

DIAGNOSTIC ACCURACY OF ULTRASONOGRAPHY IN EVALUATION OF SUPRASPINATUS TEAR TAKING MAGNETIC RESONANCE IMAGING AS GOLD STANDARD

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ABSTRACT

BACKGROUND: Tears of the rotator cuff are a common occurrence affecting millions of people globally. Magnetic resonance (MR) imaging is the most accurate imaging modality for evaluating potential causes of shoulder instability. The rotator cuff can also be visualized with ultrasonography (US). Initial US results in the detection of rotator cuff tears varied, probably due to the use of low frequency transducers and limited experience with the examination procedure. **OBJECTIVE:** To determine the diagnostic accuracy of ultrasonography in evaluation of supraspinatus tear taking magnetic resonance imaging as gold standard. **MATERIAL AND METHODS:** This was a cross sectional study, conducted at department of radiology, BVH Bahawalpur from 29-9-2015 to 28-09-2016. The calculated sample size was 135. Data was analyzed using SPSS version 19. Sensitivity, specificity, negative predictive value (NPV), positive predictive value (PPV) and accuracy were calculated for USG using MRI as gold standard. **RESULTS:** A total of 135 patients was enrolled. Mean age of the patients was 39.86 ± 4.21 years. There were 46.67%(n=63) male patients. Frequency of supraspinatus tear was revealed in 21.48% (n=29) patients on MRI. Diagnostic accuracy of ultrasonography revealed sensitivity, specificity, positive predictive value, negative predictive value and accuracy rate as 86.21%, 95.28%, 83.33%, 96.19% and 93.33% respectively. **CONCLUSION:** The authors of the study conclude that the diagnostic accuracy of ultrasonography for the evaluation of supraspinatus tear is high and comparable to gold standard magnetic resonance imaging.

Keywords: Supraspinatus tear, evaluation, ultrasonography, diagnostic accuracy

Introduction

Shoulder is a complex joint with wide range of motion. Rotator cuff tendons are crucial for its normal functioning. Tears of the rotator cuff are a common occurrence affecting millions of people all over the world.¹ Patients having rotator cuff tears most commonly present with the complaint of shoulder pain. Clinical examination alone is insufficient to make a definitive decision for appropriate management of the rotator cuff tears.^{2,3} Therefore, imaging has invaluable role to accurately assess integrity of rotator

cuff and make a decision whether to proceed with surgery or conservative management.^{4,5}

Magnetic resonance imaging and ultrasonography are the two most-commonly practiced non-invasive imaging modalities to achieve this goal. Currently, MRI is the modality of choice for shoulder joint imaging because of its superb contrast resolution and high sensitivity and accuracy in the diagnosis of rotator cuff tears.⁶ However its higher cost and limited availability are the main constraints for its universal

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application, whereas ultrasonography is easily available, tolerable by the patients and cheaper imaging technique.⁷

Initially when detection of rotator cuff tears was evaluated by ultrasonography, the results were not promising.⁸ This was due to use of low frequency probes and inadequate operator experience with the examination procedure. With the passage of time, the continued research and technical developments (use of high frequency transducers 7.5-14 MHz and increased operator experience) have led to encouraging results and reliability of ultrasonography.⁹ According to a recent study, US imaging for rotator cuff tears yields sensitivity of 92.3% and specificity of 94.4%, whereas MRI has 100% accuracy in this regard.¹⁰

The rationale of this study was to find out the sensitivity, specificity and accuracy of ultrasonography in detection of the rotator cuff tears taking MRI as gold standard, so that it can be used in subsequent patients in future as it is easily available and cost effective modality which will help to reduce financial burden and unnecessary delay in patient management.

Objective

The objective of the study was to determine the diagnostic accuracy of ultrasonography in evaluation of supraspinatus tear taking magnetic resonance imaging as gold standard.

Material and Methods

This cross sectional study was conducted in the department of radiology and diagnostic imaging, Bahawal Victoria hospital, Bahawalpur from 29.9.2015 to 28.09.2016. The calculated sample size with 10 % margin of error, 95% confidence level with sensitivity, specificity and prevalence of supraspinatus tear i.e. 92%, 94% and 26%¹⁰ respectively was 135 cases. Non-probability purposive sampling was done. Patients with the age between 25 to 60 years, of both genders having history of trauma over the shoulder leading to pain on elevation and limitation of movements were included in the study. The patients who had absolute

contraindication to MRI like metallic implants or cardiac pacemakers and claustrophobia, patients with congenital skeletal dysplasia, muscular dystrophy and known connective tissue disorders were excluded from the study.

A total of 135 patients fulfilling the inclusion criteria were included after taking approval from the hospital ethics committee. Written informed consent was obtained from the patient included in this study. Ultrasound examination was performed on Logic P5 Ultrasound machine using 7.5-14 MHz probe. Examination of female patients was carried out in the presence of her attendant and female staff nurse. Patients were asked to undergo an MRI examination after ultrasonography, as required in the study. MRI was performed on 1.5 Tesla Philips machine. T2-weighted images in both the oblique coronal and oblique sagittal planes and fat-suppressed FSE T2-weighted images of shoulder were obtained. Entire data collected was recorded on a performa containing identity of the patient and all necessary details required for the study.

Data was analyzed using SPSS version 19. Descriptive statistics were used to describe the data. Mean and standard deviations were calculated for the numeric valuable like age. Frequencies and percentages were calculated for categorical variable like gender. Stratification was done to control effect modifiers like age and gender to observe outcome. Sensitivity, specificity, negative predictive value (NPV), positive predictive value (PPV) and diagnostic accuracy were calculated for USG using MRI as gold standard. Two by two table was used.

