



Synovial Fluid Analysis and Biopsy in Diagnosis of Joint Diseases

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Worldwide, Arthritis is a communal clinical incidence of joints, and very predominant chronic disease in India. To evaluate to affect 1% of world's adult population. Biopsies of Synovial fluid are being done as an adjuvant technique to assist in the diagnosis of arthritis. It offers a non-invasive method to diagnose any condition of the joint like traumatic, non-inflammatory/ inflammatory. Cytomorphological examination of Synovial fluids received in the Department of Pathology, Sree Balaji Medical College and Hospital, Chennai. To examine the gross, microscopic, biochemical and microbiologic variations in the synovial fluid in percutaneous synovial biopsy along with synovial fluid analysis was studied in 102 enrolled cases of arthritis. The liquefied was subjected to physical, biochemical and cytological analysis. To correlate synovial fluid cytology with biopsies whenever possible to increase the accuracy of diagnosis. Synovial fluid analysis plays an important role in categorizing various arthritis and thereby helps in arriving at a diagnosis early.

Keywords: Synovium; synovial fluid; cytology and traumatic disorders.

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1. INTRODUCTION

Swelling is usually encountered in clinical practice and is an important cause of morbidity, affecting all age groups and both sexes is called as arteritis. Synovial fluid analysis and biopsy is a valuable adjunct to conventional investigations and are routinely advised in most cases of joint diseases [1]. Synovial fluid fills the spaces in the joint cavities in small amount. It is a viscous, mucinous substance secreted by synovium that lubricates most joints [2]. Excess fluid can accumulate in any synovial joint as a result of a broad range of processes, including non-inflammatory, inflammatory, and septic disorders. In addition, obvious hemarthroses can result from both traumatic and nontraumatic disorders. The ease with which synovial fluid is aspirated from effused joints has allowed a broad spectrum of studies like cytology, immunology, antinuclear – antibody detection, complement levels, therapeutics concentrations of drugs, PCR for detecting different microorganisms in arthritis patients, enzymes like acid phosphatase and other enzyme levels to be conducted [3]. A number of widely available biochemical tests may add to the diagnostic impression of aspirated synovial fluid samples, although lack of specificity of these biochemical analyses tends to limit their value [3].

Aspiration of joint fluid is indicated for any patient with a joint effusion or inflamed joints [2]. Sampling synovial fluid is among the most useful test available to the clinician evaluating the patient [4]. In cases where septic or crystal-induced arthritis is suspected, as in acute monoarthritis, synovial fluid analysis is critical for making the diagnosis. It forms a vital step in the diagnosis and management of arthritis [5]. Sampling of synovial tissue is a direct approach to defining the pathologic processes that cause joints to be swollen and painful. In clinical settings, it is valuable in evaluating an undiagnosed persistent monoarthritis when other investigations, including synovial fluid analysis, have failed to provide a specific diagnosis.

In cases of undiagnosed chronic monoarthritis, synovial biopsy may provide absolute to evaluate the efficiency of arthroscopic synovial biopsy as a diagnostic aid and study the characteristics of synovial fluid in various joint diseases of conditions such as tuberculosis, sarcoidosis, and pigmented villonodular synovitis. SF analysis and biopsy helps to distinguish between various inflammatory, noninflammatory, traumatic, crystal induced and metabolic arthritis [5-10].

2. MATERIALS AND METHODS

The study of synovial fluid analysis and biopsies was conducted in the department of Pathology, Sree Balaji Medical College and Hospital, Chennai. The study was conducted during the period from April 2015 – September 2016. Joint fluid was obtained by arthrocentesis, from 102 joint effusion cases. The aspirations were done by orthopedic surgeons. Synovial fluid analysis was done before biopsy for histological confirmation. The synovial biopsies were obtained by open method in the operation theatre. After obtaining the specimens, detailed gross examination was done and salient morphological features were recorded and the whole biopsy material was fixed in 10% formalin for 12 - 24 hours. Finally representative bits were given. Tissues were processed routinely and paraffin blocks were prepared. 4 μ thin sections were cut and stained with haematoxylin and eosin routinely and wherever necessary special stains like Ziehl–Neelsen stain for Acid Fast Bacilli, Prussian blue stain for haemosiderin were carried out. Sampling size - 102 patients with one or more joint discharges.

