Original Article

Efficacy of High Resolution Ultrasound in Evaluation of Rotator Cuff Tear in Comparison to MRI

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ABSTRACT

Introduction: The rotator cuff mechanism is very important to shoulder function and disease of this mechanism is a very common clinical problem facing the physician who sees patients with shoulder pain. Purpose of the present study was to evaluate the role of ultrasound (USG) in rotator cuff tear and biceps tendon pathology and correlate the findings with MRI.

Methodology: The study population consisted of 40 patients who were suspected for rotator cuff tear and biceps tendon pathology that underwent ultrasound evaluation and then findings were correlated with MRI examination.

Results: Ultrasound has a sensitivity of 76.19%, specificity of 89.47%, and accuracy of 82.50% to detect partial thickness tear. For full thickness tear, sensitivity was 81.81%, specificity was 100%, and accuracy was 95%. Most common biceps tendon pathology found was biceps sheath effusion.

Conclusion: Though operator dependent, a well performed USG can be considered as a primary diagnostic modality. MRI should be used secondarily because it provides more information about the extent of the lesion and about labrum, joint, and ligaments around joint.

Keywords: Rotator cuff, biceps tendon, ultrasound, MRI.

INTRODUCTION

There are various causes for shoulder pain, including rotator cuff injuries which are described as partial and full thickness, acute and chronic, traumatic and degenerative.[1] Other causes include adhesive causalities, cervical nerve root compression, and acute joint inflammation. 60% of shoulder abnormalities have been attributed to rotator cuff disease, which is the most common cause of shoulder pain and dysfunction in patients above 40 years of age.[2,3]

Musculoskeletal USG has established itself as a versatile imaging modality in the field of radiodiagnosis, sports medicine, and rheumatology. Cost effectiveness and ready availability are its biggest advantages in several clinical settings. The real time capability of ultrasound in conducting dynamic studies in areas like shoulder is a real asset. It helps to do quick comparison with the contra-lateral side, which is of great help in many difficult situations. USG has its own limitations like high operator dependency, long learning curve, and problems of anisotropy. It has limited utility in evaluation of labrum, rotator cuff interval, and in demonstrating subtle bony lesions.[4,5]

MRI has become the gold standard for detecting subtle and obvious internal derangement and assessing over all joint structure.[6] The strength of MR imaging lies in its potential for assessing sonographically inaccessible areas such as bone, labral cartilage, deep parts of various ligaments, capsule, and areas obscured by bone.[7] MRI can evaluate the size and shape of the tear, the amount of tendon retraction, muscle atrophy. In addition, it can accurately evaluate other potential causes of shoulder pain that may mimic rotator cuff tears.[8] There are potential benefits from the combined use of both USG and MRI.[7]

In the present study, 40 patients with shoulder joint pain, with a clinical suspicion of rotator cuff tear and biceps tendon pathology, were subjected to USG and MRI. The aim was to correlate and compare the findings of USG with MRI in evaluation of shoulder joint pain, especially in cases of rotator cuff tear and biceps tendon pathology.

METHODS

The present study was conducted in the Department of Radiodiagnosis in a government medical college and attached hospital, in Rajasthan. The study group included all patients who attended the Orthopaedic OPD with complaints of shoulder pain and with clinical suspicion of having rotator cuff tear or biceps tendon pathology. The ultrasound criteria for the diagnosis of full-thickness rotator cuff tear is non-visualisation of cuff tissue, localized hypoechoic zones throughout the entire cuff thickness, and loss of convexity from the outer contour. The ultrasound criteria for partial thickness rotator cuff tear is hypoechoic defect that involves the articular or bursal surface but not the entire cuff thickness, thinning of the cuff, and straight outer cuff border with loss of convexity.

Sonography images were also evaluated for secondary findings including cartilage interface sign (a thin hyperechoic line at the surface of the humeral head), cortical irregularity of the greater tuberosity, and fluid in subacromial-subdeltoid bursa.

MRI scans were carried out and correlation of ultrasound findings was done alongwith thorough evaluation of rotator cuff, biceps tendon, glenoid labrum, acromio-clavicular joint, and subdeltoid-subacromial bursa.

RESULTS

The present study included 40 patients with suspected rotator cuff tear and biceps tendon pathology**.** Most of the cases were in 41-50 years of age, 22 patients were males and 18 were females suggesting no significant sex predilection for rotator cuff tear (Table 1). Supraspinatus tendon tear was the most common finding on ultrasound accounting 22 patients (55%). Partial thickness tears were more common (15 patients) than full thickness tear (7 patients). Most common MRI finding was also supraspinatus tendon tear, noted in 26 patients (65%). Out of these 26 patients, 17 (42.5%) were partial thickness and 9 (22.5%) were full thickness tear (Table 2).

