Original Article

Arthroscopic synovial biopsy in definitive diagnosis of joint diseases: An evaluation of efficacy and precision

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Abstract

Context: Arthritis is an important cause of morbidity, presenting as monoarticular or polyarticular lesion. Arthroscopic synovial aspiration and biopsy can help in arriving specific etiological diagnosis. **Aim and Objectives:** To evaluate the efficacy of arthroscopic synovial biopsy as a diagnostic aid and study the characteristics of synovial fluid in various joint diseases. **Materials and Methods:** Arthroscopic synovial biopsy along with synovial fluid analysis was studied in 30 of the 50 enrolled cases arthritis. The fluid was subjected to physical, biochemical, and cytological analysis. **Results:** Both rheumatoid (n = 14, 28%) and tubercular (n = 13, 26%) arthritis were found to be more common compared to other etiologies. Next common etiology observed was chronic nonspecific synovitis (n = 10, 20%). Clinicopathological correlation was seen in 34 out of 50 cases. As a diagnostic tool, synovial biopsy had a sensitivity of 85%, specificity of 100%, positive predictive value of 100%, and negative predictive value of 62%. **Conclusion**: Arthroscopic synovial biopsy is a simple and easy to perform technique and is an important useful investigative adjunct that may give conclusive diagnosis where clinical diagnosis is equivocal.

Key words: Arthroscopy, synovial fluid analysis, synovial biopsy

Introduction

Arthritis is frequently encountered in clinical practice and is an important cause of morbidity, affecting all ages and both sexes. It may present as a monoarticular or polyarticular lesion. Monoarticular lesion often follows trauma or infective etiology, while polyarticular lesion is commonly seen in rheumatoid pathology. The relatively frequent occurrence of this problem has led to the indiscriminate use of NSAIDs by medical practitioners, without arriving at a specific etiological diagnosis. The latter can be easily arrived at by using a fairly simple technique of arthroscopic synovial aspiration and biopsy and specific treatment be instituted in cases like tuberculosis. It has the added advantage of being therapeutic in certain cases like early osteoarthritis wherein loose bodies etc., can be removed earlier on in the disease process.

When the synovium gets afflicted, the pattern may indicate the etiopathogenesis. Synovial fluid analysis and biopsy have been found to be a valuable adjunct to conventional investigations and are routinely advised in most cases of joint diseases.[1] Needle arthroscopy of the knee has been advocated as it allows good macroscopic evaluation of synovial inflammation and selective sampling of the synovial membrane, thereby overcoming the disadvantage of closed needle biopsy.[2]

This study aims to evaluate the efficacy of arthroscopic synovial biopsy as a diagnostic aid and study the characteristics of synovial fluid in various joint diseases.

Materials and Methods

Fifty cases of monoarticular/polyarticular arthritis who presented to the outpatient department of orthopedics department were studied. There were no specific exclusion criteria. Arthroscopic synovial biopsy was studied along with synovial fluid analysis in 30 of these. The patients were

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counseled about the study, and synovial biopsy was done after obtaining their consent. The fluid was insufficient for analysis in 20 cases. Clinical criteria for diagnosis of various joint diseases were followed.[3]

The fluid was subjected to physical, biochemical, and cytological analysis. The parameters studied in physical examination included color, clarity, viscosity, mucin clot test, and wet preparation. The biochemical analysis included difference in fasting blood and synovial fluid glucose and estimation of protein in synovial fluid. Cytology entailed estimation of the total leukocyte count and study of the centrifuged deposit to see predominant white blood cells (WBCs) and the presence of red blood cells (RBCs). Air dried smears were prepared after centrifugation at 2000 rpm and stained with Leishman's stain following the standard procedure.

Synovial fluid was aspirated before arthroscopy. Analysis was started as soon as the fluid was aspirated. The fluid was categorized into four groups based on the gross appearance [Table 1].[4,5]

Synovial biopsy was obtained under arthroscopic guidance and was processed and sectioned following the standard procedure. Two sections of each case were stained by haematoxylin and eosin. Gram stain, Prussian Blue, and Ziehl Nielson (ZN) stain were performed where required. The affected joints were the portals for diagnostic arthroscopy in each case. A tourniquet was used to achieve a possible bloodless field, and avoid exsanguinations. Each joint was irrigated with irrigating solution.