2.1 Source of Data

Patients attending OPD and admitted patients in the Orthopaedic department at Sree Balaji Medical College and Hospital, Chennai.

2.2 Inclusion Criteria

All the patients with one or more joint effusions were included in the study.

2.3 Exclusion Criteria

Whether by arthrocentesis or arthroscopy to prevent septic contamination of the sterile joint in patients with septicemia or with cutaneous soft tissue infection mimicking acute arthritis were not subjected to arthrocentesis to avoid direct introduction of the offending organisms into the joint space.

2.4 Specimen Collection

Synovial fluids were collected with sterile, disposable needles and plastic syringes to avoid contamination by birefringent particulates. Oxalate, lithium heparin and powdered ethylenediaminetetraacetic acid (EDTA) anticoagulants were avoided because they form

crystal artifacts that may be misleading during aspiration.

2.5 Total Cell Count

Cell counts are performed using Neubauer's counting chamber. Using WBC pipette synovial fluid is drawn up to 0.5 mark and diluted with RBC diluting fluid by drawing up to [11] mark. Traditional WBC diluting fluid cannot be used as it contains acetic acid that causes the formation of mucin clots.

2.6 Haematoxylin and Eosin Staining Method

1. Deparaffinised slides were immersed in 2 changes of xylene and then hydrated by passing through 2 changes of absolute alcohol and 2 changes of 95% alcohol before bringing section to running water.
2. Rinsed in running water for 1 minute and then briefly with distilled water.
3. Immersed in Harris hematoxylin for 5 minutes and rinsed in tap water.
4. Differentiated by dipping 3 -4 times in 1% acid alcohol and then washed briefly in tap water.
5. Blueing done with lithium carbonate until section turned blue.
6. Rinsed in distilled water for 10- 15 minutes.
7. Stained with 1% aqueous eosin for 15 seconds to 2 minutes.
8. Dehydration by passing through 2 baths of 95 % alcohol for 1 minute each and then cleared in 2 changes of xylene.
9. Mounted in D.P.X.

Finally, histopathological gauges assessed though inferring the lesions comprised hypertrophy and hyperplasia of the synovium, proliferation of synoviocytes, proliferation of villi, occurrence of fibrin and its location, sorts of inflammatory cells and their distribution, presence of bone and cartilage fragments with or without inflammation, capillary proliferation with or without inflammation, pannus formation, presence of hemorrhage, and hemosiderin pigment. Conditions for specific histopathological diagnosis of various joint diseases.

3. RESULTS

The following observations were made in this study of joint effusions. A total of 102 synovial fluid and biopsies were studied.

Of the 102 synovial fluid samples analyzed, 93 patients had a single joint involvement and in 09 cases more than one joint involvement was present. In all the cases the knee joint was aspirated. The fluid was not diagnostic in 09 cases. Duration of joint swelling was from one week to seven years. Swelling was present in all cases. Deformity was seen in 30 cases. On examination swelling of the knee joint was present in all cases. Pain and restriction of movement was present in 52 cases.

4. DISEASES

Volume of SF aspirated ranged from 2 to 10 ml. Straw yellow color fluid was aspirated in 78 cases, white in 16 cases, haemorrhagic in 05 cases, yellowish to brown in 02 cases and gray in 01 case. The age range was between 45 -72 yrs, with a mean age of 63.2 yrs. 11/15 were male and 4/15 were female patients with M: F ratio of 11:4. Right knee joint was involved in 06/15 and left knee joint in 03/15 patients. Both knee joints were involved in 06/15 patients. The duration of swelling was between 6 months to 4 years with a mean age of 2.5 yrs.

The patient was a 63 year old male with right knee joint involvement. Serum uric acid level was 9.2 mg/dl. The age of patients ranged from 30 - 70 yrs with a mean age of 47.8 yrs. 4/9 cases were male and 5/9 were female patients. Right knee joint was involved in 5/9 patients and left knee joint in 4/9 patients. Wet mount examination which is a very important aspect of SF analysis could not be done. The total cell count could also not be estimated as SF reaches the laboratory after 24 hours without refrigeration. SF samples were only ideal for making permanent stained preparations.

