ORIGINAL RESEARCH PAPER

Pathology

SYNOVIAL FLUID ANALYSIS IN THE DIAGNOSIS OF VARIOUS JOINT DISEASES.

KEY WORDS: Joint diseases, Synovial fluid, arthritis

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ABSTRACT

Introduction: The synovial fluid in the joint cavity is a biological medium with unique biophysical, physicochemical, and composition qualities. Synovial fluid analysis is one of the few laboratory tests that is solely utilised for musculoskeletal disease diagnosis and assessment. The purpose of this study is to investigate fresh synovial fluid aspirates using a standard procedure of gross and microscopic examination with wet mount preparation in order to determine the cytomorphological characteristics of abnormal synovial fluid. **Method:** The study was done in 50 cases of Joint diseases. Synovial fluid was collected and sent for physical and cytological analysis. **Results:** Out of 50 cases, tubercular arthritis (26%) and rheumatoid arthritis (26%) are the most common aetiology. Females predominated over males. In most disorders, the synovial fluid was pale yellow or yellowish in colour, however reddish colour was detected in cases of Tubercular arthritis, traumatic arthritis, and rheumatoid arthritis. **Conclusion:** When a patient presents with a joint effusion, the assessment of synovial fluid should be a key aspect of the investigation.

INTRODUCTION:

The skeleton relies on joints for movement and support. They are made up of two bony surfaces that are separated by a joint capsule, which contains synovial fluid. The synovial fluid in the joint cavity is a biological medium with unique biophysical, physicochemical, and composition qualities (1).Joint fluid has been studied since Hippocrates' time, with Paracelsus being the first to notice viscid fluid in the joint cavity(2). The synovium forms when primitive mesenchymal tissue cavities, forming a recognizable joint space at approximately 8 weeks of embryonic life. Synovial fluid is a physiologic fluid that serves as a lubricant for articular cartilage and a nutrient supply for surrounding structures such as cartilage, meniscus, and labarum. Synovial fluid is predominantly made up of hyaluronic, lubricin, proteinase, collagenases, and prostaglandins and is formed as an ultra-filtrate of blood plasma. Synovial fluid is produced by type B synovial cells, which resemble fibroblasts. Trauma, inflammation, and bacterial, fungal, or viral penetrance all cause physiological changes in synovial fluid volume and content(3). It ensures the sliding of the articular surfaces of bones by acting as a damper, and its injury produces a change in the synovial fluid's cellular composition(4). Synovial fluid, also known as synovia, is a type of indication of the joint's vital activity that is created and renewed by chemicals derived from blood plasma and secreted by the synovial membrane, which serves as a boundary layer between the synovial membrane, cartilage, and subchondral bone(5).

Synovial fluid analysis is one of the few laboratory tests that is solely utilised for musculoskeletal disease diagnosis and assessment. It was first used to diagnose and assess arthritis in the late 1950s, thanks to the efforts of Hollander et al, who advised the use of microscopic analysis of cell count, microbiologic, and biochemical tests to distinguish between different types of arthritis(6). To identify urate crystals, Hollander and Mc Carty introduced polarised light microscopy (PLM) of synovial fluid in the early 1960s(6). Hollander & colleagues established synovial fluid analysis as a standard diagnostic tool, detailing in detail the key findings of synovial fluid in various kinds of arthritis and coining the phrase synovial analysis. In 1963 Parker and Pearson described a simplified 14 gauge needle that did not need skin incision(7). The investigation of synovial fluid has long been advised as an important part of the diagnostic assessment of patients with arthritis and other joint effusions(8). Analysing synovial fluid in joint disease is comparable to analysing urine in kidney disease. Synovial fluid analysis is referred to by rheumatologists as "liquid biopsy of the joints." Synovial biopsies are commonly used to detect joint problems, however synovial fluid analysis may be a less intrusive alternative(9). Synovial fluid sampling is one of the most important tests for evaluating patients available to clinicians(10). It is an important stage in the diagnosis and treatment of arthritis, as it aids in the differentiation of inflammatory, non-inflammatory, traumatic, and crystal-induced arthritis(11,12).

