ROLE OF ULTRASOUND IN ROTATOR CUFF TEARS

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ABSTRACT

Objective: The study was designed to evaluate the efficacy of ultrasound in rotator cuff tears and to compare it with MRI.

Study Design: Descriptive study.

Place and Duration of Study: The study was conducted in the radiology department of Combined Military Hospital Rawalpindi from July 2005 to January 2006.

Patients and Methods: Total number of patients was thirty. All of these were above thirty years of age and were referred by clinicians, with shoulder pain for diagnostic workup. Post operative patients were excluded. Ultrasound and Magnetic Resonance Imaging (MRI) were performed on each patient. Same operator performed ultrasound in all patients.

Results: Ultrasound (US) and Magnetic Resonance Imaging (MRI) detected equal number of full thickness tears while two partial thickness tears were missed on US. Hypoechoic defect was the most important primary sign while cortical irregularity and fluid in subacromial and subdeltroid busra were the most important secondary signs on US.

Conclusion: US was equally effective to MRI in detection of rotator cuff tears. It should be the primary investigation because of its availability, cost effective and real time evaluation provided significant expertise is developed, as it is highly operator dependent.

Keywords: Ultrasound, Magnetic Resonance Imaging, Rotator cuff, Partial thickness tear, Complete thickness tear.

INTRODUCTION

The shoulder is a complex joint, having great range of motion but its stability is compromised. The rotator cuff tendons are key to the healthy functioning of the shoulder. Shoulder pain is a significant cause of morbidity. The prevalence of self-reported pain is estimated to be between 16 and 26% and it is the third most common cause of musculoskeletal consultation in primary care centers [1]. Sixty percent of shoulder abnormalities have been attributed to rotator cuff disease [2]. Rotator cuff tears are uncommon below the age of 30 but start increasing in frequency after the age of 40 and affect about 40% of the population in the seventh decade of life [2, 3].

Ultrasonography of the rotator cuff is a non-invasive, painless and cost-effective method for evaluation of patients with a suspected rotator cuff tear. Dynamic evaluation of the early rotator cuff impingement using real time ultrasound is promising, as it can not only give us information about the range of movement but also muscular coordination about the joint. Ultrasound is over 90% specific and sensitive for diagnosis of rotator cuff tears with an almost 100% negative predictive value. This makes ultrasound an ideal screening test [4, 5]. MR imaging is still the most sensitive imaging method, its high negative predictive value for the diagnosis of complete rotator cuff tears and its reliability in evaluating different shoulder joint pathologies make it the preferred imaging modality [6]. Ultrasound should be the primary diagnostic method in screening of shoulder pain because it is economical and readily available. The MRI technique should be used secondarily because it provides more information about the extent of injury to tendons and has lower risk of artifacts [7]

The aim of the study was to compare the efficacy of ultrasound with MRI in diagnosing rotator cuff tears.

PATIENTS AND METHODS

Study was conducted in Department of Radiology at Combined Military Hospital, Rawalpindi from 19 July 2005 to 25 January

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2006. All the MRI were performed in Military Hospital, Rawalpindi. This is a descriptive study. Thirty patients with shoulder pain, referred by clinicians, for diagnostic work up were included in our study by non probability convenience sampling. Post operative patients and patients less than 30 years of age were excluded. US is operator dependent and has a long learning curve so in order to develop expertise in US and understand the normal anatomy and variants, a number of ultrasounds were performed before starting the study.

