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Diagnostic accuracy of ultrasound vs. MRI in evaluation of rotator cuff injuries

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Abstract

Background: Rotator cuff pathology accounts for 10% causes of shoulder pain. A gamut of imaging techniques comprising of ultrasonography (USG), Magnetic Resonance Imaging (MRI) and MR arthrography (MRA) have been commonly used for the characterisation of rotator cuff (RC) disorders. With the advent of high-end USG machines, accuracy rates of USG is comparable to that of MRI in evaluation of rotator cuff pathologies.

Materials and Methods: 50 patients who had presented with symptoms of rotator cuff injuries and were referred to Department of Radiodiagnosis JSS Medical College and Hospital, Mysuru during the period August 2017 to September 2019 for Ultrasound and MRI of the shoulder.

Results: Diagnostic accuracy of USG in correlation to MRI showed 93% sensitivity and 97% specificity for supraspinatus, 88% sensitivity and 96% specificity for detecting the infraspinatus tears; 74% sensitivity and 86% specificity for subscapularis indicating detection of supraspinatus was comparatively easier than subscapularis in ultrasound.

Conclusion: MRI was more superior and sensitive tool than ultrasound in detecting and delineating the musculoskeletal injury in terms of grading the partial tear & tendinopathy, however accuracy of ultrasound in initial evaluation of rotator cuff injuries is comparable to MRI. Anatomical delineation of the rotator cuff injury which is of prime value for treating surgeon is better visualized by MRI.

Keywords: Rotator cuff tear injuries, MRI, Ultrasound

Introduction

Of the several factors accounting for shoulder pain and disability, Rotator cuff pathology accounts for up to 10% of the cases, a definite upward trend is observed with increase in age [1]. Gold standard for evaluation of tears was contrast arthrography, however the same is an invasive procedure, expensive with increased rate of delayed morbidity [2, 3].

Advances in imaging techniques such as ultrasound (USG) and Magnetic Resonance Imaging (MRI) with dedicated protocols have rendered invasive arthrography as an obsolete technique and is replaced by MRI as the imaging modality of choice in evaluation of rotator cuff pathologies. High resolution real-time ultrasonography has also shown accuracy rates comparable to that of MRI in diagnosing both full & partial-thickness tears and in evaluation of tendinopathy.

Most common causes of shoulder pain leading to disability includes the tears of the rotator cuff. Timely diagnosis and successful treatment would help in preventing the functional impairment. Apart from partial or full thickness tears, rotator cuff defects include degenerative cuff failure, impingement syndromes, tendinitis, tendinopathy, posterior capsular tightness, subacromial abrasion and cuff tear arthropathy. MR provides great details on site, extent of the lesion and the secondary changes associated with the surrounding structures, aiding in prompt diagnosis and therapeutic approach. However, as a point of care tool or as a preliminary imaging modality, ultrasound can be nearly as accurate as MRI in addition to the cost-effective imaging modality to help in screening of rotator cuff pathologies.

Our study evaluates the diagnostic efficacy of USG in correlation with MR imaging in detection and evaluation of rotator cuff pathologies, including partial and full thickness tears, acute or chronic tear, secondary to trauma or degenerative in aetiology. The age and sex distribution, symptomatology and secondary changes/sequel of the conditions among the sample will also be studied.

Materials and Method

50 consecutive patients who had presented with shoulder pain, clinically suspected to have rotator cuff injuries during the period August 2017 to September 2019 underwent Ultrasound and MRI of the shoulder at Department of Radiodiagnosis, JSS Medical College and Hospital, affiliated to JSSAHER. Clinical examination findings were recorded. Subsequently patients underwent ultrasound of the shoulder with high frequency 5-12MHz probe, Philips iu22 using dedicated settings as per the guidelines of ultrasound technical guidelines for shoulder of European society of musculoskeletal radiology. Following this patient, underwent MRI, (3Tesla, Philips Ingenuity, with 16

Channel anterior shoulder coil). Ultrasound and MRI findings were correlated, tabulated. Statistical analysis was done with SPSS version 21, IBM to determine accuracy of ultrasound in correlation with MRI.

Results

In our study, of the 50 patients enrolled for the study, 14 were females and 36 males the M: F ratio was 1.27: 1, a definite male preponderance was noted. The mean age at presentation to the hospital was 39years, the mean age among males being 40.44 years and in females being 37.44 years, irrespective of the age at time of injury. (Table 1).