Out of 40 patients who underwent ultrasound examination, 22 patients diagnosed positive for supraspinatus tendon tear on ultrasonography. Two patients were diagnosed with full thickness tear on MRI but missed on USG. Two patients with partial thickness tear of supraspinatus tendon on MRI could not be diagnosed on USG as shown in Table 2.

Table 1: Age wise distribution of cases

Age	No. of patients
21-40	16 (40%)
41-60	19 (47.5%)
61-80	5 (12.5%)

The comparison of USG findings with MRI in partial thickness rotator cuff tear and full thickness rotator cuff tear is depicted in table 3 and 4, respectively.

On ultrasound examination, 21 patients showed biceps sheath effusion out of total 40 patients which is the most common abnormality detected in the biceps tendon. Out of these 21 patients of biceps tendon sheath effusion on USG, 13 were associated with rotator cuff tear (61.9%). Eight patients had bone irregularity on USG. On MRI, 5 patients out of these 8 patients showed rotator cuff tear (62.5%). These results indicate frequent association of rotator cuff tear with biceps tendon sheath effusion and bone irregularity at tendon insertion site (Table 5).

Fluid in sub-deltoid bursa was detected in 5 patients on ultrasound. Out of these 5 patients, 4 showed associated rotator cuff tear (80%) which indicates a strong association between rotator cuff tear and sub-deltoid bursa effusion (Table 5).

DISCUSSION

All the 40 patients included in study showed some abnormality related either to rotator cuff tendons or biceps tendon or some bony irregularity except 2 cases in whom

Table 2: Comparison of USG and MRI findings for rotator cuff tear

	USG	MRI
Supraspinatus partial thickness tear	15 (37.5%)	17 (42.5%)
Supraspinatus full thickness tear	7 (17.5 %)	9 (22.5%)
Subscapularis partial thickness tear	3 (7.5 %)	3 (7.5 %)
Subscapularis full thickness tear	1 (2.5 %)	1 (2.5 %)

Table 3: Partial thickness rotator cuff tear (MRI gold standard)

	Present	Absent
Ultrasonography Positive	16	2
Ultrasonography Negative	5	17

Positive predictive value 16/18*100=88.88
Sensitivity 16/21*100=76.19
Negative predictive value 17/22*100=77.27
Specificity 17/19*100=89.47

USG findings were normal but their MRI scan was done due to their excessive symptoms and came out to be positive for partial thickness tear of rotator cuff.

In the present study, we focused on the presence or absence of rotator cuff tears, biceps tendon effusion, and other associated findings for example, fluid in sub-acromial bursa and bone irregularity. The most common USG finding in rotator cuff tendons was partial thickness tear, most commonly involving the supraspinatus tendon i.e.15 patients (37.5%). Three patients (7.5%) had shown partial thickness tear of subscapularis tendon (Table 2), 7 patients (17.5%) had shown full thickness tear of supraspinatus tendon while one patient showed full thickness tear of subscapularis tendon (Table 2).

The present study correlates with the well established fact as well as the study done by Neer[9] that the most common tendon involved in rotator cuff tear is supraspinatus tendon (Table 2).

Resnick et al[10] and Matava et al[11] had concluded that partial thickness tear are common than full thickness tears which is reflected in the results of the present study. Isolated subscapularis tendons tears were uncommon (5%) in the present study which correlates with the study of Codman et al[12] reporting an incidence of 3.5% involvement of the subscapularis in a series of 200 rotator cuff tears. In the present study, 2 subscapularis tendon tears (full as well as partial thickness) were isolated and 2 partial thickness tears were associated with supraspinatus tendon tears, so it has been seen that 5% of patient showed isolated involvement of subscapularis tendon and 5% patients showed its association with supraspinatus tendon tear.

Most common biceps tendon pathology on USG was biceps tendon sheath effusion which was present in 21 (52.5%) patients. In 13 patients, biceps sheath effusion was noted with associated rotator cuff tear (61.9%). Eight patients with biceps tendon sheath did not show any rotator cuff tear (Table 5). Subdeltoid bursal fluid was noted in 5 patients. Out of these five patients four patients (80%) have shown associated rotator cuff tear (Table 5).

Figure 1: Longitudinal view of supraspinatus tendon on USG showing full thickness tear.

