ORIGINAL RESEARCH ARTICLE

Comparative Study of Ultrasound and MRI In Assessing Rotator Cuff Tear

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A B S T R A C T

Introduction: Shoulder pain is one of the most common problems presenting in orthopedic outpatient clinics. Rotator cuff pathology is the most common cause of shoulder pain. Both ultrasound and MRI are widely used to assess rotator cuff pathology. Accurate detection of site and size of rotator cuff tear is crucial for decision making and further management. The aim of this study was to assess the accuracy of ultrasound in detecting and evaluating the morphology and extent of rotator cuff tears as compared to MRI.

Material and Methods: Thirty five patients with clinical suspicion of rotator cuff tear who were referred for shoulder MRI were taken for the study. Our institute human ethical committee clearance was obtained. High resolution ultrasound was done for all the referred cases before MRI of the shoulder. Both ultrasound and MRI was done by the same radiologist to minimize interobserver variation.

Results: Out of 35 patients undergoing ultrasound, 12 had partial tear, 6 had complete tear and 13 had tendinopathy involving supraspinatus tendon. When compared to MRI ultrasound had sensitivity, specificity and diagnostic accuracy of 86%, 86% and 91% for complete tear and 75%, 95% and 86% for partial tear and 93%, 81% and 86% for tendinopathy respectively.

Conclusion: Ultrasound has comparable accuracy with MRI for identifying rotator cuff tear. Though it's difficult to differentiate high grade partial tear from complete tear, Ultrasound can be used as screening modality to detect rotator cuff integrity since it is easily available and cost effective. MRI should be done as a preoperative work up.

Key words: Rotator Cuff Tear, MRI, Ultrasound

INTRODUCTION

Shoulder pain is one of the most common problems presenting in orthopedic outpatient clinics. Rotator cuff pathology is the most common cause of shoulder pain.[1,2] Varied pathology can affect rotator cuff like trauma, inflammation, impingement and instability. Rotator cuff tear is the most common pathology in patients presenting with shoulder pain.[3]

Clinical information regarding rotator cuff pathology is limited for treatment planning, hence imaging forms the integral part in evaluating these patients. Both ultrasound and MRI are widely used to assess rotator cuff pathology. Accurate detection of site and size of rotator cuff tear is crucial for decision making and further management. Conservative or surgical (open or arthroscopy) depends on the diagnosis. Associate finding like condition of the muscle and tendon, retracted ends, underlying degenerative changes of tendon and impingement are important for choosing an appropriate treatment option[4]. With the advent of high resolution ultrasound and increased user experience, it has become more and more reliable modality to detect rotator cuff integrity. It is a noninvasive, easily available, inexpensive and real time imaging modality making it easier and better for the assessment of rotator cuff muscles. However diagnostic difficulties are attributed to limited movement of shoulder in painful conditions, long learning curve, technical restrictions and insufficient expertise.[5-7]

MRI is a noninvasive, multiplanar imaging modality with excellent soft tissue resolution and is considered as the imaging of choice in detecting rotator cuff pathologies.[8-10] Being operator independent and high quality images makes it inherently easier to understand the pathology for orthopaedicians. Shoulder joint can be completely assessed including joint, labrum, ligaments which can contribute to the symptoms. Limitations of MRI is its availability, cost and time consumption in addition to absolute contraindications like pacemaker, defibrillators etc.

MR arthrogram is MRI imaging with intraarticular radio-

opaque contrast injection and is superior in delineating rotator cuff integrity as compared to plain MRI. Being invasive, it is not considered as first line imaging[4]. The aim of our study was to evaluate the accuracy of ultrasound as a screening modality in detecting and evaluating the extent of rotator cuff tear as compared to MRI (which is considered as golden standard in our study).

MATERIAL AND METHODS

This study included 35 patients presented to our MRI department with clinical suspicion of rotator cuff pathology from January 2016 to November 2016. Exclusion criteria included fractures of shoulder bones, pregnant women and infective pathologies. Ultrasound had been done by a radiologist with 8 years of experience before performing MRI. All the patients underwent MRI shoulder after ultrasound evaluation. MRI is evaluated by the same radiologist to minimize multiple observer variability.

