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Original Article

Role of Magnetic Resonance Imaging in Differentiating the Features of Rheumatoid and Tubercular Arthritis

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Abstract

Introduction: Rheumatoid arthritis (RA) is a chronic autoimmune inflammatory arthritic disease affecting about 1% of global population while tuberculosis (TB) is a disease that is being most frequently reported in the literature and musculoskeletal TB occurs in 1–3%. Differentiation between rheumatoid and tubercular arthritis is difficult as the both arthritis may not only have same clinical course but also same radiological features. The role of magnetic resonance imaging (MRI) has been advocated in characterization of both rheumatoid and tubercular arthritis and differentiation between the two.

Materials and Methods: The study is retrospective in nature which is conducted in the Department of Radiodiagnosis, GSVM Medical College, Kanpur, with the help of orthopedics department in a duration period from January 2020 to October 2021. The study subjects are selected based on inclusion and exclusion criteria.

Results: Uneven synovial thickening is visualized more in rheumatoid (88.5%) than in tubercular arthritis (32.4%) and patients with RA present with higher grade of degree of synovial thickening. Patients with tubercular arthritis have higher grade of bony erosion size as compared to RA. In tubercular arthritis (67.6%), patients show rim enhancement while in RA (15.4%), patients show rim enhancement.

Conclusion: In the present study, we conclude that MRI becomes unparalleled imaging in differentiating diagnosis of rheumatoid and TB arthritis when clinical and plain radiographic features are inconclusive, especially at early stage or with atypical presentation because of the excellent soft-tissue detail and the ability of contrast-enhanced T1-weighted imaging to differentiate between joint effusion and synovial thickening.

Key words: Musculoskeletal and oligoarticular, Rheumatoid arthritis, Spondylitis, Tubercular arthritis

INTRODUCTION

Rheumatoid arthritis (RA) is a chronic autoimmune inflammatory arthritic disease affecting about 1% of global population.[1] It often presents with symmetrical polyarthritis commonly involving peripheral joint. It may also manifest as monoarticular disease. Early diagnosis is often difficult as serological and conventional radiological features are often absent. Tuberculosis (TB) is a disease that is being most frequently reported in the literature. Extrapulmonary TB occurs in approximately 20% of the patients with TB. Of that, musculoskeletal TB occurs in 1–3%.[2] Spondylitis constitutes 50% of the cases followed by peripheral arthritis in 30%.[3] Peripheral tubercular arthritis is generally a monoarticular disease that typically involves large or medium sized joints such as hip or knee.

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Delay in the diagnosis of the both arthritis may lead to severe joint destruction and joint deformity. Differentiation between rheumatoid and tubercular arthritis is difficult as the both arthritis may not only have same clinical course but also same radiological features such as bone erosion, joint effusion, and periarticular osteoporosis.[4] The distinction by the number of joints involved does not always hold true because early asymmetric oligoarticular involvement of RA is not rare,[5] and polyarticular involvement in tuberculous

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Table 1: Distribution among joints

	Result		
Joint	**Rheumatoid (%)**	**Tubercular (%)**	**Total (%)**
Bilateral hip	0 (0.0)	1 (2.9)	1 (1.7)
Left ankle	8 (30.8)	6 (17.6)	14 (23.3)
Left elbow	1 (3.8)	1 (2.9)	2 (3.3)
Left hip	0 (0.0)	13 (38.2)	13 (21.7)
Left knee	4 (15.4)	1 (2.9)	5 (8.3)
Left shoulder	1 (3.8)	0 (0.0)	1 (1.7)
Left wrist	3 (11.5)	0 (0.0)	3 (5.0)
Right ankle	2 (7.7)	2 (5.9)	4 (6.7)
Right elbow	1 (3.8)	1 (2.9)	2 (3.3)
Right hip	0 (0)	8 (23.5)	8 (13.3)
Right knee	2 (7.7)	1 (2.9)	3 (5.0)
Right shoulder	2 (7.7)	0 (0.0)	2 (3.3)
Right wrist	2 (7.7)	0 (0.0)	2 (3.3)
Total	26	34	60