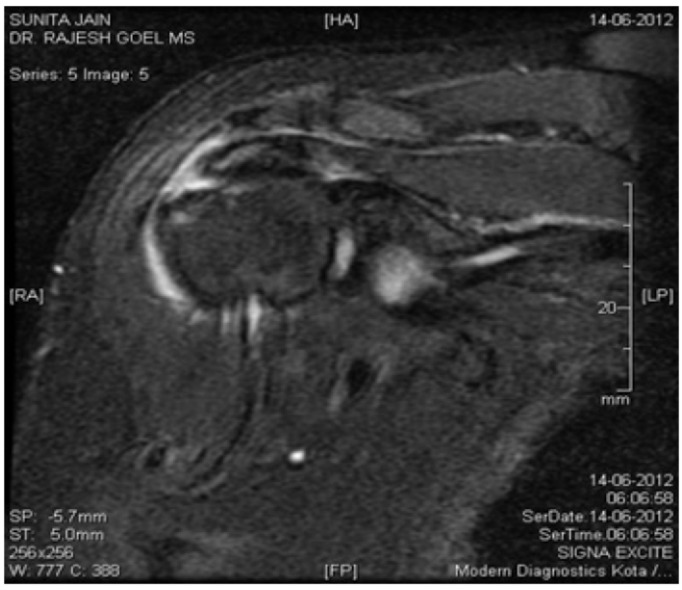

Figure 2: Coronal STIR MRI image showing hyperintense signal intensity at the site of insertion of supraspinatus tendon suggestive of full thickness tear of supraspinatus tendon.

Table 4: Full thickness rotator cuff tear (MRI gold standard)

	Full thickness present	Full thickness absent
Ultrasonography Positive	9	0
Ultrasonography Negative	2	29

Positive predictive value 9/9*100=100.00
Sensitivity 9/11*100=81.81
Negative predictive value 29/31*100=93.54
Specificity 29/29*100=100.00

Bone surface irregularity was noted in 8 patients on USG, and 5 (62.5%) out of these 8 patients had associated rotator cuff tear on USG as shown in table 5.

On comparison of USG findings with MRI in partial thickness tear, 18 patients were diagnosed with partial thickness tear on USG. Out of them, 16 patients were positively diagnosed on MRI and these patients were considered as true positive. Two patients who did not show any sign of partial thickness tear on MRI were considered as falsely positive (Table 3). Twenty two patients were negative for partial thickness tear of rotator cuff on USG, out of them 5 patients were diagnosed with partial thickness tear on MRI and were considered as falsely negative. Seventeen cases which were negative on USG as well as on MRI were considered as true negative (Table 3). Thus, we obtained sensitivity of 76.19% and specificity of 89.47% for detecting partial thickness tear. Negative and positive predictive values were 77.27% and 88.88%, respectively and accuracy was 82.5%.

The results of current study for partial thickness tear are in concordance with the study done by Kayser et al[13] who assessed **"**Validity of ultrasound examinations of disorders of the shoulder joint". While comparing the USG findings with MRI in case of full thickness tear of rotator cuff we found 9 patients of full thickness tear of rotator cuff on USG. All of these 9 patients were positively diagnosed as full thickness tear on MRI. There were 2 patients who were positive for full thickness on MRI but could not be detected on USG and were considered as falsely negative. Thirty one patients were negative for full thickness tear of rotator cuff on USG. Out of them 29 patients were negative on MRI and this group of 29 patients was considered true negative. Thus we observed the sensitivity of USG for full thickness tear as 81.8% and specificity as 100%. Negative

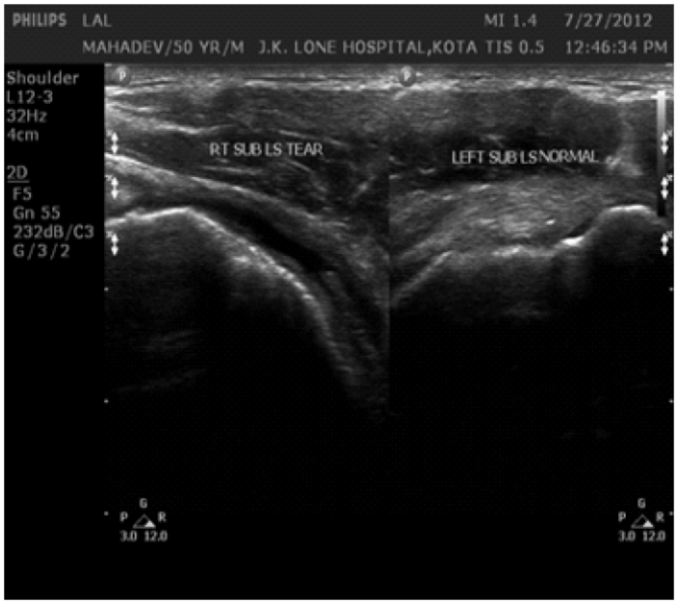

Figure 3: Longitudinal view of subscapularis tendon showing fluid filled defect with retracted ends of torn tendon ends (on left side of image). On right side subscapularistenon of normal side is shown for comparison.

