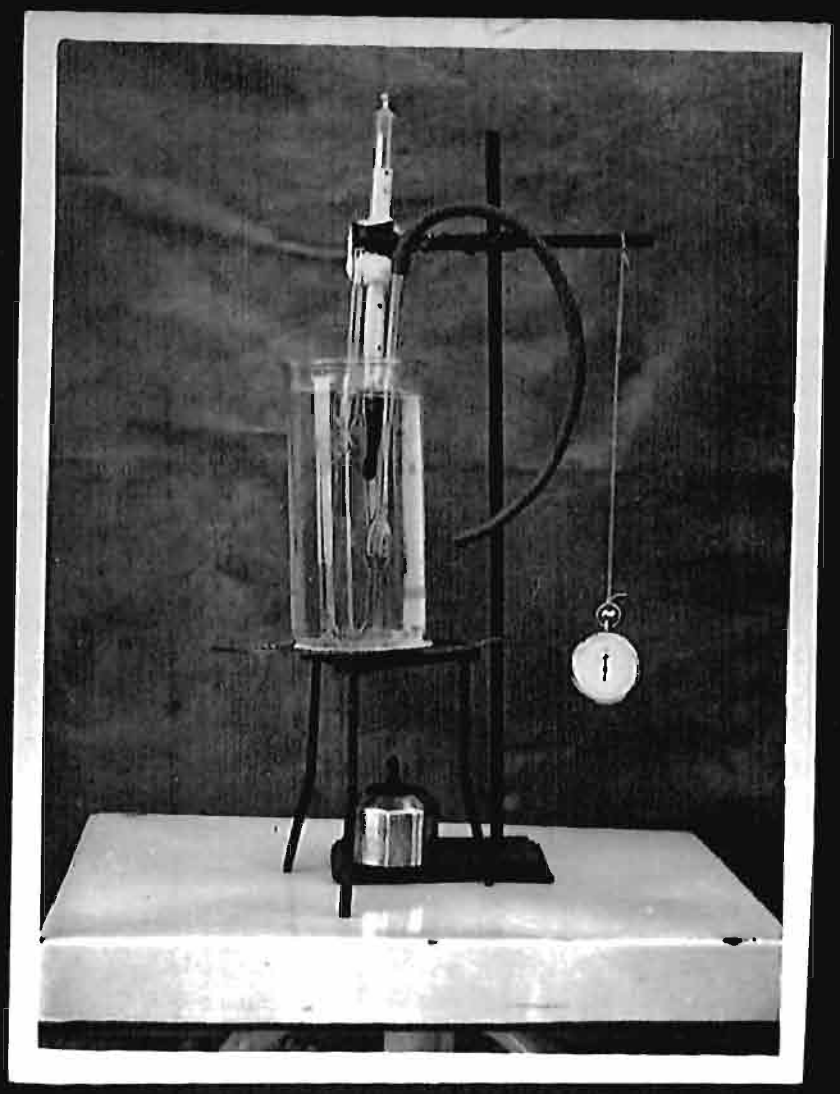


Fig. 6 Viscosimeter assembly

to pass from C to D. Repeat the method until constant values are obtained. Nowrepeat with synovial fluid sample and calculate the relative viscosity of the synovial sample. When working with infected samples use a rubber tube adopter for blowing at F to avoid chances of personal infection (Fig. 6 and 7).

4. Cellular contents- The total erythrocyte and leucocyte of synovia was performed by the same method adopted for their determination in blood and has already been described earlier in this thesis. The only difference was that 1 per cent methyl violet solution in normal saline was used as diluting fluid for leucocyte count.

5. Total protein and sugar and ALP activity were determined by following the same method as described for their determination in blood.

RADIOLOGICAL EXAMINATION

Animals showing severe post-infection local symptoms were selected for radiological examination.

Thirty minutes before the radiological examination the animal was sedated with 50 to 75 mg. of largactil depending on body weight given by intramuscular injection. The surface over the joint was cleaned by mopping with moist swabs and finally drying with dry swabs. The radiograph was obtained with the animals in standing position. Only one view of the

joint was taken. The animal was made to stand near the X-ray tube with the joint to be radiographed at a distance of 36". The casette was held at the back of the knee joint and on the medial aspect of the hock joint for the radiography of these two joints. The necessary factors were previously chosen and exposure given. The film was processed in the conventional way, dridd by hanging in the dark room, numbered and preserved for interpretation. Extreme precaution was taken in the selection of factors to avoid chances of movement during exposure.

INTRA ARTICULAR THERAPY

Intra-articular therapy was given into the affected joint on the twelfth post-infection day. All the animals were given identical therapy which consisted of 200 mg. of oxytetracycline and 25 mg. of hydrocortisone acetate intra-articularly after withdrawing as much of the infected synovia as possible. The preliminary precautions and preparations as mentioned for arthrocentesis were undertaken for intra-articular therapy also. A light protective bandage was applied over the joint and the animal returned to the shed.

POST MORTEM EXAMINATION

After 20 days of post-infection studies and observations 2 animals from each group (6 in all) were randomly selected ahd sacrificed for autosical examination of the affected joint. The findings in respect of macroscopical appearance of the different components of the joint including the colour of synovia were noted. No histopathological study was, however, undertaken.