4.1 Microscopic Examination

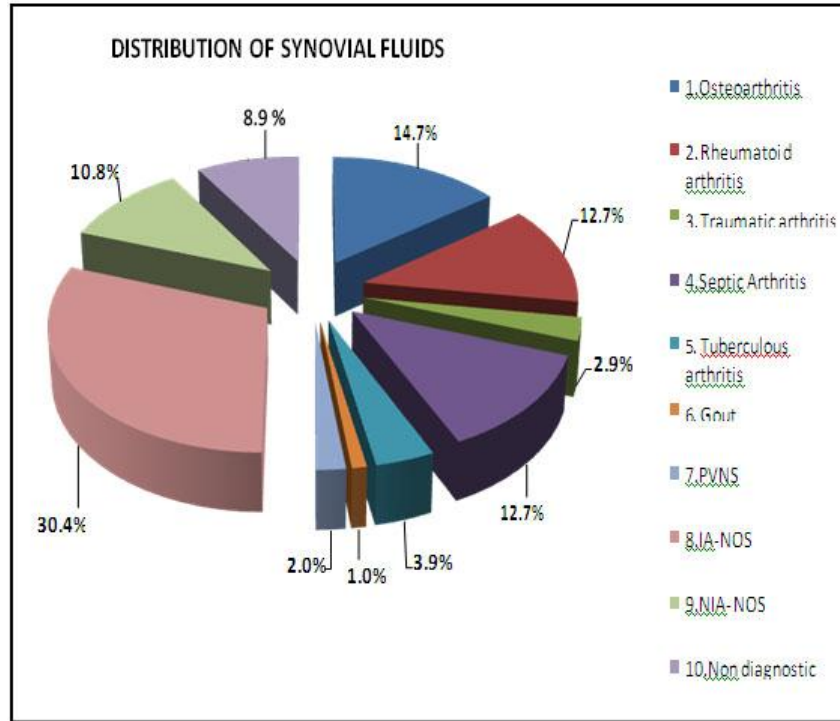
Hyperplastic and congested synovial membrane overlying fibrocollagenous stroma, enclosing islands of eosinophilic amorphous material surrounded by histiocytes and foreign body type of giant cells (Figs. 12, 13).

5. DISCUSSION

In the present study, a total number 102 SF and 102 SB were analysed. 93 SF were diagnostic fluids which were correlated with the SB. Male to female ratio was 1.37:1. The most commonly affected age group was 50 -60 years. 8-11 Out of the 102 synovial fluid samples received, only 93 were diagnostic but in case of synovial biopsy a

definite diagnosis was made against all the biopsy samples received. 09 Samples which were diagnosed as non diagnostic aspirate in SF

were diagnosed as bursitis, synovial chondromatosis and ochronotic arthritis in SB [12].



Graph 1. Showing distribution of sf cases

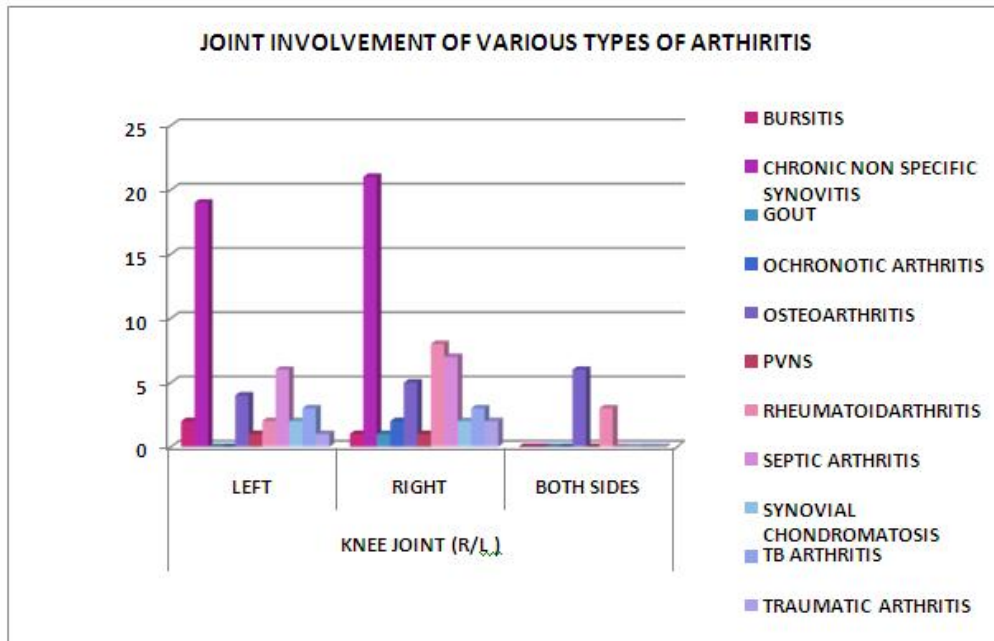
Table 1. Sex wise distribution of cases with joint effusions