The purpose of this study is to investigate fresh synovial fluid aspirates using a standard procedure of gross and microscopic examination with wet mount preparation in order to determine the cytomorphological characteristics of abnormal synovial fluid. In addition, microbiologic, biochemical, immunological, and cultural investigations, synovial fluid analysis will be used to assess the relevance of various cytomorphic characteristics in diagnosis of various arthropathies.

METHODS:

From December 2020 to December 2021, this investigation of synovial fluid analysis was carried out in the pathology department of Index Medical College Hospital and Research Centre, Indore. The study included all patients (N=50) with one or more joint effusions who visited the OPD or were hospitalised to the orthopaedic department. Patient information was recorded, including socio-demographic information, trauma history, steroid injection history, and past history of joint aspirations, as well as many other investigations as needed. A specific attempt was made to discover any history of non-inflammatory osteoarthritis, chronic infection and inflammation such as TB, rheumatoid arthritis, and gout, as well as severe inflammation such as septic arthritis. To avoid contamination, orthopaedic surgeons used sterile disposal needles and plastic syringes to extract joint fluid from joint effusion cases using arthrocentesis. Before the biopsy for histological investigation, the synovial fluid was analysed. Total volume, colour, clarity, viscosity, and a mucin clot test were all examined grossly. Total and differential leucocyte counts were examined under the microscope. Glucose, protein,

enzymes, and organic acids are all analysed chemically. Immunological analysis included Rheumatoid factor and gram stain and culture were done under microbiological evaluation

Arthrocentesis

Arthrocentesis is a surgical procedure in which the synovial fluid from the afflicted joints is aspirated. Local preparation, draping of the patient, and cleaning by the surgeon were all done with complete aseptic surgical care. The epidermis, subcutaneous tissue, and joint capsule were all injected with 2 ml of 2% lignocaine. Synovial fluid was moved from the suprapatellar pouch to the medial or lateral aspect of the patella while the knee was held in extension. The needle was inserted into the joint cavity through a location on the lateral aspect 2 cm above and 2 cm lateral to the middle of the upper border of the patella, and synovial fluid was aspirated and collected in test tubes after infiltration of the joint capsule. The needle was removed from the cannula. A 20 mL syringe with a notched needle is put through the mouth of the cannula, allowing the blunt end of the needle to enter the synovial cavity easily. The barrel was then suctioned and a few ml of synovial fluid was recovered. Suction was kept on the synovial specimen to keep it in the notch. The syringe and inner needle were held steady in the right hand, while the outer cannula was gently advanced with a small twisting and rotating motion in the left hand for about 1 cm to ensure that the specimen was cut and held in the notch. The needle is removed after aspiration, but the cannula is left in place. A bit of tissue is taken with another needle, then transferred to formalin and sent for histopathological investigation(13).

Statistical Analysis:

Data was collected and entered simultaneously in statistical package for social sciences (SPSS) version 23 and coded appropriately. The data was analysed keeping in view the aims and objectives of the study. Descriptive statistics were calculated to summarize the sample characteristics in terms of frequency and percentage. Graphs and Charts were made. Analytical and inferential analysis was applied between dependent variable and other independent variables. Significance was set at standard 0.05.

RESULTS:

This study was conducted in pathology department of Index Medical College Hospitaland Research Centre. Total of 50 cases were studied. The joints included ankle, knee, wrist, sacroiliac and hip joint. In this study females were predominant, the male to female ratio was 1:1.5.Table 1 shows, Rheumatoid arthritis was mostly identified in people between the ages of 30 and 60, according to our findings. Tubercular and traumatic arthritis were mostly found in people under the age of 45 years. In the age group of 31-45 years, septic arthritis and osteoarthritis were more common. In the elder age group, chronic non-specific synovitis was prevalent. Table 3 shows joint aetiologies found in our study. There were 13 cases of tuberculosis arthritis (26 %), 13 cases of rheumatoid arthritis (26 %), and 10 cases of chronic non-specific synovitis (20 %). Septic arthritis was the cause of the fewest cases (6%). Osteoarthritis accounted for 12% of the total cases.Table 4 shows distribution of physical examination of synovial fluid among cases. The presence of opaque fluid and low viscosity was found in 7 cases with Rheumatoid arthritis. There were 9 cases of tuberculosis in which the fluid was opaque and had a poor viscosity. This consistency was seen in all 3 cases of septic arthritis. Two cases of osteoarthritis had clear fluid with normal viscosity. The volume ranged from 2 to 10 millilitres. In most disorders, the synovial fluid was pale yellow or yellowish in colour, however reddish colour was detected in cases of Tubercular arthritis, traumatic arthritis, osteoarthritis and rheumatoid arthritis. Table 5 shows Cytological study of synovial fluid shows differential cell count and predominant cell in disease condition. Rheumatoid arthritis (4313-15340) and septic arthritis (17590-75709 cells/cu.mm) have higher TLC counts. Rheumatoid arthritis, traumatic arthritis, Septic arthritis, and chronic non-specific synovitis were all shown to have polymorphic cells, whereas osteoarthritis, septic arthritis, and tuberculous arthritis had lymphocytes. Protein and glucose levels ranged from 1.4-6.9 gram and 21-90 milligrams, respectively.

Table: 1- Showing age distribution pattern in different joint diseases

Disease Diagnosis	Age Group			
	16-30 years	31-45 years	46-60 years	>60 years
Osteoarthritis	1	4	1	0
Traumatic Arthritis	0	4	1	0
TB Arthritis	4	5	2	2
Septic Arthritis	0	2	0	1
Chronic Non Specific Synovitis	0	3	5	2
Rheumatoid Arthritis	1	4	5	3

Table: 2- Sex distribution of diseases

Disease Diagnosis	Gender	
	Male	Female
	Count	Count
Osteoarthritis	3	3
Traumatic Arthritis	2	3
TB Arthritis	5	8
Septic Arthritis	1	2
Chronic Non Specific Synovitis	4	6
Rheumatoid Arthritis	5	8

Table: 3 Cases of Joint Effusion

Disease Diagnosis	Count	Column N %
Osteoarthritis	6	12.0%
Traumatic Arthritis	5	10.0%
TB Arthritis	13	26.0%
Septic Arthritis	3	6.0%
Chronic Non Specific Synovitis	10	20.0%
Rheumatoid Arthritis	13	26.0%

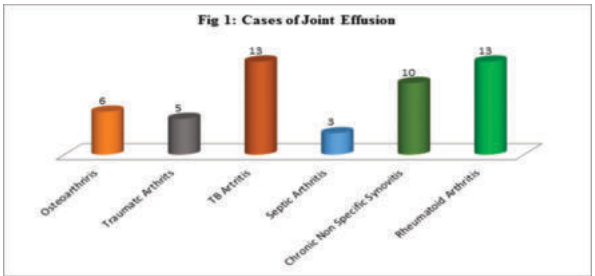

Table: 4 Physical examination of synovial fluid among cases

Physical Examination		Diagnosis					
		Osteoarthritis	Traumatic Arthritis	TB Arthritis	Septic Arthritis	Chronic Non Specific Synovitis	Rheumatoid Arthritis
Volume (ml)		2 - 8	2 - 8	4 - 10	6 - 8	5 - 8	2 - 8
Colour	Straw Yellow	4	4	7	3	7	10
	White	1	0	2	0	3	2
	Haemorrhagic	1	1	4	0	0	1
Clarity	Clean	2	2	4	0	3	6
	Opaque	4	3	9	3	7	7
Viscosity	Normal	2	1	4	1	3	6
	Low	4	4	9	2	7	7