## CLINICAL CASES

### CASE No.1

A six year old bullock (O.P.No.774) was brought to the hospital with the complaint of lameness in both forelimbs. Physical examination showed swelling of both knee joints (Fig. 8), and frequent shifting of weight from one limb to the other. Palpation revealed cold joint moderately painful and manual flexion indicated restricted mobility. Paracentesis revealed slightly turbid synovia in both joints. In the absence of any definite history besides normal temperature, pulse and respiration a tentative diagnosis of traumatic arthritis was made although signs of trauma were not visible.

### Treatment

After sedation with largactil and anaesthetisation of the skin at the proposed site of intra-articular approach, 250 mg. of oxytetracycline and 50 mg. of hydrocortisone acetate were given into each joint after aspirating as much of synovia as possible. Advised rest for a week. On the 3rd day after the treatment the swelling over both joints subsided and definite improvement in gait was noticed.

The same treatment was repeated on the 7th day with 50 per cent reduction in the dosage and the animal discharged at owners insistence.

CASE No.2

Cow calf, five months old (O.P.No.883) belonging to the District Dairy Demonstration Farm, Mathura, was brought to the hospital with the complaint that the animal was lame in the right hind fetlock joint (Fig. 10). Physical examination revealed a swollen right fetlock joint, hot to touch and painful. Close examination showed signs of trauma on the posterior aspect of the joint. The temperature, pulse and respiration were within the normal range.

A tentative diagnosis of traumatic arthritis was made.

Treatment

For the first two days the joint was covered with thick cotton wool pad soaked in white lotion and retained in position with a bandage which was removed on the 3rd day. The swelling showed slight decrease. 100 mg. of oxytetracyclin and 25 mg. of hydrocortisone acetate were given intra-articularly and a pressure bandage was applied over the joint. With this treatment the animal showed improvement on the 3rd day when it was discharged. The lameness had diminished significantly by this time.

CASE No.3

A cow calf, eight months old (O.P.No.1599) belonging to District Dairy Demonstration Farm, Mathura was presented at

the hospital with the complaint of anorexia and difficulty in movement. Physical examination revealed elevated temperature (103°F), pulse (40 per minute) and respiration (106 per minute). Both hock joints were swollen (Fig. 9), painful on palpation and hot to touch. There was wound on the lateral aspect of each joint. D.L.C. revealed lymphocytosis and neutropenia. Paracentesis of the joint revealed slightly reddish, turbid and opaque synovial fluid.

A tentative diagnosis of infectious arthritis was made.

Treatment

100 mg. of oxytetracycline and 25 mg. of hydrocortisone acetate were given intra-articularly into each joint after aspiration of synovia.

The animal showed miraculous improvement after 48 hours and maintained the progress.

CASE No.4

Female cow calf No.17 belonging to the District Dairy Demonstration Farm, Mathura, was brought to the hospital with the complaint of swollen left knee joint.

Physical examination revealed a swollen left knee joint with a wound on the joint discharging pus.

A tentative diagnosis of septic arthritis was made.

Treatment

The animal was treated conventionally with antiseptic wash, antiseptic dressing and antibiotic parenterally. After protracted treatment the animal improved but there was definite restricted mobility of the joint.

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Fig. 8 Both carpal joints affected (bullock)

Fig. 9 Both hock joints affected (Cowcalf).

Fig. 10 Right fetlock joint affected (cow calf)

# RESULTS AND DISCUSSION

## RESULTS AND DISCUSSION

Successful establishment of infection was evident from the physical symptoms which usually developed 48 to 72 hours after the introduction of infection intra-articularly. The affected joints showed different degrees of inflammation characterised by varying degrees of swelling, hyper-arthrothermia and hyper-arthresthesia, pain, lameness, transient to static arthrogryposis in all the animals. These findings are in agreement with those of VanPelt (1966, 1968 and 1970). The physical symptoms mentioned were most apparent and marked in animals of group I infected with Staph. aureus organism. Next in order of severity of physical symptoms were animals of group III followed by animals of group II. However, VanPelt (1966) stated that the most severe joint affections were produced by C. pyogenes organism alone or in combination with Streptococcus species. In the present study, however, arthritis induced with C. pyogenes organism (Group II) was of sub-acute and chronic nature in view of the fact that appreciable visible symptoms of arthritis appeared almost on the seventh post-infection day whereas they were apparent within 48 to 72 hours of introduction of infection with Staph. aureus and E. coli. In none of the animals there was remission of the physical symptoms till the 12th day when intra-articular therapy was instituted.

The animals included in this study were almost of identical age and also procured through the same source and thus they may be considered to represent an almost homogenous population. The animals were kept on a rigid seven day pre-experimental observation period obviously to preclude chances of any hidden or exosting infection. The same regimen of diet and management further obviated chances of experimental errors attributable to different feeding and managemental practices.

Since observations on the different attributes of blood and synovia were made in the same animal before and after introduction of infection, each animal served as its own control. Indirectly, it may be said that in each group of four animals, identical number of controls were also run.

Temperature, pulse and repiration (TRP) are indicators of normal physiological functions of the body. Increase or decrease in their range and rate is indicative of diseased condition due to varied etiological factors including microbial infection and "Stress phenomenon".

In the present study, however, as is evident from Table I, there has been an increase in the temperature in the post-infective stage in almost all animals. However, keeping in view the normal range of temperature in this species of animal, the increase appears to be within the normal range and hence not of much diagnostic signifance. The non-significant increase in temperature can probably

be accounted for the post-infection stress. VanPelt (1966) stated that in infectious arthritis in calves attributed to metastasis of bacterial organisms to the joint cavity, calves generally had an elevated body temperature.