Sex	Frequency	Percentage (%)
Female	43	42.2
Male	59	57.8
Total	102	100.0%

Out of 102 samples studied, 59 were from male patients and 43 were from female patients. Male: Female ratio was 1.37: 1

Table 2. Gross appearance of synovial fluids

S. No	Diseases	Clear	Opaque
1	Osteoarthritis	12	03
2	Rheumatoid arthritis	01	12
3	Traumatic arthritis	-	03
4	Septic arthritis	-	13
5	TB arthritis	-	04
6	Gout	-	01
7	PVNS	-	02
8	IA- NOS	01	30
9	NIA- NOS	06	05
10	Non diagnostic aspirate	-	09



Graph 2. Joint involvement of various diseases

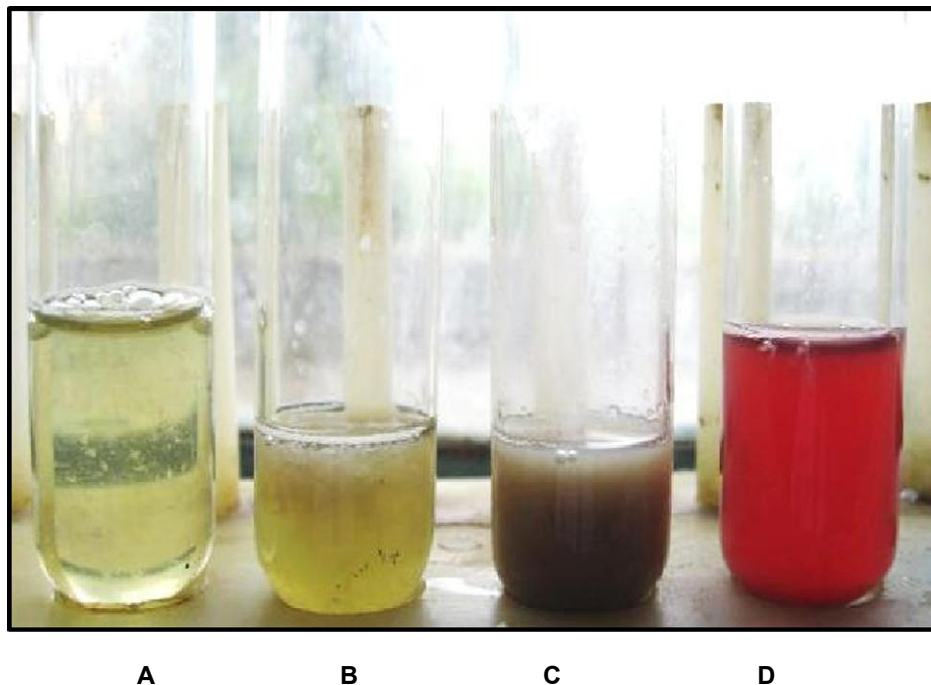


Fig. 1. Samples of SF from various diseases affecting knee joint

Tube A : Osteoarthritis - clear, straw yellow color Tube B : Zheumatoid arthritis - opaque, yellow Tube C : Septic arthritis - opaque Tube D : Trauma – hemorrhagic Perivascular infiltration with lymphocytes and mononuclear cells were seen (Fig. 1)

PHOTOGRAPHS

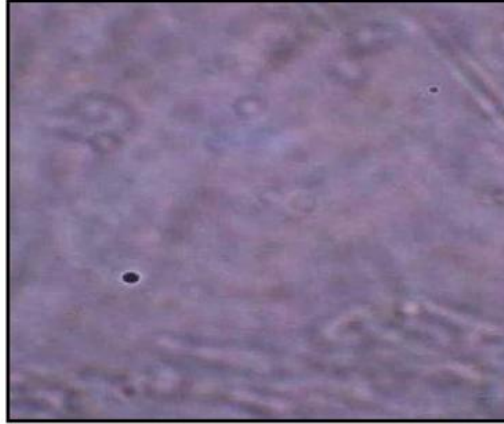


Fig. 2. Wet mount examination of synovial fluid from a case of osteoarthritis showing cartilage fibrils appearing as needle like particles.(10 x 40)