The histopathological criteria evaluated while interpreting the lesions included hypertrophy and hyperplasia of the synovium, proliferation of synoviocytes, proliferation of villi, presence of fibrin and its location (superficial or deep), types of inflammatory cells and their distribution, capillary proliferation with or without inflammation, presence of bone and cartilage fragments with or without inflammation, pannus formation, presence of hemorrhage, and hemosiderin pigment. Criteria for specific histopathological diagnosis of various joint diseases were followed as proposed by Goldenberg DL and Cohen AS.[6] Synovial fibroblast (SF) hyperplasia is said to contribute to the pathogenesis of rheumatoid arthritis.[7]

Table 1: Categorization of synovial fluid based on gross appearance[4,5]

Group	Characteristics	Category
Normal	Viscous, clear, colorless	Normal synovial fluid
Group I	Clear, pale yellow to yellow viscous fluid which usually does not clot	Noninflammatory fluid
Group II	Turbid, yellow, tends to clot on standing and of poor viscosity	Inflammatory fluid
Group III	Purulent fluid, shows no mucin clot formation	Septic arthritis
Group IV	Bloody or xanthochromic fluid	Recent or old trauma; coagulation defects; neurotropic arthropathy; neoplasm and pigmented villonodular synovitis

Those cases where synovial tissue biopsy confirmed clinical diagnosis in specific diagnoses like tuberculosis, osteoarthritis, rheumatoid arthritis, septic arthritis gout, pigmented villonodular synovitis, and traumatic arthritis were considered true positive. Likewise, true negatives were those wherein clinical diagnosis of nonspecific arthritis was confirmed on biopsy. The cases where clinical diagnosis of nonspecific arthritis was changed to a definite etiology on biopsy were taken as false negative and those where the clinical diagnosis was specific and was changed to nonspecific arthritis on biopsy were to be taken as false positive. However, we did not have any false positive cases.

Results

Of the 50 cases we studied, monoarticular joint involvement predominated over polyarticular (n = 38; 76%). The joints studied included the knee joint, wrist, hip, elbow, ankle, and sacroiliac joints. Involvement of the knee joint was found to be the common both in monoarticular (65.78%) and polyarticular (75%) arthropathy. Hence, knee was subjected to arthroscopy more than other joints.

Both rheumatoid (n = 14, 28%) and tubercular (n = 13, 26%) arthritis were found to be more common compared to other etiologies. Next common etiology observed in our study was chronic nonspecific synovitis (n = 10, 20%). There were three cases (6%) each of septic and osteoarthritis. There were four cases (8%) and two cases (4%), respectively, of traumatic and gouty arthritis. One case (2%) of pigmented villonodular synovitis was also noted. The polyarticular presentation was mainly due to rheumatoid arthritis (9 out of 12 cases; 75%).

Most cases in the monoarticular category were due to Tubercular etiology (12 out of 38 cases; 31.6%). The initial diagnosis was based on clinical presentation coupled with radiology, which was confirmed subsequently on biopsy. This was possible in 34 out of 50 cases where synovial biopsy tissue was available.

Rheumatoid arthritis was found between fourth to sixth decades and tubercular arthritis was found mainly in the younger age group between second to fourth decades. Males predominated over females in this study (n = 36, 72%).

Out of 50 cases of arthritis, synovial fluid was obtained in 30 cases (60%). Synovial fluid was insufficient for analysis in

the rest. We had 10 cases of rheumatoid arthritis with pale to yellow, turbid synovial fluid with low viscosity and fair to poor clot formation. There were seven cases of tubercular arthritis having yellowish and turbid synovial fluid with low viscosity and poor clot formation on mucin clot test. ZN Stain for acid fast bacilli (AFB) was negative. We had five cases of chronic nonspecific synovitis and three each of septic and traumatic arthritis. There was one case each of osteoarthritis and pigmented villonodular synovitis.