Table 2: Distribution of all parameters

Grade	**RA (%)**	**TB (%)**	**Total (%)**
Uneven synovial thickening			
No	3 (11.5)	23 (67.6)	26 (43.3)
Yes	23 (88.5)	11 (32.4)	34 (56.7)
Degree of synovial thickening			
0	0 (0)	0 (0)	0 (0)
1	2 (7.7)	19 (55.9)	21 (35)
2	12 (46.2)	15 (44.1)	27 (45)
3	12 (46.2)	0 (0.0)	12 (20)
Size of bony erosion			
0	11 (42.3)	3 (8.8)	14 (23.3)
1	4 (15.3)	4 (11.7)	8 (13.3)
2	9 (34.6)	6 (17.6)	15 (25)
3	2 (7.6)	7 (20.5)	9 (15)
4	0 (0)	14 (41.1)	14 (23.3)
Rim enhancement of erosion			
No	22 (84.6)	11 (32.4)	33 (55)
Yes	4 (15.4)	23 (67.6)	27 (45)
Bone marrow edema			
No	7 (26.9)	10 (29.4)	17 (28.3)
Yes	19 (73.1)	24 (70.6)	43 (71.7)
Soft-tissue edema			
0	9 (34.6)	10 (29.4)	19 (31.7)
1	13 (50)	18 (52.9)	31 (51.7)
2	4 (15.4)	6 (17.6)	10 (16.7)
Extra-articular cystic lesion			
No	21 (80.8)	20 (58.8)	41 (68.3)
Yes	5 (19.2)	14 (41.2)	19 (31.7)

RA: Rheumatoid arthritis, TB: Tuberculosis

arthritis has been reported.[2] There have been many reports where tubercular arthritis was misdiagnosed as RA.[4,6,7]

The role of magnetic resonance imaging (MRI) has been advocated in characterization of both rheumatoid and tubercular arthritis and differentiation between the two. Excellent soft-tissue detail and multiplanar capability make MRI an unparalleled imaging technique for the evaluation of joint diseases. MRI may help by demonstrating early changes, which are not visible on radiographs, such as synovitis, bone marrow edema, and central erosions. MRI can also demonstrate joint fluid, synovial hypertrophy, pannus, bone erosions, cartilage destruction, associated osteomyelitis, and intra-articular and extra-articular abscesses.[8] Conventional spin-echo T1-weighted (T1W) and T2-weighted (T2W) images are sufficient to demonstrate anatomy, as well as pathology; proton-density sequences better demonstrate articular cartilage abnormality; post-contrast medium enhanced T1W images differentiate effusion from synovitis and acute synovitis from chronic synovitis; fat-suppressed, post-contrast medium enhanced T1W images are used for better delineation of inflamed tissues.

There is a scanty literature available on MRI features of rheumatoid and tubercular arthritis. The purpose of this study was to determine the MRI features of rheumatoid and tubercular arthritis, especially on differentiating features.

MATERIALS AND METHODS

The study is conducted in the Department of Radiodiagnosis, GSVM Medical College, Kanpur, with the help of orthopedics department in a duration period from January 2020 to October 2021. The study design is retrospective.

The inclusion criteria of study are the patients that were clinically and pathologically diagnosed either rheumatoid or tubercular arthritis and having joint manifestations for the 1st time with clinical symptoms duration of 2–36 months. Patients with the age group of more than 80 years and history of trauma are excluded from the study.

MRI was performed on various MR scanners including 1.5 T and 3 T machine. In all patients, T1-weighted spin-echo and fast T2-weighted spin-echo images with fat suppression, proton-density sequence, and gadolinium-enhanced spin-echo T1-weighted images were acquired with the help of various coils including wrist, shoulder, knee, head, and body surface coils.

MR images were analyzed retrospectively for the following:

- Uniformity of synovial thickening
- Degree of synovial thickening,
- Size of bone erosion
- Enhancement around bone erosion
- Degree of marrow edema
- Degree of soft-tissue edema, and
- The presence of extra-articular cystic masses.

Analysis of the features on MRI on the basis of the classification suggested by Choi *et al.*[9] The degree of