There was a time interval between the performances of US and MRI as they were carried out in different setups. In some patients ultrasound was performed before MRI and in others it was vice versa. In those patients where either US or MRI was performed earlier, in order to avoid bias the reports were kept confidential from the radiologist. Ultrasound machine (Toshiba) with 12 MHz probe was used for all the patients. Same operator performed ultrasound of all the patients. Ultrasound was performed as per established protocol. Patients were seated on a backless chair or stool facing the operator which allowed the operator's convenient access to desired imaging planes. Patients were asked to adopt various positions for optimal visualization of all the tendons and facilitate the shoulder movement during dynamic imaging. The US examination was standardized and included imaging of the subscapularis (SSC) and supraspinatus (SSP) tendons (with images obtained on the long and short axes of the tendon), and the infraspinatus tendon (with images obtained the long axis).The long biceps tendon was imaged in both transverse and longitudinal planes. Imaging of the acromioclavicular (AC) joint (with the transducer perpendicular to the joint space) was also performed but not included in the study. The patient was asked to place his or her hand on the ipsilateral thigh for the examination. However, for better exposure of the tendon from underneath the acromion, the SSC tendon was evaluated with the arm externally rotated and the SSP tendon was evaluated with the wrist behind the patient's back.

MRI of shoulder joint was also performed in all patients by 1.5 T Sigma MR imaging (Siemens). Patients were supine and shoulder was in external rotation. Multi plane imaging including coronal and oblique sagittal planes was performed. T1/T2 weighted and fat-suppressed FSE T2-weighted images were obtained.

Statistical Analysis

Data was entered into Computer package SPSS version 11 for analysis. Frequency and percentages were used to describe the data. Chi-square test was used to compare the result of ultrasound and MRI. P-value <0.05 was considered as significant.

RESULTS

Out of 30 patients 67% were male and 33% were female. Figure 1 shows the frequency of rotator cuff pathologies detected in three age groups with highest number of 11(52.38%) in the above 50 age bracket.

On Ultrasound, 19(63.34%) patients were having rotator cuff tear out of 30 patients, while 11(36.67%) patients were having normal cuff. Out of 19 patients with tear, 11 (57.9%) had full thickness tear and 8 (42.1%) had partial thickness tear. Out of 8 patients who had partial thickness tear, 6 (75%) were on the articular and 2 (25%) were on the bursal side. The important ultrasound signs in diagnosing partial and complete thickness tears and their relative frequencies are shown in the Table 1.

MRI detected 21 (70%) rotator cuff tears while 9 (30%) patients had normal cuff. Out of 21 patients with rotator cuff tear 11 (52.4%) had full thickness tear and 10 (47.62%) had partial thickness tear. MRI was conducted on these patients; hyperintense focus in rotator cuff tendon on T2W images was seen in 100% of the patients with rotator cuff tear (Fig. 2). Other signs included Bicep tendon sheath fluid collection (33%), subdeltoid or subacromial fluid collection (52%) and retracted tendon (28%) (Fig. 3). Their comparable occurrence with ultrasound is given in the table 2.

Comparison of US and MRI results for the patients suspected of rotator cuff tear was done. US and MRI detected equal number of patients with complete thickness tears i.e. 11 (36.67%). MRI detected 10 (33.33%) patients with partial thickness tears, as compared to 8 (26.67%) detected on US. Ultrasound and MRI are equally effective in detecting rotator cuff pathologies (Fig. 4).

Table 1: Frequency and percentages of ultrasound signs in complete and partial thickness tears

Ultrasound Signs	Complete Tears =11 Frequensy	Partial tears =8 frequency
Hypoechoic defects.	9	7
Hyperechoic defects/Abnormal echogenicity	1	1
Tendon non-visualization.	3	0
Double cortex/cartilage interface sign	5	0
Flattening or concavity of the subdeltoid bursal fat (Sagging peribursal fat sign.)	4	1
Cortical irregularity.	7	5
Fluid in subacromial / subdeltoid bursa	6	2
Fluid in the long head of biceps tendon sheath.	4	1
Dynamic examination- bulging	8	3

Table 2: Frequencies of pathological findings seen on ultrasound and MRI.