The mean rate of pulse and respiration in the pre- and post-infection periods have been found to be 52.7 and 20.46; 62.20 and 22.32 respectively. It is apparent that change in rate of pulse and respiration are also non-significant when considered as diagnostic factors.

The mean haemoglobin and PCV values of the experimental animals in the pre- and post-infection periods found in this study are 10.83 gm. and 35.08 per cent and 9.73 and 31.03 per cent respectively. These values also appear not to have shown significant change although in the post-infective stage there has been definite decrease in their mean values when compared groupwise as well as overall. This is in confirmation with the finding of VanPelt (1970) who observed that mean Hb content and PCV in blood samples from infectious arthritic cattle were reduced in comparison to these mean values for control cattle. Van Pelt (loc.cit.) in his observations on idiopathic septic arthritis in calves also stated that the Hb content and PCV in blood samples from calves affected with idiopathic septic arthritis were slightly less than the Hb content and PCV in control calves.

As is evident from Table II the RBC and WBC counts in the pre- and post-infection stages showed a difference and of these two attributes of blood, RBC showed a decrease and WBC an increase after the introduction of infection. The mean pre- and post-infection values of RBC in the different groups (Group I to III) are 5.5, 6.35, 5.82 and 5.5, 3.70, 4.89 respectively and thus there has been a significant fall in the total RBC value in group II in post-infection period in which the animal was infected with C.pyogenes.

In contrast to RBC values, WBC showed a rise in all the groups. The pre- and post-infective mean WBC values group-wise are 10262, 9637, 11037 and 11862, 12616 and 15650 respectively. Since leucocytosis is the result of the stress of infection, the increase in the mean WBC values are explained by this fact. The increase in the mean values has been maximum in group III, followed by group II and Group I. According to this finding, E. coli organism appears to be most pathogenic of the three types of organisms used. VanPelt (1970) also observed elevated TLC in arthritic cattle in comparison to control animals. The same author (loc.cit.) in connection with degenerative joint disease of carpus and fetlock in cattle, however, observed little difference between mean TLC in arthritic and control groups of animals. As regards pathogenicity our finding of E. coli being more pathogenic

than C. pyogenes and Staph. aureus, is in variance with VanPelt (1966) who stated that most severe joint infections were produced with C. pyogenes alone or in combination with Streptococcus organisms.

The mean differential leucocyte count in the pre- and post-infection periods shows neutropenia in group I and group II and neutrophilia in group III. Besides this, there has been lymphocytosis in group I and lymphopenia in group II whereas group III did not show any change in the lymphocyte values in the post-infective periods.

The chemical analysis of blood for estimation of sugar, protein and ALP in the pre- and post-infection periods have shown some significant findings (Table III). The mean protein values in the post-infection period has shown significant rise in group I and group II and appreciable rise in group III. The mean sugar value in group I has shown a rise (96.11 against 77.95) and a fall in group II and group III. The fall in mean blood sugar content in group II and group III differs from the findings of VanPelt (1970) who reported mean blood sugar content in control cattle significantly less than the mean blood sugar contents of arthritic cattle. The same author (1968) in connection with traumatic arthritis in cattle observed blood sugar values in both arthritic and control cattle within normal limits. Further, in 1970, in connection with

degenerative joint disease of carpus and fetlock joints of cattle, he found that mean sugar content of blood of arthritic cattle was significantly less than that of control cattle. From these observations it appears that much diagnostic importance cannot be attached to the blood sugar level in arthritic animal.

The ALP activity in the post-infection period has shown a fall in all the 3 groups. VanPelt (1970) did not observe any significant difference in the ALP activity values between arthritic and control cattle. With this observation in view, the finding in the present study in so far as blood ALP is concerned, differs from VanPelt (loc.cit.).

## SYNOVIAL ANALYSIS

### Carpal Joint

Table IV shows the results of analysis of synovial fluid including its physical characters in the pre- and post-infection periods. In the pre-infection period samples collected from all the animals were clear, viscous and free from any flocculent material. The average clotting time in all the samples were almost identical. In the post-infection period in group I, the synovia was less viscid and turbid and reddish in one. This reddish colouration could have been the result of trauma at the time of aspiration. Cornelius and Kaneko (1963) also stated that when red blood cells are found

in the fluid, they are usually the result of trauma occurring due to aspiration technique. Collins (1936) also stated that it is certain that trauma inflicted by the passage of the needle through the vascular synovial membrane accounts for some of the blood found in the synovial fluid.

In group II, in the post-infection period the synovia was opaque, pale yellow and contained floculli in one sample. Cornelius and Kaneko (1963) observed that pathological haemorrhage into the joint produces a yellow coloured synovial fluid from the presence of bilirubin formed in the fluid.

In group III, the synovial fluid was thin, reddish and opaque. The thinness of the synovia is the result of infection present into the joint. Incidentally, it may be mentioned here that the animals of this group were infected with E. coli culture and on the basis of leucocytic response obtained, this organism has been found to be most pathogenic of the three types of organisms used.

Hock Joint

The synovia of hock joint in group I was less viscid and turbid, in group II opaque and pale yellow, in group III thin, reddish and opaque.