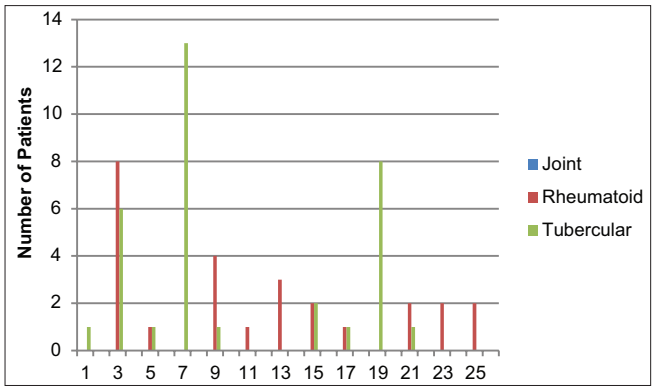

Figure 1: Distribution among joints

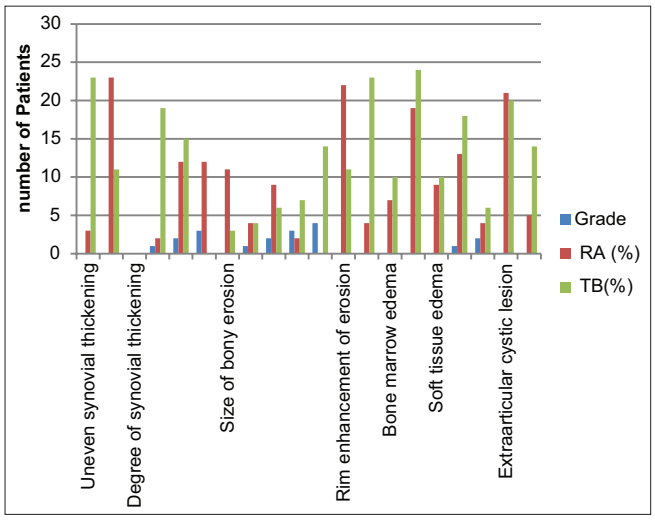

Figure 2: Distribution of all parameters

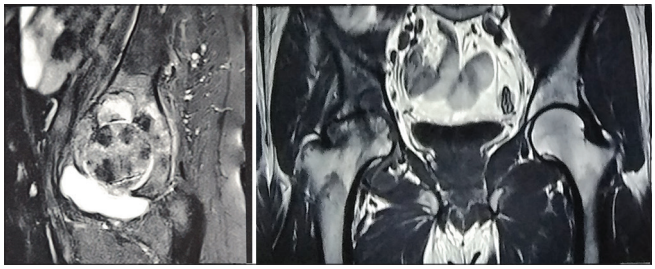

Figure 3: Sagittal T2-weighted fat-saturated and coronal T1-weighted magnetic resonance imaging sequences of a 45-year-old male with tubercular arthritis sequence show even thin synovial thickening of hip joint with marrow edema acetabulum and femoral head region and multiple subchondral lytic lesions with joint effusion visualized

synovial thickening after IV gadolinium administration was classified into four grades according to the maximal thickness of enhancing synovium: Grade 0, 0–3 mm; Grade 1, 3.1–6 mm; Grade 2, 6.1–9 mm; and Grade 3, >9 mm. Size of the largest bone erosion in longest diameter was reported. The size of the bone erosions was classified into five grades: Grade 0, no erosion; Grade 1, <6 mm; Grade 2, 6–10 mm; Grade 3, 11–15 mm; and Grade 4, >15 mm on T1-weighted images. Enhancement around bone erosion was determined on gadolinium-enhanced images as either present or absent. The number of erosions was not counted. Bone marrow edema was classified into four grades after calculation of the extent of marrow edema for the joint as ([maximal distance from articular margin to outer margin of signal change of bone marrow on sagittal or coronal image/maximal diameter of articular surface on axial image] × 100[%]) into the following four grades: Grade 0, no edema; Grade 1, 1–25%; Grade 2, 26–50%; and Grade 3, >50%. Soft-tissue edema was classified into three grades after measuring the maximal vertical distance from the outer margin of joint capsule to the outer margin of periarticular soft-tissue edema on coronal or sagittal image as follows: Grade 0, no edema; Grade 1, 0.1–1 cm; and Grade 2, >1 cm.

Statistical Analysis

For statistical analysis, data were entered into a Microsoft Excel spreadsheet and then analyzed by SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and Graph Pad Prism version 5. Two-sample *t*-tests for a difference in mean involved independent samples or unpaired samples. Paired *t*-tests were a form of blocking and had greater power than unpaired tests. One-way analysis of variance was a technique used to compare means of three or more samples for numerical data (using the F distribution). Unpaired proportions were compared by Chi-square test or Fisher's exact test, as appropriate.

Once a *t*-value is determined, *P*-value can be found using a table of values from Student's *t*-distribution. $P \leq 0.05$ was considered for statistically significant.

RESULTS

In the present study, 41–50 years are the most common age group with RA while 1–20 years are the most common age group in tubercular arthritis. In rheumatoid, 73.1% of patients were female while in tubercular, 70.6% of patients were male. In rheumatoid, 23 (88.5%) patients had uneven synovial thickening while in tubercular, 11 (32.4%) patients had uneven synovial thickening, that is, uneven synovial thickening is visualized more in rheumatoid than in tubercular arthritis.

In rheumatoid arthritis, 46.2% of patients were degree of synovial thickening with Grade 2 and 46.2% of patients were with Grade 3 while in tubercular arthritis, 55.9% of patients were degree of synovial thickening with Grade 1 and 44.1% of patients were Grade 2, that is, patients with RA present with higher grade of degree of synovial thickening.