Pathology Finding in Rotator Cuff	Ultrasound Freq (%)	MRI Freq (%)
Hypo or hyperechoic area on US & hyperintense signal on MRI	18 (94%)	21 (100%)
Tendon non visualization/retraction	3 (15%)	6 (28%)
Bicep tendon sheath fluid collection	5 (26%)	7 (33%)
Subdeltoid or subacromial fluid collection	8 (42%)	11 (52%)

- No of patients (n =30)
- No of patients with tear on MRI= 21
- No of patients with tear on US= 19

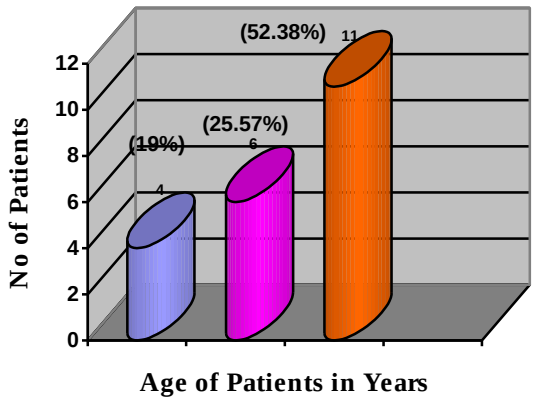

Figure.1: Frequencies of patients with rotator cuff pathologies in three age brackets. (n=21)

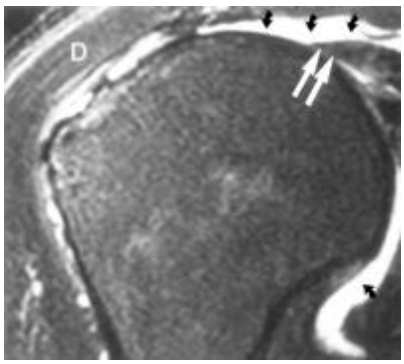

Figure 2: Large, full-thickness tear of the rotator cuff. Oblique coronal T2-weighted MR image shows a large cuff defect, with the edge retracted far medially (white arrows). Fluid is within both the glenohumeral joint and subacromial-subdeltoid bursa (black arrows). The overlying deltoid muscle (D) nearly opposes the humeral head.

DISCUSSION

Rotator cuff tear is a well known cause of pain and disability in shoulder especially in old age [8]. Patients present with pain, dysfunction or both. We performed US and MRI in each patient with the time period not exceeding three months. There was gradual increase in the incidence of rotator cuff tears with age in patients. Maximum number of patients i.e. 11 (52.38%) out of 21 were present in the above 50 yrs age group. This is very much in accordance with international studies i.e frequency of rotator cuff tears increases with age and mostly occurs over 40 years of age [1-3].

High frequency in males were observed in our study which is in contradiction to the study carried by Sharlene et al [9]. However our study was of small sample size and the proportion of

the patients who presented to us was mostly entitled military personnel (males).

Specific US criteria have been established

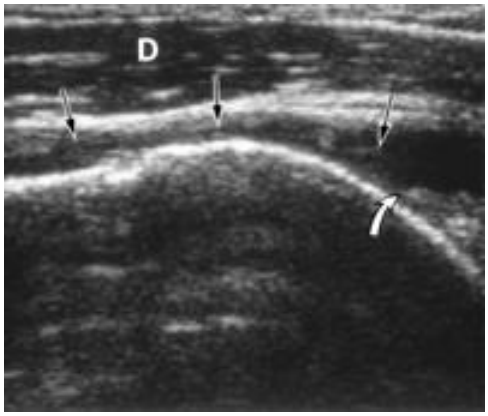

Figure 3. Large, full-thickness tear of the rotator cuff. Coronal (longitudinal) sonogram shows a large cuff defect filled with fluid and debris (straight arrows). Also apparent are the medially retracted edge of the supraspinatus tendon (curved arrow), near apposition of the deltoid muscle (D) to the humeral head, and loss of outer convexity.