Thus the physical characters of synovial fluids obtained from carpal and hock joints have not shown any significant difference probably because of the identical organism used.

pH

The pH in the pre- and post-infection periods have not shown any significant change and remained alkaline (8.5 to 9.50) throughout. Cornelius and Kaneko (1963) reported average pH of joint fluid in cattle as 7.31. Levene and Meyer (1912) stated that leucocytes have glycolytic properties, and this glycolysis results in an increased pH of the fluid (Boots and Cullen, 1922). Thus the findings of alkaline pH in this study is in general agreement with other workers.

Viscosity

Collins (1936) stated that viscosity is due to synovial mucin. Cajori and Pemberton (1928) pointed out that the removal of mucin (together with some other protein) results in a fall of the viscosity of the fluid to a level lower than that of plasma. They further stated that when the same joint was aspirated twice within the space of a few days, the viscosity of the second sample was lower than that of the first. Blair et al. (1954) also observed that when the joint is repeatedly emptied neither the viscosity nor the quantity of effusion remains constant. They further stated that greater the amount of effusion, the lower is the viscosity. Eisenmenger (1968) observed reduced specific gravity and viscosity following joint puncture or injection into the joint. VanPelt (1968) reported viscosity of traumatic synovial effusion from tarsal joint

lower than that of normal cattle. Further, VanPelt (1970) found the mean relative viscosity value for synovial fluid samples from control cattle significantly higher than the mean relative viscosity value for the synovial effusion samples from arthritic cattle. Cornelius and Kaneko (1963) stated the average relative viscosity of fluid from the hock joint of cattle at 25°C is 3.72 (2.84-4.15) and is chiefly due to the presence of mucin, an acidoglycoprotein, which contains hyaluronic acid. VanPelt (1970) found the mean relative viscosity in cattle as 5.40 (3.53-9.46) in the hock joint. The same author (1970) while reporting on the degenerative joint disease of the carpus and fetlock in cattle observed the mean relative viscosity of the carpal joint in arthritic cattle at 27.59 as against 50.17 in control cattle.

From the above observations the following conclusions may be drawn:-

1. Relative viscosity becomes lowered in synovial fluid in arthritic condition.
2. The relative viscosity of the synovial fluid in the carpal joint and hock joint differ significantly being higher in the carpal joint.

In the present study also the relative viscosity of synovial fluid in the post-infective period in all the experimental animals was found lower than the pre-infection

relative viscosity values. This is in agreement with workers cited above. Besides this, the mean viscosity values group-wise were significantly lower in the hock joint as compared to the mean values of carpal joint. This is in agreement with VanPelt (1970).

RBC and WBC

The RBC and WBC values in the synovial fluid have shown significant change. In all the experimental animals there has been a rise in RBC values in the synovial fluid in the post-infection period. This rise in the case of carpal joint has been almost 100 per cent in group I and 400 per cent in group III, where there has been a fall by 5000 in group II. In case of hock joint in group I, the value remains constant. In group II, it decreased by 6,000 and in group III, there was a rise by 25,000. Likewise, the WBC values in carpal joint of group I increased by 11,250, in group II it fell by 2,125 and in group III there was a rise of 7,900. In hock joint in groups I and III, there was significant rise whereas in group II, the rise was appreciable.

Cornelius and Kaneko (1963) stated that the range of WBC in normal bovine joint fluid was between 55 and 575 cells per mm. Ropes et al. (1939) reported the average nucleated cell count for cattle in synovia to be 131 cells per mm. with the range of 65 to 250 cells per mm., while erythrocytes were 140 (0-1540).

Cornelius and Kaneko (1963) reporting on cell counts from synovial fluids of clinical cases in bovines found 4100 per mm. RBC and 46,700 per mm. WBC. VanPelt (1970) reporting on infectious arthritis in cattle found the mean WBC values in arthritic and control cattle as 30,063 and 8350 respectively. The same author (1970) reporting on degenerative joint disease in cattle obtained the mean RBC and WBC values in arthritic cattle as 19,960 and 456±136 respectively, compared to 775 and 104 respectively in control cattle.

The observations on synovial RBC and WBC values are, therefore, in general agreement with workers stated above.

ALKALINE PHOSPHATASE

Bauer et al. (1940) reported presence of higher ALP activity in joint fluid than in the serum of cattle. This has been confirmed in the present investigation also. As is evident from Table V, there has been a fall in the ALP activity in both carpal and hock joints in the post-infection periods. But this fall has been more apparent in the serum samples. VanPelt (1960) stated that, "The ALP activity levels in the synovial effusions from the joints in cattle affected with infectious arthritis never attained the mean level reported for normal dairy cattle (5.07±0.47 sigma units per ml.). Synovial effusions from some joint attained

extremely high ALP activity levels. The neutrophils in synovial fluid also provide a source of ALP". VanPelt (1970) stated that in healthy joints of cattle, synovial fluid ALP is derived mainly from articular cartilages rather than from the cytoplasm of synovial intimal cells. VanPelt (1970) found the ALP activity in synovial effusions from joints of cattle with infectious arthritis caused by C. pyogenes was slightly but significantly higher than serum value. This observation is in agreement with the present finding only in relation to the hock joint. VanPelt (loc.cit.) in connection with synovial effusion changes in idiopathic septic arthritis in calves found that the mean synovial ALP activity values were significantly higher than mean synovial effusion ALP activity value in 3 calves with septic arthritis. The same author (1970) in degenerative joint diseases of the carpus and fetlock of cattle observed the mean ALP activity value for synovial fluid samples was significantly less than mean value for synovial fluid sample of control cattle.