The cytological and biochemical features of synovial fluid in various disease groups in this study are summarized in Tables 2 and 3.

Of the 50 cases of arthritis, 34 were diagnosed clinically and confirmed histologically. These included rheumatoid arthritis (n = 11), tubercular arthritis (n = 10), osteoarthritis (n = 3), septic arthritis (n = 3), traumatic arthritis (n = 4), pigmented villonodular synovitis (n = 1), and gout (n = 2). Out of the remaining 16 (32%) cases, no definite histopathological diagnosis was reached in 10 cases and these were labeled as chronic nonspecific synovitis. In the remaining six cases, definite histopathological diagnosis was provided against a clinical diagnosis of nonspecific arthritis (tubercular and rheumatoid arthritis in three cases each). Clinicopathological correlation was seen in 34 out of 50 cases.

Of the 14 cases of rheumatoid arthritis, 13 showed villous hypertrophy with pannus formation along with mononuclear cell infiltration and lymphoid follicles. Fibrin deposition was seen in 2 out of 13 cases. In one case, giant cells were noted with fibrin deposition. We had 13 cases of tubercular arthritis, in which caseation necrosis was seen in five cases, along with granulomas. Only granuloma formation with Langhan's type of giant cells was noted in eight cases. AFB was positive in three cases on ZN stain. Among the 10 cases of chronic nonspecific synovitis, the histological picture showed collagenous tissue with both acute and chronic inflammatory cells in small numbers. We had three cases of septic arthritis showing synovial lining cell hyperplasia in two cases and polymorphonuclear cell infiltration in all. No organism was identified on Gram stain.

All the three cases of osteoarthritis showed minimal inflammation with chronic inflammatory cell infiltrate and destruction of bone and cartilage in all the cases on synovial biopsy. The four cases of traumatic arthritis showed mild inflammation consisting of mixed inflammatory cells. The two cases of gouty arthritis showed tophaceous masses surrounded by foreign body giant cells with chronic inflammatory cells. We had one case of pigmented villonodular synovitis confirmed on histopathology by villous expansion of the synovium with osteoclast-like giant cells and hemosiderin laden macrophages on the Prussian blue stain [Figure 1].

On estimating the efficacy of synovial biopsy as a diagnostic tool, it was found to have a sensitivity of 85%, specificity of 100%, positive predictive value (PPV) of 100%, and negative predictive value (NPV) of 62%.

Table 2: Synovial fluid appearance of normal and diseased joints (30 cases)

Joint diseases	Total WBC count/c mm	Predominant cell type
Normal synovial fluid	<200	Mixed cells with polymorphs (20%) lymphocyte (15%) and monocyte (65%)
Rheumatoid arthritis	8500-14500	Polymorphs (65 to 80%)
Tubercular arthritis	5000-12000	Lymphocytes (60 to 80%) with monocytes
Chronic nonspecific synovitis	500-12000	Variable from polymorphs and lymphocytes
Traumatic arthritis	200-2000	Variable with erythrocytes
Septic arthritis	14000-22000	Polymorphs (30 to 95%)
Osteoarthritis	350	Variable, polymorphs-lymphocytes
Pigmented villonodular synovitis	6500	Polymorphs (40%) with erythrocytes

Table 3: Biochemical analysis of synovial fluid in various joint diseases (30 cases)

Joint diseases	Protein (gm%)	B-SFGD (mg%)
Normal synovial fluid	1.5-2.5	<10
Rheumatoid arthritis	3.5-6.4	21-30
Tubercular arthritis	4-6.8	21-35
Chronic nonspecific synovitis	2-3	11-16
Septic arthritis	5-7	41-60
Traumatic arthritis	2-2.5	<10
Osteoarthritis	1.5	<10
Pigmented villo nodular synovitis	3.5	11-20