Table 1: Gender and age Distribution of rotator cuff injuries

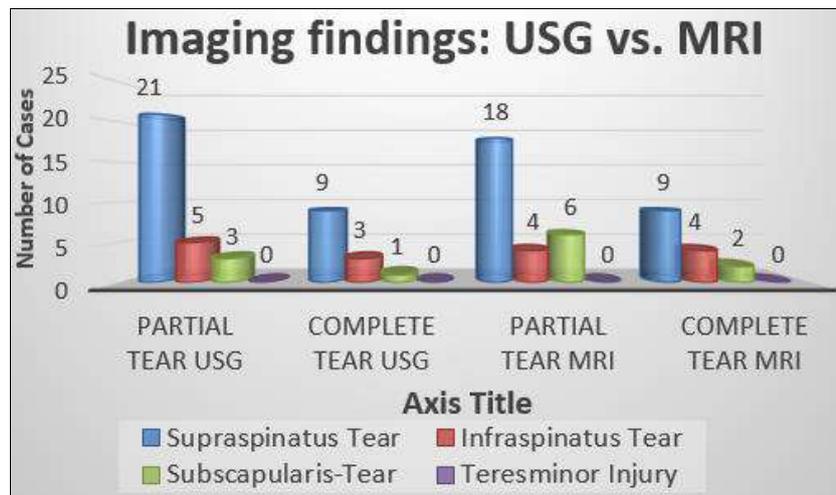
Age	Females	Males	Age	Females	Males	Total
Mean	40.571	37.444	less than 20	1	2	3
Median	36	31	21-30 years	3	14	17
Mode	34	29	31-40 years	4	5	9
Std. Deviation	18.4962	14.935	41-50 years	2	5	7
			51-60 years	2	5	7
			>60 years	2	5	7
			total	14	36	50

Based on clinical evaluated, 39 were referred with clinical diagnosis of supraspinatus injury, 11 with infraspinatus injury and 7 with clinical diagnosis of subscapularis injury.

Imaging findings as on ultrasound and MRI are as depicted. (Table 2 and Graph 1)

Table 2: Comparison of findings in USG and MRI Modalities

Prevalence of Injuries	Frequency				Percentage			
	USG Partial Tear	Complete Tear USG	Partial Tear MRI	Complete Tear MRI	USG Partial Tear	Complete Tear USG	Partial Tear MRI	Complete Tear MRI
Supraspinatus Tear	21	9	18	9	42	18	36	18
Infraspinatus Tear	5	3	4	4	10	6	8	8
Subscapularis Tear	3	1	6	2	6	2	12	4
Teres Minor Injury	0	0	0	0	0	0	0	0



Graph 1: Comparison of Imaging findings: USG vs. MRI

In evaluation of supraspinatus tears, the accuracy of ultrasound for partial thickness tear was 90% and 96% respectively with Sensitivity of 92.74%, Specificity of 88.57%, Positive predictive value (PPV) and Negative predictive value (NPV) of 81.82% and 96.88% respectively. Full thickness tear showed accuracy rates of 96% with Sensitivity of 93.46%, Specificity of 97.5%, Positive predictive value (PPV) and Negative predictive value (NPV) of 90% and 97% respectively. Pearson’s Chi-square test was

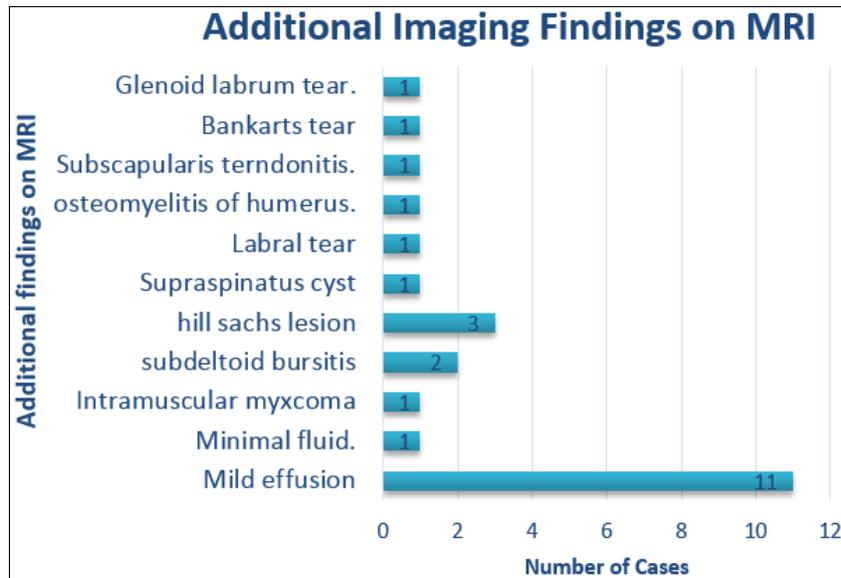
indicative of significant correlation of Ultrasound and MRI findings, with p value <0.05.