Thus it appears that it is generally accepted that there is fall in the ALP activity value of synovial fluid of arthritic animals and this is in agreement with the findings in this study.

Sugar

From Table V, it is evident that there has been a fall in the mean sugar content in the synovial fluid in the post-infection period in all the three groups of animals. This fall has been maximum in group III in which animals were infected with E. coli organisms. In group II, however, the fall has been comparatively less than in group I.

Collins (1936) stated that the routine estimation of sugar may be well be done on all fluids, as a very low sugar concentration is a strong presumptive evidence of bacterial invasion of the fluid. Allison et al. (1926), Myers, Keefer and Holmes (1934) observed low sugar concentration in infected fluids from which bacteria could be recovered.

Cornelius and Kaneko (1963) stated that the average glucose concentrations of bovine synovial fluid have been found to be slightly lower than the serum glucose level. They further stated that bacterial joint infection and increased cell counts are responsible for low concentration of monosaccharides in the joint fluids from their glycolytic activities. Low sugar levels from glycolysis is quite common in infectious arthritis. The findings of low sugar content in the post-infection period in this study can be explained by above facts.

VanPelt (1968) in infectious arthritis in cattle observed that blood and synovial fluid sugar levels in contrast to

blood and synovial fluid levels of other non-electrolytes are of diagnostic value. In normal cattle, concentration of sugar in synovial fluid is approximately equal to that in blood. The difference between the two concentrations has diagnostic importance. The synovial fluid : blood sugar ratio, 0.5 : 1.0 for cattle affected with infectious arthritis was considerably altered in contrast to the 1:1 ratio reported for normal cattle. He further stated that several factors contributed to reduce sugar levels in synovial effusion from joints affected with infectious arthritis. The degree of initial lag and reduction in subsequent rate of sugar entrance into the joint cavity increases as the severity of the inflammation progresses. This disturbs the normal equilibrium between entrance and utilization of sugar. Further, in connection with observations on C. pyogenes arthritis in cattle VanPelt (1970) stated that the mean synovial effusion sugar content in arthritic cattle was significantly less than their mean blood sugar content. The blood sugar content in control cattle proved to be significantly less than the blood sugar content in the arthritic cattle; the synovial fluid sugar content in control cattle, however, was significantly greater than the synovial effusion sugar content in arthritic cattle.

Observations on the present study are also in general agreement with the above findings.

Total Protein

Fisher (1923) reported 0.92 gm. per cent total protein in the synovial fluid of cattle whereas, Bauer et al.(1930) found 145.1 mg. per 100 ml. total protein nitrogen in the normal joint fluids of cattle. Collins (1934) estimated protein nitrogen of a number of specimens in cases of rheymatoid arthritis and found that total protein content ranged from 2.72 gm. to 8.55 gm. per cent and in two cases of traumatic effusion it was 3.25 and 3.55 gm. per cent. Bauer et al. (1940) obtained average protein concentration excluding mucoprotein in cattle fluid as 0.88 gm. per 100 ml. VanPelt (1970) observed that the protein content in synovial effusion increases as inflammation progresses; synovial effusion protein, however, possesses no lubricating property. VanPelt (1971) analysed synovial effusion samples from 8 arthritic horses and found an increase in the mean total protein content.

Thus the findings in respect of protein value of synovial fluid in the post-infection period in this experiment are in agreement with other workers stated above. Rise in the protein value has been observed in all the 3 groups of animals in the post-infection period. The rise has been most marked in the carpal joint of group I and hock joint of group II.

RADIOLOGICAL FINDINGS

Radiology as a diagnostic aid in the detection of joint diseases needs no emphasis. It is a very useful aid in the detection of diseased condition in the very early stage before clinical symptoms are apparent. Morgan et al. (1962) diagnosed radiographically multiple exostosis in horses. Rhodes (1962) gave demonstrations of degenerative joint disease radiographically in horses. He noted characteristic soft tissue swelling or increased soft tissue density about an articulation, a decrease in the radiolucent joint space and exaggeration of peri-articular contours etc. In contrast to these findings, Morgan (1969) observed peri-articular osteophytes, subchondral bone sclerosis, collapse of joint spaces and sub-luxation or rotation of bones in degenerative joint diseases of stifle in dog. VanPelt (1971) observed radiographic changes in septic arthritis in horses characterised by periarticular soft tissue swelling and distension of joint capsule to some degree in all the horses. Radiographically, bony or cartilaginous defects were not noticed in the joint of 6 of the 8 horses. In one horse evidence of a well developed focus of exostosis on the anterior aspect of the distal end of tibia was present. Narrowed intra-articular spaces or marginal osteophytes were not noticed.

In the present study, monoarticular infectious arthritis was induced with potent bacterial suspension by intra-articular injection. Though radiological examinations were undertaken only in selected cases showing intense local reaction yet such animals on radiological examinations did not reveal any gross defect to the bones or cartilage except soft tissue swelling. This latter finding is in concurrence with other workers mentioned above.