Ultrasonography of the shoulder was done using ultrasound machine (SEIMENS, ACCUSON) 12MHz linear array transducer with musculoskeletal, shoulder settings. Ultrasound was done using musculoskeletal ultrasound technical guidelines for shoulder of European society of musculoskeletal radiology.

a) For Long head of biceps tendon

Arm was placed in internal rotation with elbow flexed to 90^0 and palm up, biceps tendon was traced till the intertuberosity groove and probe was shifted to examine the intraarticular course of biceps tendon.

b) For subscapularis tendon:

Rotate the arm externally fixing the elbow on iliac crest to see the subscapularis tendon inserting to lesser tuberosity tendon. It was evaluated in transverse and longitudinal planes with passive internal and external rotation of arm.

c) For supraspinatus tendon

Arm was positioned posteriorly placing the palmar side of the hand on superior aspect of iliac bone with elbow flexed and posteriorly directed. Supraspinatus was imaged considering intraarticular portion of biceps as landmark. Supraspinatus tendon was also assessed with arm internally rotated with dorsum placed on opposite back.

d) For subacromial impingement

Dynamic assessment was done with arm abducted and internally rotated and Probe placed in coronal plane at the lateral margins of acromion.

e) For Infraspinatus and Teres minor muscle

Arm was placed as that for biceps tendon using the spine of the scapula as landmark and increasing the depth, the infraspinatus and Teres minor muscles were seen as individual strictures filling the infraspinatus fossa, deep to the deltoid. Probe was moved towards greater tuberosity in sagittal plane where two tendons are examined till there insertion.

Ultrasound of the shoulder was done in both static and dynamic positions. Rotator cuff was assessed for the integrity, thickness and echo pattern. Tendons were classified into normal, tendinopathy, partial tear and complete tear depending on the appearance. Normal tendon has a homogenous appearance with fibrillar pattern throughout. Tendinopathy has inhomogeneous appearance with thickened tendon or abnormally thin tendon. Partial tear is diagnosed when there is focal abnormal echogenicity seen in two perpendicular planes either on the bursal or articular surface of the tendon and midsubstance of the tendon with normal bursal or articular surface.

Complete tear is diagnosed when there is complete non-visualization of the cuff, focal abnormal echogenicity involving full thickness of the tendon with retracted torn edges. Width of the tear is measured in sagittal plane. Indirect signs of rotator cuff that is seen on ultrasound are fluid along the biceps tendon, fluid in the subacromial or subdeltoid bursa, concavity of bursal surface of the tendon and irregularity of greater tuberosity (figure-1).

MRI of shoulder was done using Achieva 1.5 T Philips scanner with patient lying in supine position and shoulder placed in the SENSE shoulder coil. Scout localizers done in axial, coronal and sagittal views. T1W FSE and PDW SPIR sequences are done in axial, coronal and axial views, T2W FFE sequence done in sagittal sections and 3D