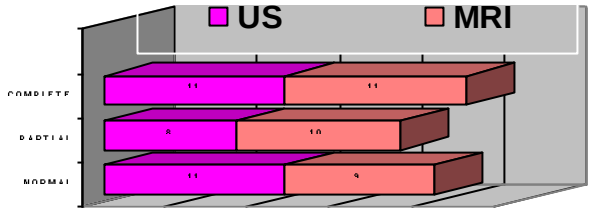

Figure 4: Frequency of tears detected on ultrasound and MRI(n=30)

as US has evolved over the years as an effective imaging method in the diagnosis of rotator cuff tears. Rotator cuff tears were diagnosed in our study by criteria of hypo or hyper echoic defects (primary signs) involving part or whole of the tendon of rotator cuff. The diagnosis of tear was made only when the defect was reproducible in different positions of the joint or transducer. The dynamic criteria of bulging and compressibility were also demonstrated in addition to static evaluation. In our study, 73% of patients with full thickness tear showed bulging of tendon on dynamic examination. Absence of tendon was taken as sign of complete tear with retraction. As explained by Weiner et al, complete absence or non visualization of a tendon indicates full-thickness tear with retraction [10, 11].

One of the aims of our study was to identify ultrasonographic findings of partial and complete thickness tears. Direct sign of abnormal tendon echogenicity was present in most of the patients. Hypoechoic defect was seen in 82% (9 out of 11) of the patients in complete thickness tears and 87% (7 out of 8) of partial thickness tear, while hyperechoic tendon was seen in only 2 (18%) out of 11 and 1 (12%) out of 8 patients of full and partial thickness tear respectively. Tendon non-visualization was the sign only of complete thickness tear and was seen in 27% of the patients. In the study conducted by Jacobson et al, tendon non-visualization was the primary US finding that best predicted full thickness tear [12]. As regards the location of a tendon abnormality, review of literature clearly shows that articular surface partial thickness tears account for up to 80% of these tears [9, 12, 13]. It is probably related to the pathophysiology of rotator cuff lesions.

We found cortical irregularity and fluid in the subacromial subdeltoid bursa as important secondary signs, seen in both full thickness and partial thickness tears. It is comparable to the study carried by Jacobson et al [12] and presence of such fluid should strongly increase the sonologist's suspicion of a full-thickness tear. Since then, it has been determined that visualization of fluid in the subacromial and subdeltoid bursa is the most reliable secondary finding of rotator cuff tear. However its importance has been debated in some of the international studies [14].

In our study 100% of the patients with rotator cuff tear presented as a hyper intense defect or a tendinous avulsion that extended from the bursal to the articular side of the cuff on MRI. The presence of retraction or both are necessary for correct diagnosis. A partial cuff tear typically appeared as a focal hyper intense region that contacts only one surface of the cuff. Frequency of secondary signs detected by MRI was high as compared to US which could be

due to the lack of experience of sonologist and incidence of increased artifacts on US.

The most significant finding in our study was that US and MRI detected equal 11 number of patients with full thickness tears. Two patients of partial thickness tears were missed on US who were detected by MRI. Out of 30 subjects proportion of rotator cuff pathologies detected by US was 19 (63%) while proportion of rotator cuff pathologies detected by MRI was 21 (70%) patients. These results clearly show that US and MRI are equally effective in detecting rotator cuff pathologies.

There were few limitations of our study. Firstly, the sample size was small consisting of 30 patients. Secondly, no gold standard was available and MRI itself is effective for evaluating rotator cuff lesions, with high reported accuracies for detection of complete tears but more disparate results for detection of partial tears [15]. Arthroscopy of shoulder joint is not performed in our orthopedic department, therefore surgical confirmation could not be done. Final limitation to our study relates to observers i.e. lack of experience in performing US of the shoulder. It requires a sound knowledge of US technique and musculoskeletal anatomy as well as common imaging pitfalls. We recommend that period of formal training and continuing audit is required to ensure operator accuracy.

CONCLUSION

The frequency of partial and full thickness rotator cuff tears detected by US and MRI are almost equal and therefore we conclude that both these modalities are equally effective in detection of rotator cuff tears.

Given the large differential in the cost of the two procedures, our study shows that ultrasound is more cost-effective for identification of rotator cuff tears. Ultrasound should be the primary diagnostic method for shoulder pain and MRI should be used secondarily because it provides more information about extent of tendons and has lower risk of artifacts.

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