INTRA ARTICULAR THERAPY

In the present study intra-articular therapy was given in all animals on the twelfth post-infection day. A combination of hydrocortisone acetate and oxytetracycline in doses of 25 mg. and 200 mg. respectively were used in all cases. Animals og groups I and III responded to this therapy and improvement was noticed, 48 to 72 hours after the therapy. One animal of group I and two animals of group III required a repetition of the therapy 7 days after the first. All the animals of group I and group III maintained progress till the end of observation period. Animals of group II, however, showed encouraging results but the symptoms reappeared a week after the first therapy given. Repetition was undertaken on 8th day but appreciable improvement could not be observed in any of the four animals of this group.

VanPelt (1963) stated, "Intra synovial therapy is useful as a temporary, palliative, repeatable therapeutic adjunct for treatment of arthritis, tenosynovitis and bursitis. In many instances this type of therapy produces a complete and lasting remission in various synovial and articular disease processes."

The result of present study also confirms the latter part of this statement, although lasting remission could not be observed in animals of group II.

Trussel (1965) achieved encouraging results with intra-articular therapy in 75 horses using corticosteroids. Two of his horses showed definite improvement but later on were found to have carpal fracture. This latter finding indicates the degree of damage which may be present in arthritic diseases but yet may respond to intr-articular therapy of corticosteroids. He further stated that corticosteroids are believed to exert their favourable influence directly on the synovial membrane lining the joint, tendon sheath or bursa. The effective concentration achieved by intra-articular injection can not be attained by any other known method including systemic administration.

Various drugs and even hormones have been suggested for intra-articular injection in cases of arthritis. VanPelt (1967) used intra-articularly 6 M.A.P. in tarsal hydrarthrosis in horses with good results.

Contrary to these findings, Simmons and Johnston (1963) failed to cure cases of mycoplasma arthritis in cattle with tetracyclins systematically as well as intra-articularly. The conflicting findings on the utility of intra-articular use of steroids cannot be appreciably explained but it appears that the varying results obtained are probably due to different steroid derivatives used.

To avoid increased articular pressure and better action of the therapy it would be wise to aspirate as much of the synovial effusion as possible prior to introducing the steroid-antibiotic combination. Since steroids are known to break the tissue barrier, in order, therefore, to avoid chance of spread of infection from the joint it should not be given alone but preferably with broad-spectrum antibiotic.

POST-MORTEM EXAMINATION

Two animals from each group were sacrificed and post-mortem examination of the infected joints conducted on the 20th post-infection day. No significant changes were observed in groups I and II animals except some thickening of synovial membrane. Besides this, the synovial fluid in 3 animals out of four in group I and in all animals of group II were turbid and opaque. Evidence of haemorrhage was not visible.

Animals of group II showed significant changes in their joints at autopsy. The synovial effusions were turbid with putrid odour and less viscous in nature. The periarticular tissue showed signs of oedema. Inter-articular cartilages showed degeneration of different degrees resulting in widening of joint spaces. Evidence of deposition of osteophytes were, however, not observed. Incidentally it may be mentioned here that the animals of this group did not recover even after the repetition of intraarticular therapy. Besides this, changes observed at autopsy were not detected on radiographs. This may probably be explained by the fact that C. pyogenes arthritis is chronic in nature whereas the radiograph was obtained only on the 11th post-infective day. These findings are in agreement with VanPelt (1970) who stated that C. pyogenes arthritis is subacute or chronic in nature. He also stated that degeneration of articular cartilage is usually preceded and nearly always followed by an ingrowth of articular pannus from the perichondral margin of the joint. This latter observation was, however, absent in the present study.

Fig. 11 Right carpal joint of calf No.2

Fig. 12 Right carpal joint of calf No.6

Fig. 13 Right carpal joint of calf No. 9

Fig. 14 Right hock joint of calf No. 12

## TABLE I

## RESULTS OF PRE- AND POST-INFECTION – TEMPERATURE, PULSE AND RESPIRATION

| Group Number | Animal Number | Temperature | | Pulse | | Respiration | |
|---|---|---|---|---|---|---|---|
| | | Pre- | Post- | Pre- | Post- | Pre- | Post- |
| I *Staph. aureus* | 1 | 101.5 | 102.5 | 79.7 | 61.7 | 32.0 | 55.70 |
| | 2 | 102.1 | 102.1 | 52.7 | 56.0 | 44.8 | 34.50 |
| | 3 | 100.4 | 102.2 | 48.5 | 50.0 | 12.5 | 13.70 |
| | 4 | 100.8 | 101.5 | 47.4 | 51.1 | 13.1 | 14.10 |
| Average | | 101.2 | 101.9 | 55.3 | 54.7 | 25.6 | 29.50 |
| II *C. pyogenes* | 5 | 99.9 | 99.5 | 53.4 | 57.3 | 20.8 | 19.3 |
| | 6 | 99.1 | 98.9 | 60.8 | 56.5 | 20.2 | 21.1 |
| | 7 | 99.7 | 99.8 | 54.8 | 62.5 | 22.2 | 20.5 |
| | 8 | 98.5 | 99.5 | 63.4 | 65.1 | 22.5 | 20.5 |
| Average | | 99.3 | 99.4 | 58.1 | 60.3 | 20.9 | 20.3 |
| III *E. coli* | 9 | 97.6 | 101.6 | 45.4 | 37.1 | 13.7 | 17.1 |
| | 10 | 97.9 | 102.3 | 42.5 | 69.7 | 13.1 | 18.2 |
| | 11 | 97.1 | 101.4 | 40.5 | 71.4 | 15.4 | 18.0 |
| | 12 | 97.3 | 100.8 | 50.5 | 72.0 | 17.3 | 15.4 |
| Average | | 97.5 | 101.5 | 44.7 | 71.5 | 14.8 | 17.2 |
| Pooled average | | 99.3 | 100.9 | 52.7 | 62.2 | 20.4 | 22.3 |

Pooled Average = Overall average of all the three groups.