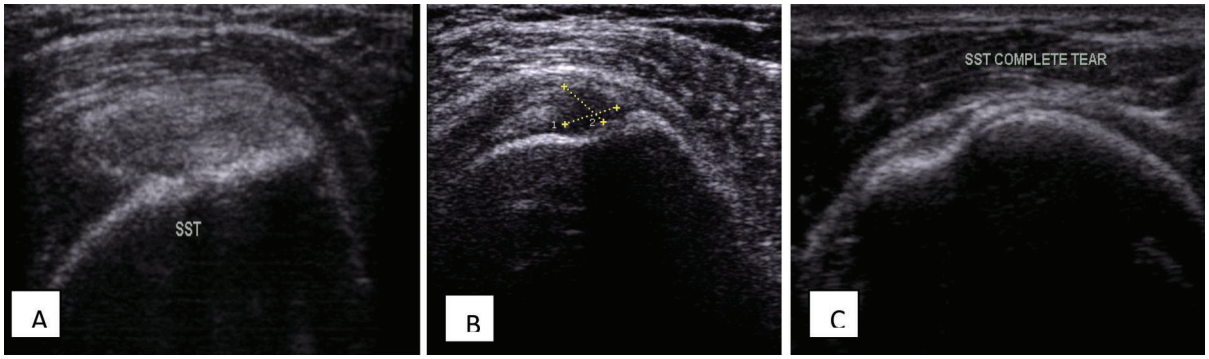

Figure-1: Ultrasound images of shoulder showing Supraspinatus Tendon pathologies
A. Tendinopathy **B.** Partial tear **C.** Complete tear

WATS sequence in axial sections (figure-2).

On MRI tendinopathy was defined as increased signal intensity on PDW images but not as bright as fluid signal on T2Wsequence. Partial thickness tear was defined as focal increased signal intensity or discontinuity of fibers on T1W, PDW and T2W sequences that is as bright as fluid signal on T2 W sequence which either involves bursal or articular surface or mid substance of the tendon. The tear is considered complete when the focal discontinuity involves full thickness of the tendon from bursal surface to articular surface with retraction of the torn ends and the gap is either filled with fluid signal intensity or altered signal intensity of granulation tissue (table-1).

STATISTICAL ANALYSIS

Microsoft office 2007 was used for the analysis. Descriptive statistics like mean and percentages were used for the data analysis.

RESULTS

Our study included 35 patients who came to orthopedic department with shoulder pain and limited range of motion were referred to MRI department with clinical suspicion of rotator cuff pathology. Non contrast MRI done following ultrasound for all the cases. Three patients had normal rotator cuff both by ultrasound as well as MRI. 31 out of 35 showed rotator cuff pathology (partial tear, complete tear, tendinopathy) by both the modalities. Out of these 13 patients had partial tear, 6 patients had complete tear and 12 patients had tendinopathy and 3 patients had tendinopathy and partial tear of supraspinatus tendon in both ultrasound and MRI. 4 patients had combined tendinopathy and rotator cuff tear.

DISCUSSION

Presence or absence of tear, size and site of tear, characteristics of rupture ends and morphology of the

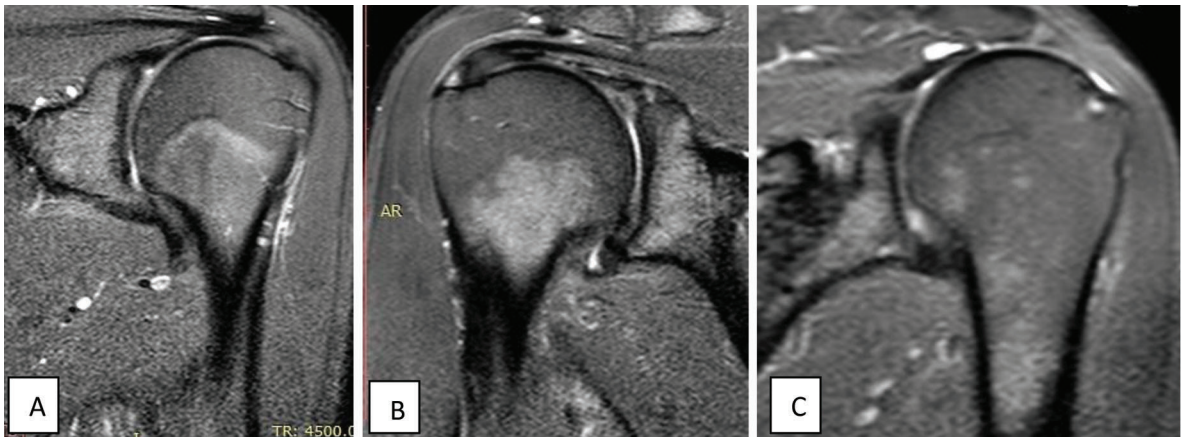

Figure-2: MRI images of same patients as Ultrasound showing Supraspinatus Tendon pathologies
A. Tendinopathy **B.** Partial tear **C.** Complete tear