For Infraspinatus tear, the accuracy of ultrasound for partial thickness tear and full thickness tear was 93% and 100% respectively. Sensitivity of 87.5%, Specificity of 96.6%. Pearson’s Chi-square test was indicative of significant correlation of Ultrasound and MRI findings, with p value <0.05.

Of 7 patients with clinical suspicion of subscapularis tear,

partial tear was detected in only 3 of 6 patients, complete tears were detected in all. Overall, ultrasound Sensitivity was 7.35%, Specificity was 86.6% and Accuracy for detection of subscapularis was 81%. Pearson’s Chi-square test was indicative of significant correlation of Ultrasound and MRI findings, with p value <0.05.

MRI, in addition to detection of tears, ancillary findings were also detected like minimal joint effusion, co-existent Intramuscular myxoma, Subdeltoid bursitis, Hill Sach’s lesion, Supraspinatus cyst, Labral tear, Osteomyelitis of humerus, Subscapularis tendonitis, Bankarts tear as depicted in Graph 2.



Graph 2: Additional Imaging Findings on MRI

Discussion

A rise in vehicular density over the last decade has also seen a surge in road traffic accidents. Increased incidence in the age group of 30-40years is directly related to road traffic accidents, predominantly during usage of two wheelers. In order to find out the exact pathology the preferred imaging modalities for evaluation of suspected tears of the rotator cuff include two modalities namely the high-resolution Ultrasound and Magnetic Resonance Imaging. Both these modalities have their own merits and demerits.

Accuracy, availability, cost effectiveness and expertise are some of the important parameters that guide the process of making a decision on the best modality. The choice on whether to follow conservative management or surgical treatment depends on an accuracy of diagnosis and severity of any underlying tear of the rotator cuff.

In our study on evaluation of rotator cuff injuries the mean age was 39years, the mean age in males was 40.44 years and in females the mean age was 37.44 years, however there was no statistically significant difference between the men and women based on the age at the time of presentation [3]. Male preponderance to predisposition for injury was observed with a Male: Female ratio was 2.5: 1, this is in concurrence with the study done by Amandeep Singh *et al* who found a gender variation of rotator cuff injuries with a M:F ratio was 1.3:1.

Of the 50 cases, 39cases had supraspinatus injury, based on provisional and pre-imaging diagnosis as compared to the USG, MRI detected only 27, the over estimation of injury on ultrasound could be secondary to magic angle artefact. (Figure 1) In our study, frequency of supraspinatus tendon injury is likely because of its course, it is commonly impinged under the acromion as it passes between the acromion & the humeral head and it is commonly injured because of its superficial position.

Infraspinatus tendon injury detection was more accurate on

MRI, so also subscapularis injury. (Figure 2, 3). Restricted mobility impedes the dynamic evaluation of the tendons rendering their visibility to suboptimal levels. In a study done by Narasimhan *et al.* [4, 5], prevalence of subscapularis tears in patients needing rotator cuff repair was found to be 31.4%, the sensitivity of ultrasound was 39.5% and specificity 93.1% in detection of these tears with overall accuracy of ultrasound was 75.8%. In a study by Brandt [6] *et al.* ultrasonography had a sensitivity of 89% and specificity of 43%, in detection of supraspinatus tendon tears, sensitivity of 30% in detection of subscapularis tendon tears. Fischer [7] *et al.* Found that the accuracy of 91.1% and 84.4% in detection of supraspinatus tendon and infraspinatus tendons respectively and 77.8% for the subscapularis tendon which is also binding by our result. In 2008 Fotiadou [8] *et al.* found that in the detection of full-thickness tears was 98% and 100% for ultrasonography and magnetic resonance imaging, respectively while the accuracy in the detection of bursal or articular partial-thickness tears was 87% and 90% for ultrasonography and magnetic resonance imaging, respectively. De Jesus *et al.* [9], stated that there is no statistically significant difference between the sensitivities and specificities of MRI versus ultrasound in diagnosing either full- or partial-thickness tears (p > 0.05).