## TABLE II

RESULTS OF PRE- AND POST-INFECTION — HAEMOGRAM

| Group No. | Animal No. | Hb | | PCV | | RBC | | WBC | | D L C L | | M | | P | | E | | B | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Pre | Post |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| I | | | | | | | | | | | | | | | | | | | |
| Staph. aureus | 1 | 10.0 | 8.5 | 35 | 30 | 6.5 | 6.1 | 9600 | 11000 | 45 | 50 | 2 | 7 | 32 | 42 | 15 | 1 | 0 | 0 |
| | 2 | 11.0 | 9.5 | 35 | 30 | 5.2 | 6.0 | 10200 | 13500 | 31 | 49 | 16 | 11 | 48 | 37 | 5 | 3 | 0 | 0 |
| | 3 | 10.5 | 9.0 | 33 | 30 | 5.2 | 5.0 | 9750 | 10250 | 54 | 71 | 5 | 3 | 41 | 26 | 0 | 0 | 0 | 0 |
| | 4 | 11.0 | 10.0 | 34 | 29 | 5.1 | 5.0 | 11500 | 12700 | 52 | 78 | 4 | 1 | 44 | 21 | 0 | 0 | 0 | 0 |
| Average | | 10.6 | 9.2 | 34.2 | 29.7 | 5.5 | 5.5 | 10262 | 11862 | 45.5 | 62 | 6.7 | 5.5 | 41.2 | 31.5 | 5 | 1 | 0 | 0 |
| II | 5 | 10.5 | 9.0 | 34 | 30 | 5.83 | - | 8000 | - | 70 | - | 9.0 | - | 19 | - | 2 | - | 0 | - |
| C. pyogenes | 6 | 10.0 | 9.5 | 35 | 32 | 6.61 | 5.35 | 10500 | 11500 | 84 | 64 | 1 | 14 | 13 | 10 | 2 | 1 | 0 | 10 |
| | 7 | 11.0 | 10.0 | 36 | 32 | 5.65 | 1.21 | 9050 | 9500 | 58 | 32 | 12 | 48 | 27 | 18 | 0 | 1 | 3 | 1 |
| | 8 | 11.5 | 10.5 | 37 | 33 | 7.32 | 4.54 | 11000 | 16850 | 71 | 65 | 5 | 6 | 24 | 28 | 0 | 1 | 0 | 0 |
| Average | | 10.7 | 9.7 | 35.5 | 32 | 6.35 | 3.70 | 9637 | 12616 | 70.5 | 53.6 | 6.7 | 22.6 | 20.7 | 18.6 | 1 | 0.75 | 0.75 | 2.7 |

.... contd.

TABLE II (concld.)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| III | 9 | 10.5 | 9.5 | 34 | 29 | 4.31 | 4.10 | 10550 | 14000 | 64 | 81 | 10 | 0 | 21 | 17 | 6 | 2 | 0 | 0 |
| E. coli | 10 | 11.5 | 11.0 | 37 | 32 | 7.07 | 5.64 | 14400 | 16250 | 66 | 53 | 7 | 1 | 26 | 44 | 1 | 2 | 0 | 0 |
| | 11 | 12.0 | 11.0 | 35 | 34 | 5.31 | 3.92 | 13150 | 15950 | 49 | 54 | 20 | 6 | 30 | 37 | 1 | 3 | 0 | 0 |
| | 12 | 11.5 | 10.0 | 36 | 33 | 6.62 | 5.95 | 6050 | 15400 | 71 | 63 | 6 | 8 | 21 | 29 | 2 | 0 | 0 | 0 |
| Average | | 11.2 | 10.3 | 35.5 | 32 | 5.82 | 4.89 | 11037 | 15650 | 62.5 | 62.7 | 10.7 | 3.7 | 24.5 | 31.7 | 2.5 | 1.7 | 0 | 0 |
| Pooled Average | | 10.83 | 9.73 | 35.8 | 3103 | 5.55 | 4.70 | 10312 | 13376 | 59.5 | 59.4 | 7.7 | 10.6 | 26.6 | 27.2 | 2.8 | 1.1 | 0 | 9 |

Pooled Average = Overall average of all the three groups.