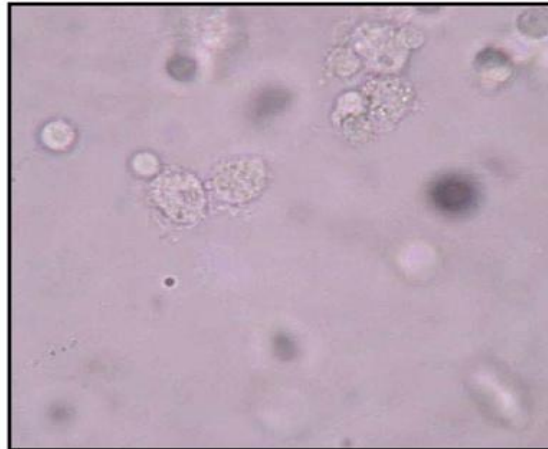


Fig. 3. Wet mount examination of sf from rheumatoid arthritis showing ragocytes (10 x10)



Fig. 4. Sf streaked on blood agar plate showing betahemolytic colonies of streptococcus Pyogenes

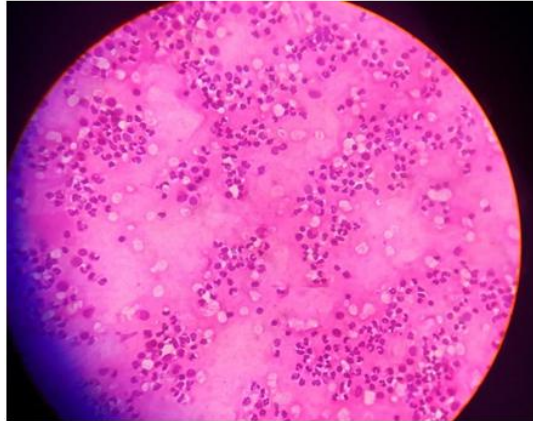


Fig. 5. Permanent stained smear showing predominance of neutrophils from a case of septic arthritis (h & e stain 10 x 10)



Fig. 6. Afb stained smear showing tuberculous bacilli (afb stain 10 x 100)

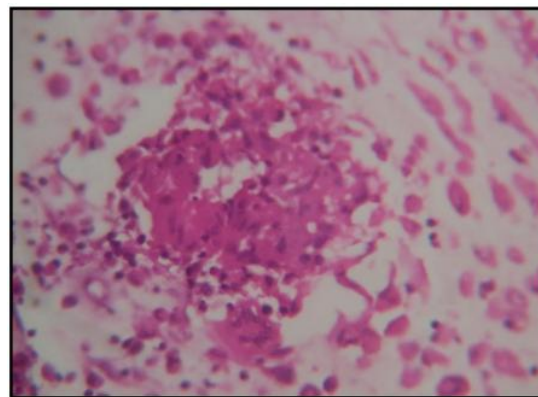


Fig. 7. Ranuloma surrounded by epithelioid cells, lymphocytes and langhans type of giant cells (h & e 10 x 40)

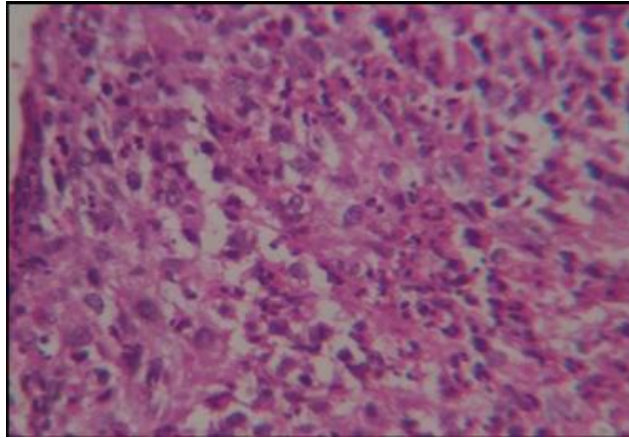


Fig. 8. Extensive infiltration of the subsynovium with polymorphs (h & e 10 x 40)