B-SFGD: Blood-synovial fluid glucose difference

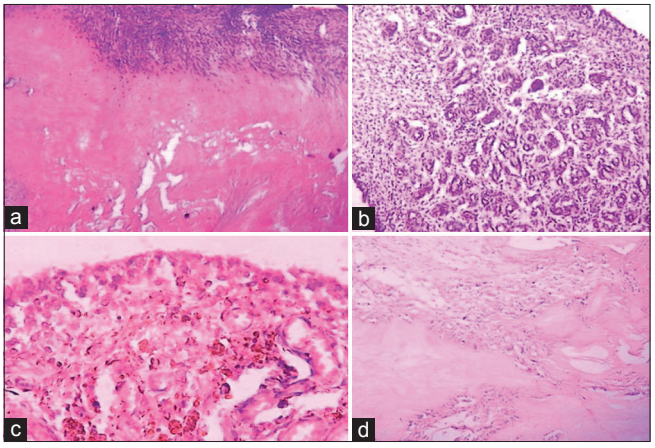

Figure 1: Arthritis: (a) fibrinoid necrosis: (b) pannus formation: (c) pigmented villonodular synovitis (d) gouty arthritis

Discussion

Arthritis is a common entity in clinical practice and an important cause of morbidity. Diagnosis of arthritis is most often made clinically and treatment given empirically. Result, therefore, is often disappointing for both patients and doctors. This is reinforced by those cases where clinical diagnosis of chronic nonspecific arthritis is changed on histopathology of synovial biopsy and definite treatment protocols adopted. Conventional laboratory aids and radiological investigations in monoarticular joint lesions are often equivocal. Further, it has been mentioned in the literature that the macroscopic features of inflammation seen at arthroscopy do not predict the microscopic features. Thus, the use of closed needle biopsy technique is justified.[8]

Study of synovial fluid has been advocated for long in distinctive diagnosis of articular diseases.[9-11] Synovial biopsy has come a long way since being attempted first with a dental nerve extractor, introduced into the joint through a large calibre needle.[12-16] Examination of synovial tissue has been thought to be the only way to make a definitive diagnosis in some infectious, infiltrative, and deposition diseases of joints. This includes granulomatous diseases and infections by difficult-to-culture organisms such as Chlamydia and Neisseria. This also includes diseases such as sarcoidosis, osteochondromatosis, pigmented villonodular synovitis, hemochromatosis, amyloidosis etc.[17] In our study, granulomatous infections, rheumatoid arthritis, septic arthritis and pigmented villonodular synovitis were diagnosed.

Rheumatoid arthritis was the commonest disease in our series, followed by tubercular arthritis. Together, these comprised of 54% of cases. Similar results were obtained by Abhyankar *et al.* with tubercular and rheumatoid arthritis comprising of 68% of cases with tubercular arthritis being the most common (42.5%).[18]

Based on the synovial fluid analysis, we found Group II to be the most common group comprising 78% of all, which is in agreement with the previously published studies.[18,19]

The clinicohistopathologic correlation in our study (68%) gave comparable results with those quoted in the literature (65%).[15] Histopathology alone gave a conclusive diagnosis in six cases (12%) in our study.

We found that histological examination by arthroscopic synovial biopsy is of a significant diagnostic value. It correlated with and confirmed the diagnosis of the underlying pathology after clinical evaluation in 34 cases (68%) including 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 nonspecific synovitis. Six cases where the clinical diagnoses were nonspecific, histologic examination of arthroscopic synovial biopsy alone gave the final specific diagnosis.

We evaluated synovial biopsy as a diagnostic tool and found a sensitivity of 85%, specificity of 100%, PPV of 100%, and NPV of 62%. It has been found in patients with an atypical presentation of RA that histopathological analysis of the synovial membrane can contribute to diagnostic classification of inflammatory arthritis. Using a multiparameter model, better results were obtained with a diagnostic prediction in 79.2% of samples and a PPV of 81.0%. In comparison, a similar multiparameter model using classic diagnostic criteria excluding synovial histopathology was found to perform poorly with a sensitivity of 56.6% and PPV of 73.3%.[20]

Conclusions

To summarize, arthroscopic synovial biopsy is a simple and easy to perform technique. It gives definitive diagnosis of various joint ailments. Arthroscopic synovial biopsy is an important useful investigative adjunct to correlate and confirm the diagnosis after clinical and synovial fluid evaluation. Synovial biopsy may give conclusive diagnosis where clinical diagnosis is equivocal.

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