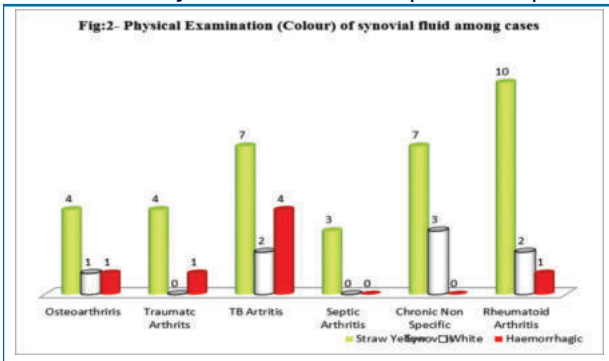

Table: 5- Biochemical and microscopic analysis

Cytological Examination	Diagnosis					
	Osteoarthritis	Traumatic Arthritis	TB Arthritis	Septic Arthritis	Chronic Non Specific Synovitis	Rheumatoid Arthritis
TLC	355 - 1645	2025-14556	6703 - 14083	17590 - 75709	9786 - 14649	4313 - 15380
Polymorphs	31	78	88	87	80	90
Lymphocytes	69	15	18	25	13	14
Macrophages	7	9	5	6	7	6
Protein (gm)	1.5-2.8	5. - 6.8	4.3 - 6.8	1.5-6.9	1.4 -6.7	1.4-6.9
Glucose	76 - 89	26 - 40	26 - 49	21-80	22-90	20- 90

DISCUSSION:

For the evaluation of arthritis with joint effusions, synovial fluid analysis is now regularly advised–(14). Based on the appearance and cell composition of the synovial fluid, Robes and Bauer were the first to define and distinguish inflammatory from non-inflammatory forms of arthritis(15). Arthritis is a prevalent clinical condition that causes significant morbidity. Due to its great frequency of recurrence, clinicians have begun to administer NSAIDS without first determining the exact etiological diagnosis. To determine the exact aetiology, a thorough clinical examination, as well as radiographic and laboratory examinations, is required. Synovial fluid analysis is a valuable and necessary adjuvant in the diagnosing process(16). The most typically impacted age group, according to Ganesh et al, was 31-50 years, which agreed with the current study(17). In our study, the most common aetiology was tubercular arthritis and rheumatoid arthritis which was followed by chronic nonspecific Synovitis. In a study conducted by Abhyankar et al(18), tubercular and rheumatoid arthritis jointly accounted for 68% of patients, with tubercular arthritis predominating. Our findings are somewhat similar with the study by M.Ganeshet al(19), Singhal et al(20) and Pathak et al(21).

The various forms of arthritis are classified based on synovial fluid evaluation (physical, biochemical, and cytological investigation) and the intensity of inflammation. In rheumatoid arthritis, the levels of TLC noted in our study were 4313 - 17187. According to a study by QaziNajeeb et al(22) it was found to be between 3000-20,000/mm3 and according to Pathak et al(21) it was found 3500- 20,000/mm3. Similarly, Ganesh et al. found that the total WBC count and the major cell type present in the afflicted joint are practically identical(17). In our present study in majority of cases synovial fluid was opaque in colour with low viscosity. In most disorders, the synovial fluid was pale yellow or yellowish in colour, however reddish colour was detected in cases of Tubercular arthritis, traumatic arthritis, and rheumatoid arthritis. Synovial analysis was found to be of significant diagnostic value in correlating the diagnosis following clinico-radiological in the current study when compared to earlier studies.

CONCLUSION:

When a patient presents with a joint effusion, the assessment of synovial fluid should be a key aspect of the investigation. The type of the underlying synovial tissue reaction is frequently reflected in synovial fluid and synovial tissue histologic studies, which can provide a definitive diagnosis in cases when the clinical diagnosis is ambiguous. Synovial fluid analysis will help us narrow down the list of possible joint illnesses. The major cells implicated in inflammatory diseases, as well as the normal content of synovial fluid, are revealed by cytology.

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Limitations: Small sample size

Conflicts of interest:
No potential conflict of interest relevant to this article was reported

Ethical approval: Approved

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