In rheumatoid arthritis, 21 (80.8%) patients were bony erosion size of Grade 1 and 4 (15.4%) patients were bony erosion size of Grade 2. In tubercular arthritis, 9 (26.5%) patients were bony erosion size of Grade 1 and 23 (67.6%) patients were bony erosion size of Grade 2, that is, patients with tubercular arthritis have higher grade of bony erosion size as compared to RA.

In tubercular arthritis, 23 (67.6%) patients were rim enhancement while in RA, 4 (15.4%) patients were rim enhancement, that is, patients with tubercular arthritis rim enhancement are more common as compared to RA. Bone marrow edema and soft-tissue edema are present in both rheumatoid and tubercular arthritis, the difference between them is not statistically significant [Tables 1, 2 and Figures 1-3].

DISCUSSION

RA usually presents as polyarthritis typically involving peripheral joints such as wrist and hand joints while tubercular arthritis presents as monoarthritis involving large or medium joints such as hip and knee. However, vice versa can also happen. Synovial tissue is the predominantly involved in both tubercular and RA.

In RA, the initial abnormalities include acute synovitis, joint effusion, periarticular edema, and juxta-articular hyperemia. As the disease progress synovial proliferation starts forming pannus and marginal bone erosions are found at the anatomic bare area. Intrusion of the pannus into the marrow spaces leads to the formation of subchondral bone cyst. Eventually, the whole joint cavity is filled with proliferating pannus, precipitating fibrous and bony ankylosis.

Tubercular arthritis begins granuloma formation in synovium which may caseate with or without cystic necrosis which may result in central as well as peripheral erosions and progress to cartilage destruction. If the disease is not timely treated lead to severe joint destruction and ankylosis. However on microscopic examination, RA shows infiltration by plasma cells and lymphocytes while in tubercular arthritis contains necrotic fibrin such as material, caseous areas, leukocytes, and mononuclear phagocytes.

In the available literature, the hypointensity of synovium on T2-weighted images has been found to be typical of tubercular arthritis. Sawlani *et al.*[10] and Sanghvi *et al.*[11] found hypointense synovium on T2-weighted imaging in 40% and 75% of cases in their study. Choi *et al.*[9] evaluated 63 joints with clinically or pathologically proven RA involving 36 joints and tuberculous arthritis involving 27 joints. Non-uniform synovial thickening was noted in 72–86% of rheumatoid cases and 45–55% cases of tubercular arthritis while in the present study, 23 (88.5%) patients with RA have uneven synovial thickening, and in tubercular arthritis, 11 (32.4%) patients had uneven synovial thickening.

Bone change of RA occurs after proliferative pannus extension over the cartilage with cartilaginous and destruction secretion of degrading enzymes, mainly metalloproteinases. TNF-α and IL-1 also play a prominent role in bone destruction. However, in tuberculous arthritis, cartilaginous destruction is associated with phagocytic and vascular processes without involvement of proteolytic enzymes. Bone erosion is seen after cartilaginous erosion, due to insinuation of granulation tissue between cartilage and subchondral bone. Agarwal *et al.*[12] large erosions with rim enhancement are visualized in tubercular arthritis. Subchondral bone erosion was more frequent in tuberculous arthritis in the present study, which may have occurred because of this subchondral extension of pannus. In the present study, bone erosions are more common in patients with tubercular arthritis with higher grade.

Extra-articular cystic lesion is seen as cold abscess in tubercular arthritic patients. On MRI, it is visualized as a cystic mass with even, thin rim enhancement usually not surrounded by prominent surrounding edema. Hence, it is difficult to differentiate it from bursal fluid collection and other extra-articular cystic lesion in RA. In the present study, extra-articular cystic mass was more frequently seen in tuberculous arthritis. This study has many limitations. Many and different joints are compared for two different diseases, for example, like many hip joints are imaged in tubercular arthritis. The study is retrospective in nature, the sensitivity, specificity, and positive and negative predicted valve of findings could not be determined.

CONCLUSION

In the present study, we conclude that MRI becomes unparalleled imaging in differentiating diagnosis of rheumatoid and TB arthritis when clinical and plain radiographic features are inconclusive specially at early stage or with atypical presentation because of the excellent soft-tissue detail and the ability of contrast-enhanced T1-weighted imaging to differentiate between joint effusion and synovial thickening.

Uneven and thick synovial proliferation was more frequently seen in RA, whereas, even and thin synovium, large bone erosions, rim enhancement around bone erosion, and extra-articular cystic masses were more frequently seen in tuberculous arthritis. Bone marrow and soft-tissue

edema is present in both arthritis; however, they could not differentiate with each other significantly. Evaluation with MRI is significantly helpful in differentiation between RA and tuberculous arthritis.

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