## TABLE III

RESULTS OF PRE- AND POST-INFECTION— CHEMICAL ANALYSIS OF BLOOD

| Group Number | Animal Number | Protein | | Sugar | | Alkaline phosphatase | |
|---|---|---|---|---|---|---|---|
| | | Pre- | Post- | Pre- | Post- | Pre- | Post- |
| I *Staph. aureus* | 1 | 9.375 | 15.450 | 73.10 | 69.30 | 3.5 | 2.5 |
| | 2 | 9.038 | 21.450 | 92.40 | 88.02 | 2.4 | 2.5 |
| | 3 | 6.875 | 5.132 | 77.00 | 96.25 | 0.6 | 0.6 |
| | 4 | 6.875 | 7.187 | 69.30 | 130.90 | 0.4 | 0.4 |
| Average | | 8.040 | 12.304 | 77.95 | 96.11 | 1.72 | 1.5 |
| II *C. pyogenes* | 5 | 21.450 | 27.300 | 84.70 | - | 4.4 | 4.2 |
| | 6 | 7.410 | 19.500 | 84.70 | 57.75 | 5.8 | 6.2 |
| | 7 | 18.525 | 18.325 | 65.45 | 61.60 | 3.0 | 2.5 |
| | 8 | 13.450 | 27.300 | 69.30 | 69.30 | 3.4 | 2.5 |
| Average | | 15.208 | 23.106 | 76.03 | 62.88 | 4.15 | 3.85 |
| III *E. coli* | 9 | 6.562 | 8.125 | 76.230 | 61.60 | 5.4 | 2.6 |
| | 10 | 6.875 | 7. 812 | 78.70 | 26.95 | 1.8 | 1.6 |
| | 11 | 6.250 | 6.250 | 64.42 | 54.00 | 1.2 | 1.8 |
| | 12 | 7.187 | 6.562 | 62.84 | 42.35 | 0.8 | 0.6 |
| Average | | 6.718 | 7.187 | 70.54 | 46.22 | 2.3 | 1.65 |
| Pooled average | | 9.988 | 14.197 | 74.87 | 68.403 | 2.7 | 2.3 |

Pooled Average = Overall average of all the three groups.

RESULTS OF PRE- AND POST-INFECTION — SYNOVIA

| Group No. | Physical characters | | Average pH | | | Average viscosity | | | Average RBC | | | Average WBC | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pre- | Post- | Pre- | Post- | Difference | Pre- | Post- | Difference | Pre- | Post- | Difference | Pre- | Post- | Difference |
| | | | | | | KNEE JOINT | | | | | | | | |
| I | Clear | Less viscid and turbid reddish in one. | 8.25 | 8.75 | 0.50 | 10.919 | 6.44 | 4.479 | 5000 | 10000 | 5000 | Nil | 11250 | 11250 |
| II | Clear | Opaque, pale, yellow with flocculi in one | 8.75 | 9.50 | 0.75 | 12.645 | 6.915 | 5.730 | 60000 | 55000 | 5000 | 125 | 2250 | 2125 |
| III | Clear | Thin, reddish, opaque | 8.25 | 8.50 | 0.25 | 11.485 | 6.730 | 4.755 | 20000 | 80000 | 60000 | 100 | 8000 | 7900 |
| | | | | | | HOCK JOINT | | | | | | | | |
| I | Clear | Less viscid and turbid | 8.75 | 8.25 | 0.50 | 4.07 | 3.655 | 0.415 | 10000 | 10000 | Nil | 206 | 5975 | 5769 |
| II | Clear | Opaque, pale yellow | 8.75 | 9.00 | 0.25 | 3.13 | 2.63 | 0.50 | 40000 | 34000 | 6000 | 75 | 200 | 125 |
| III | Clear | Thin, reddish, opaque | 8.50 | 8.25 | 0.25 | 3.58 | 2.87 | 0.71 | Nil | 25000 | 25000 | 50 | 12225 | 12175 |

## TABLE V

### RESULTS OF PRE- AND POST-INFECTION-- CHEMICAL ANALYSIS OF SYNOVIA

| Group Number | Average Protein | | | Average sugar | | | Average alkaline phosphatase | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pre- | Post- | Difference | Pre- | Post- | Difference | Pre- | Post- | Difference |
| **KNEE JOINT** | | | | | | | | | |
| I | 1.770 | 6.425 | 4.655 | 51.731 | 37.385 | 14.346 | 3.5 | 1.1 | 2.4 |
| II | 2.747 | 4.925 | 2.178 | 86.625 | 76.386 | 9.239 | 5.3 | 4.1 | 1.2 |
| III | 5.312 | 4.837 | 0.475 | 52.235 | 34.650 | 17.585 | 3.4 | 2.1 | 1.3 |
| **HOCK JOINT** | | | | | | | | | |
| I | 3.281 | 5.937 | 2.656 | 106.800 | 76.960 | 29.840 | 6.1 | 0.5 | 5.6 |
| II | 2.872 | 7.747 | 4.875 | 56.787 | 54.625 | 2.162 | 12.2 | 5.2 | 7.0 |
| III | 4.062 | 6.562 | 2.500 | 52.712 | 23.100 | 29.112 | 5.8 | 2.0 | 3.8 |

## SUMMARY

1. Arthritis was experimentally induced by giving intra-articular injection of cultures of Staph. aureus, C. pyogenes, E. Coli organisms in 12 calves.

2. Symptoms of arthritis were apparent on the 3rd post-infection day except in group II animals infected with C. pyogenes organisms.

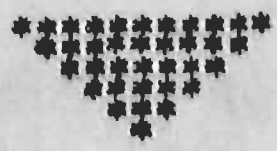
3. Analysis of blood and synovial fluid in the pre- and post-infection periods were undertaken and showed significant differences.

4. In the post-infection periods there was significant rise in protein, R.B.C. and W.B.C. values in the synovial fluids whereas there was a decrease in sugar content and ALP activities.

5. Intra-articular therapy was given using Terramycin and Hydrocortisone acetate in clinical and experimental animals. Animals infected with C. pyogenes did not respond favourably to the therapy.

6. Radiological examinations in selected cases did not confirm the gross pathological changes observed in animals of group II (C. pyogenes).

7. Analysis of synovial fluid gives maximum information about joint diseases even in the early stage and hence its importance as a diagnostic measure is emphasised.



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