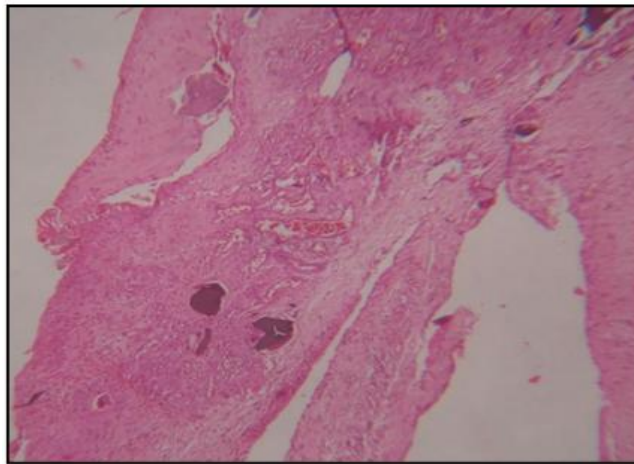


Fig. 9. Synovial proliferation with deposits of brownish material (h & e 10 x 10)

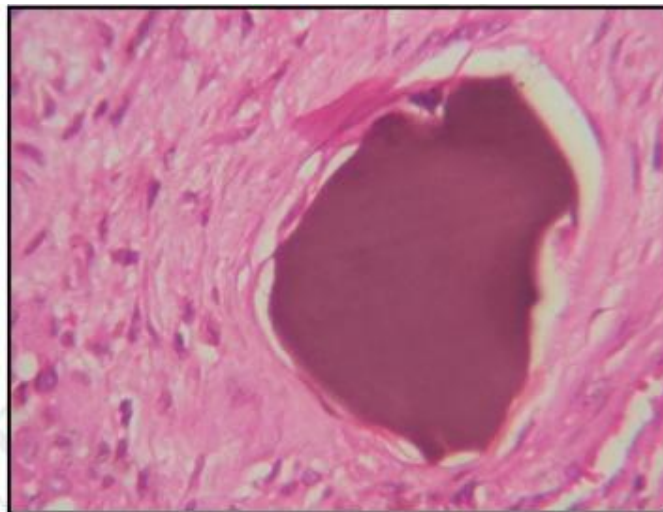


Fig. 10. Synovium with deposits of brownish material (h & e 10 x 40)

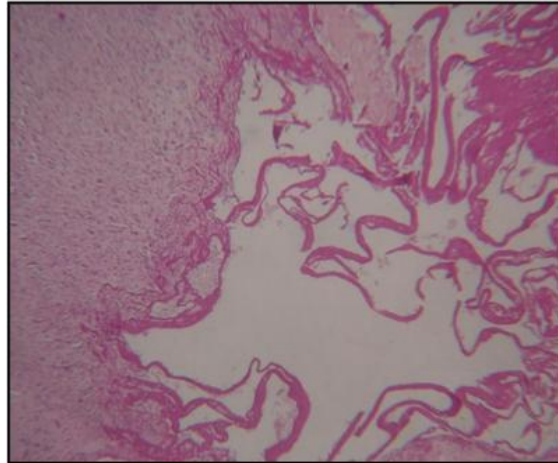


Fig. 11. Cystic lesion with degenerative changes (h & e 10 x 10)

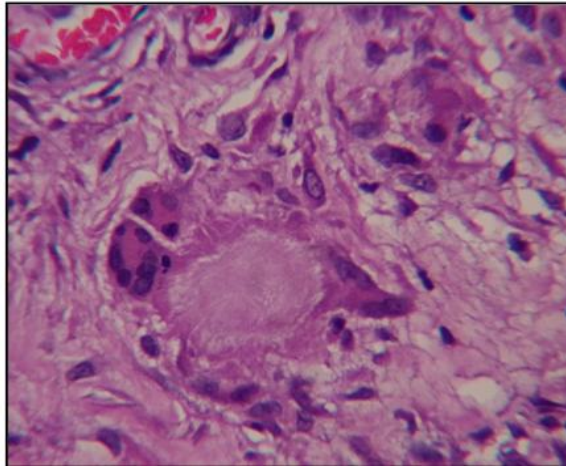


Fig. 12. Synovial lining enclosing eosinophilic amorphous material surrounded by histiocytes and foreign body type of giant cells. (h&e10x 40)