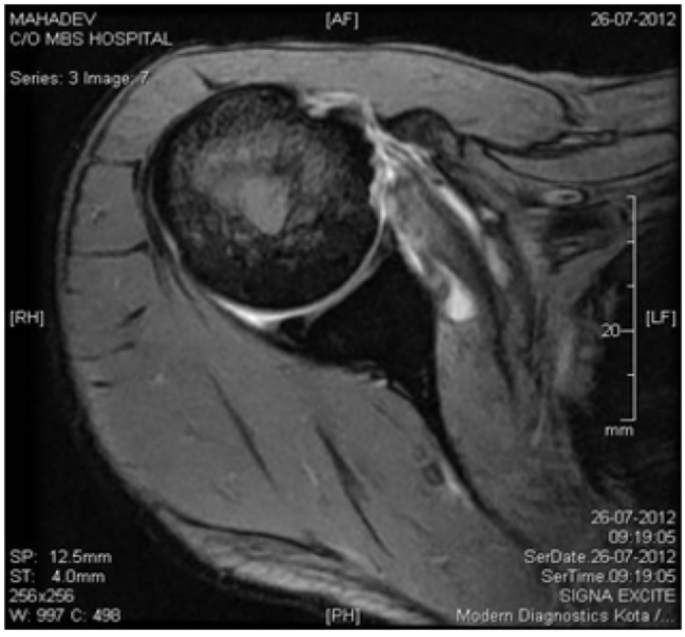

Figure 4: MRI T2 GRE axial image showing osteophyte formation at coracoids process with subcoracoid impingement and full thickness tear of subscapularis tendon.

Table 5: Associated findings in patients of rotator cuff tear with tear

	Total number	Associated with tear
Biceps tendon: sheath effusion	21	13 (61.9%)
Subacromial-subdeltoid bursa fluid	5	4 (80%)
Bone irregularity	8	5 (62.5%)

and positive predictive values were 93.54% and 100%, respectively and accuracy of was 95% (Table 4).

Fotiadou et al[14] reported that accuracy in the detection of full-thickness tears was 98% for ultrasonography and correlates with the current study. Dinnes et al[15] concluded that ultrasound was most accurate when used for the detection of full-thickness tears and sensitivity was lower for detection of partial-thickness tears correlating with the results of the present study.

Apart from rotator cuff tear the following associated findings were also observed on USG and correlated with MRI. Among them fluid in subacromial bursa was detected in 5 patients on ultrasound and 25 patients have shown fluid in subacromial bursa on MRI. MRI additionally diagnosed labral tear in 3 patients and bone marrow edema in 6 patients which could not be detected on USG, sensitivity and specificity of MRI in detecting labral tears in the present study were 100%. This suggests that MRI is better than ultrasound in detecting bursal fluid and bone marrow edema. Gusmer et al[16] carried out unenhanced MR imaging in 103 patients with clinically suspected shoulder injuries. They were prospectively assessed for the accuracy of MRI in the detection of labral injuries. The sensitivity and specificity for detection of these tears with MRI was 86% and 100%, respectively.

CONCLUSION

In the current study we found that USG has comparable accuracy to MRI for the detection of full thickness tears but is slightly less sensitive for partial thickness tear. MRI is better in detecting labral and ligamentous pathology. USG can be considered as a screening diagnostic modality because of its widespread availability, low cost, and ability to perform dynamic study and correlation with contra-

Figure 5: Transverse view supraspinatus tendon on USG showing hypoechoic area in supraspinatus tendon suggestive of partial thickness tear.

Figure 6: MRI STIR coronal image showing fluid in joint with altered hyperintense signal in supraspinatus tendon suggestive of partial thickness tear.

lateral side at the same time. MRI should be used secondarily or where the diagnosis is doubtful on USG because it provides more information about the extent of the lesions of labrum, joint, and ligaments around the joint.

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