In our study, sonographic evaluation showed 93% sensitivity and 97% specificity for supraspinatus tendon injuries; 88% sensitivity and 96% specificity for detecting the infraspinatus tears; 74% sensitivity and 86% specificity for subscapularis indicating detection of supraspinatus was comparatively easier than subscapularis in ultrasound [10]. MRI however is the modality of choice and must be done prior surgical intervention or arthroscopy as co-existent I njuries or other pathologies can be detected with exquisite anatomic delineation which is imperative prior surgical repair.

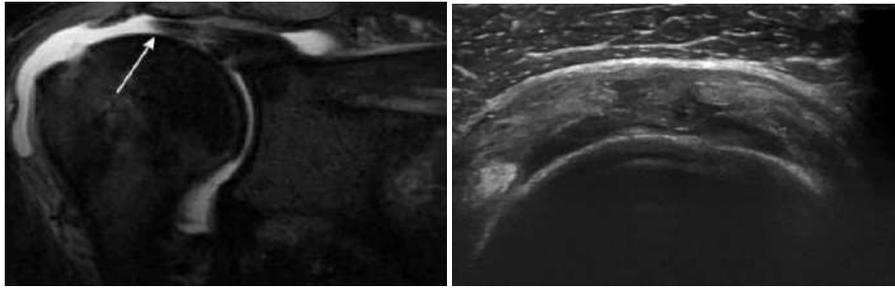


Fig 1: a) USG shows heteroechoic supraspinatus with disruption and peritendinous fluid- indicative of complete tear; b) MRI shows complete tear of supraspinatus tendon.

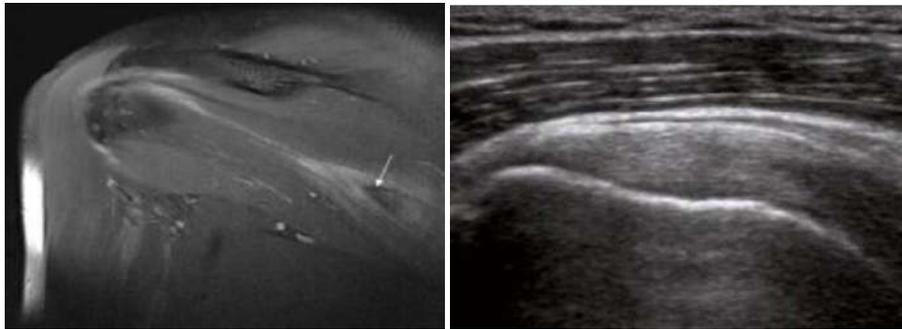


Fig 2: a) USG shows normal infrapinatus; b) MRI showing isolated myotendinous rupture of the muscle which was not picked up in ultrasound due to limitations of USG.

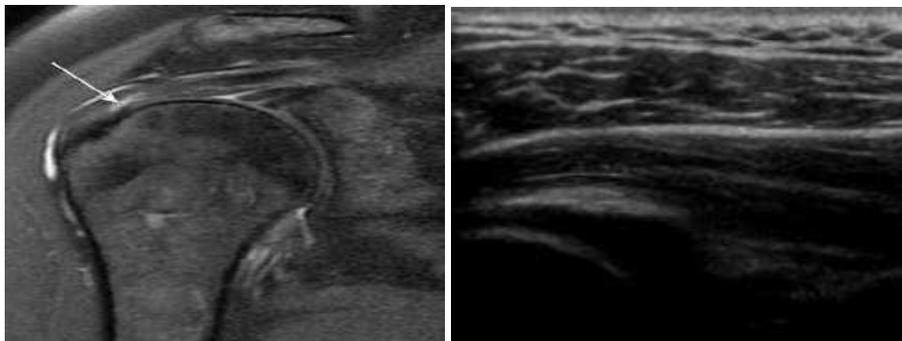


Fig 3: a) USG shows only joint effusion with no significant RCT pathology; b) MRI shows focal high signal within the supraspinatus tendon fibres - Partial interstitial SST tear.

Conclusion

While MRI is more superior and sensitive tool than ultrasound in detecting and delineating the musculoskeletal injury with respect to rotator cuff muscles and grading of injuries were more accurate, accuracy rates as noted in this study mandates the same be used as a point of care imaging tool and also as a screening tool in patients with suspected rotator cuff injuries.

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