	TR ms	TE ms	EPI factor	Turbo factor	FOV mm	MATRIX	Slice thickness mm
T1W	450	18	1	3	140	180/ 448 r	3.0
T2W FFE	601	18	1	1	140	125/448r	3.0
PDW SPIR	4500	30	1	13	140	192/ 448 r	3.0
3D Wats	24	7.8	1	1	130	96/224r	2.4

Table-1: Showing various Sequences and their factors for MRI of shoulder

	TP	TN	FP	FN
tendinopathy	13	17	04	01
Partial tear	12	18	01	04
Complete tear	06	26	02	01

TP- true positive, TN- true negative, FP- false positive, FN- false negative.

Table-2: Results of ultrasound findings compared with MRI findings

	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive value	Diagnostic accuracy
Partial tear	75%	95%	92%	82%	86%
Complete tear	86%	93%	75%	96%	91%
Tendinopathy	93%	81%	76%	94%	91%

Table-3: Showing diagnostic percentages of sensitivity, specificity, accuracy and predictive values of ultrasound

muscles is necessary to decide whether patient needs surgical or non-surgical management. Since many years, studies and metaanalysis have been done to compare the ultrasound and MRI in evaluating clinically suspected rotator cuff disease and shown comparable diagnostic accuracy, sensitivity and specificity.[11-16] In our study as compared to MRI, ultrasound had sensitivity, specificity and diagnostic accuracy of 86%, 86% and 91% for complete tear, 75%,95%% and 86% for partial tear and 93%, 81% and 86% for tendinopathy respectively which are comparable to many studies.

Al shawi et al studied 143 consecutive patients ultrasound and compared with sub-segment arthroscopy and showed that ultrasound had sensitivity of 95.4%, Negative predictive value of 95.7% for full thickness tear and 89.5% for partial thickness tear.[17] The results were comparable to our study with negative predictive value for our study is 96% for complete tear and 82% for partial tear. Iannotti. JP et al reported that office based ultrasound to assess rotator cuff has 88% accuracy for full thickness tear and 70% for partial thickness.[18] with comparable results to our study

Currently many clinicians prefer MRI as a preoperative imaging than ultrasound because ultrasound provides less information regarding the mophology of torn ends of cuff muscles and the exact size and extent of tear.[19,20] Keelechi et al retrospectively studied ultrasound and MRI of 144 patients who underwent arthroscopic repair of rotator cuff and showed that there is a greater difference between the two modalities in the measurement of tear size and retraction status and concluded that ultrasound is the imaging modality for detection of rotator cuff tears and MRI should be done for surgical planning of large tears.[21] Sipola et al prospectively studied 77 patients with suspected rotator cuff tear with ultrasound and MRI and showed that ultrasound underestimated the tear size by ~15mm as compared to MR arthrogram and suggested that ultrasound should be used as screening modality for detection of rotator cuff tear.[15]

Similarly in our study one patient was diagnosed as high grade partial tear on ultrasound, had full thickness tear on MRI and two patients with high grade partial tear on MRI was diagnosed to have complete tear on ultrasound, this might be because of difficulty in distinguishing the most medial extent of supraspinatus tendon insertion at the junction of acromion and greater tuberosity of humerus.[22,23] As per our study and previous other studies the accuracy of ultrasonography in detecting rotator cuff tear is comparable with that of MRI. However accuracy of ultrasound in distinguishing high grade partial thickness tear and full thickness tear is poor.

Limitations of our study are the number of patients included in the study is less and we have considered MRI has the gold standard to compare our ultrasound findings and not the surgical findings.

CONCLUSION

Ultrasonography should be considered as the screening modality of choice in evaluating patients with clinical suspicion of rotator cuff tear. MRI should be considered as preoperative work up.

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