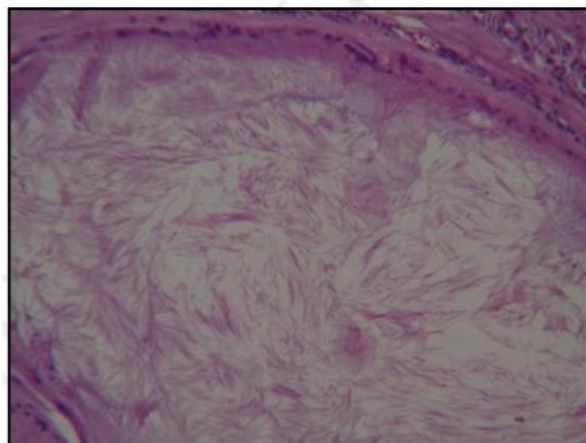


Fig. 13. Eosinophilic amorphous material (h&e10x 40)

The cases of NIA-NOS where mild number of inflammatory cells(200 -2000WBC/ml) and IA-NOS where more number of inflammatory cells (2000 -75000 WBC/ml) were seen on SF were diagnosed as Chronic non specific arthritis on SB. A correlation of SF with SB was made in 93 cases . 2 cases were discordant as they were diagnosed as IA -NOS in SF analysis but turned out to be tuberculous arthritis in SB, probably the reason could be that in cytology no definite pattern is seen whereas in biopsy a definite pattern of arrangement of cells could be seen so a diagnosis is made more accurately. Therefore it is essential to confirm the diagnosis subsequently on biopsy [13-15].

Though SF analysis has diagnosed more cases and given 100% sensitivity in cases of Gout, Septic arthritis, Osteoarthritis, Rheumatoid arthritis, Traumatic arthritis, PVNS, sensitivity in cases of IA-NOS observed was 93.54%, and in cases of tuberculous arthritis, the sensitivity has further come down to 66.66% [16]. In the present study 40 (41.17%) cases of chronic non specific synovitis were encountered, the affected age group was 24-75 years with male dominance. M.S. Sant in their study in 1994 had similar incidence in 65 patients (47.1%) and observed that if these patients are followed up and repeat biopsies are carried out in due course they may present with specific diagnostic features or patients may have self limited disease or may undergo complete therapeutic remissions. We found that histological examination by arthroscopic synovial biopsy is of a significant diagnostic value. It associated with and confirmed the diagnosis of the underlying pathology after clinical assessment in 34 cases (68%) counting rheumatoid arthritis, tubercular arthritis, osteoarthritis, septic arthritis, pigmented villonodular synovitis, and gout of the remaining [16] (32%) cases, in 10 cases no specific pathology was seen on histopathology and they were labeled as chronic general synovitis. Six cases where the clinical diagnoses were nonspecific, histologic examination of arthroscopic synovial biopsy alone gave the final specific diagnosis [17-18].

Abhyankar et al in the study of 200 synovial biopsies, diagnosed 80 patients as chronic non specific synovitis. When re-examined these cases were classified into various disease entities Following reclassification only 6 patients (3%) remained as non specific synovitis indicating the necessity of follow up or re-examination for further categorization [19].

Thus cases of chronic nonspecific synovitis definitely needs a follow up. In a study by Partik M et al of 178 patients of osteoarthritis, mean age was 72, range 33 to 96 yrs [20]. In the present study of 102synovial fluids, mean age was 63.2 years, range 13 to 75 yrs.

Though septic arthritis can affect any group, Mc Catchan et al found their patients averaged 47 years of age, in a study of 41 patients. In our study of 13 cases th e mean age of the patients with septic arthritis was 39 years with a male dominance [21-22].

6. CONCLUSION

In our study 93 cases of SF analysis were SB. In cases of Gout, Septic arthritis, Osteoarthritis, Rheumatoid arthritis, Traumatic arthritis, PVNS 100% correlation was seen but 2 cases of tuberculous arthritis were missed on SF analysis and were reported as IA-NOS. SB picked the tubercle granuloma. Hence overall correlation between SF analysis and SB was 97.8%. Synovial fluid analysis plays an important role in categorising various arthritis and thereby helps in arriving at a diagnosis preoperatively. Therefore SF analysis is a rapid, complex and rate current test which can be easily done on outpatient set up and an appropriate treatment can be started at the earliest before destructive arthropathy becomes advanced.

CONSENT

As per international standard or university standard written patient consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

The study was approved by the institutional human ethical and research committee of Sree Balaji Medical College and Hospital, Chennai.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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