Results

The age distribution of the patients is shown in (Tab.1). The mean age of the patients is calculated as 39.86 ± 4.21 years.

Gender distribution of the patients reveals that there were 46.67% (n=63) male (Tab. 2).

Frequency of supraspinatus tear was found in 21.48% (n=29) patients on MRI (Tab. 3).

Diagnostic accuracy was 18.52% (n=25) true positive, 3.70% (n=5) false positive, 74.81% (n=101) true negative and 2.96% (n=4) false negative. Sensitivity,

specificity, positive predictive value, negative predictive value and accuracy rate was 86.21%, 95.28%, 83.33%, 96.19% and 93.33% respectively (Tab. 4).

Age (in year)	No. of patients	%
25-30	19	14.07
31-40	34	25.19
41-50	47	34.81
51-60	35	25.93
Total	135	100
Mean and SD	39.86 ± 4.21	

Table 1: Age distribution of the patients (n=135)

Gender	No. of patients	%
Male	63	46.67
Female	72	53.33
Total	135	100

Table 2: Gender distribution (n=135)

Supraspinatus	No. of patients	%
Yes	29	21.48
No	106	78.52
Total	135	100

Table 3: Frequency of supraspinatus tear (n=135)

USG	Supraspinatus Tear on MRI		Total
	Positive	Negative	
Positive	True positive(a) 25 (18.52%)	False positive (b) 5 (3.70%)	a + b 30(22.22%)
Negative	False negative(c) 4 (2.96%)	True negative (d) 101 (74.81%)	c + d 105(77.78%)
Total	a + c 29 (21.48%)	b + d 106(29.17%)	135(100%)

Sensitivity = $a / (a + c) \times 100 = 86.21\%$
 Specificity = $d / (d + b) \times 100 = 95.28\%$
 Positive predictive value = $a / (a + b) \times 100 = 83.33\%$
 Negative predictive value = $d / (d + c) \times 100 = 96.19\%$
 Accuracy rate = $a + d / (a + d + b + c) \times 100 = 93.33\%$

Table 4: Diagnostic accuracy of ultrasonography

Discussion

Rotator cuff tear is a common cause of shoulder joint instability. For the accurate detection of the rotator cuff tears, MRI and ultrasonography are the mainstay imaging modalities. Currently, MRI is considered as the most accurate means of evaluation of rotator cuff integrity.^{11,12}

Both USG and MRI have shown comparable results in detecting rotator cuff tears, demonstrating that the overall accuracy for both imaging tests was 87%. No significant differences between ultrasonography and magnetic resonance imaging were observed ($p > 0.05$).¹³ If the radiologist is experienced with both imaging tests, the decision regarding which test to perform for rotator cuff assessment should not be based solely on accuracy concerns. Other factors such as cost, availability, patient's tolerance, must also be taken into consideration when choosing a particular imaging modality.

In the study by Chauhan,¹⁴ USG showed a sensitivity of 86.7% and a specificity of 100% for full-thickness tears, and a sensitivity of 89.7% and a specificity of 98.8% for partial-thickness tears; observed accuracy for full thickness tears was 98.4% and 95.9% for partial thickness tears. This study concluded that considering the comparable diagnostic accuracy of USG and MRI, the former modality can be used as a first-line investigation for diagnosis of rotator cuff tears. MRI should be used secondarily as a problem-solving tool either following an equivocal shoulder USG or for delineation of anatomy in cases where surgical correction is needed.

Al-shawiet al.¹⁵ have studied 143 consecutive patients with shoulder problems, and reported a sensitivity and specificity of US as 96.2% and 95.4%, respectively. There are several advantages of US over MRI. Ultrasonography has the benefit of being a dynamic form of imaging as compared to the static MRI. Ultrasonography is portable, quick, and a more cost-effective method, which is also better tolerated by the patient and allows interaction with the patient, who can point at the symptomatic area, which will optimize the diagnostic yield.

The study by Fotiadou¹⁰ reported that the accuracy in the detection of full-thickness tears was 98% and 100% for ultrasonography and magnetic resonance imaging respectively, while for bursal or articular partial-thickness tears was 87% and 90% respectively.

The study conducted by de Jesus¹⁶ states that there is no statistically significant difference between the sensitivities and specificities of MRI versus ultrasound in diagnosing either full-or partial-thickness tears ($p > 0.05$). Fischer¹⁷ mentioned that ultrasound is comparable to MRI and should be preferred in revision cases. Their study revealed accuracy of 91.1% and

84.4% in detection of supraspinatus and infraspinatus tendons respectively and 77.8% for the subscapularis tendon.

The results of the study in hand revealed that frequency of rotator cuff tear was 21.48% (n=29), diagnostic accuracy of ultrasonography in evaluation of rotator cuff tear taking magnetic resonance imaging as gold standard was calculated as 86.21%, 95.28%, 83.33%, 96.19% and 93.33% sensitivity, specificity, positive predictive value, negative predictive value and accuracy respectively. Due to the limited number of partial-thickness tears in this study, a statistical analysis could not be performed separately, and they were considered as 'no tears'.

According to our and previous study results, ultrasound is as accurate as MRI for assessment of rotator cuff tears either full-thickness or partial thickness. In addition to its lower cost it may be the most cost-effective imaging method for screening for rotator cuff pathologies under the conditions that the examiner has been properly trained.^{18,19} Delzell has reported on the effect of a comprehensive musculoskeletal sonography training program to improve accuracy (sensitivity and specificity) for the diagnosis of rotator cuff tears in relatively inexperienced operators. After implementation of the training program, the sensitivity of US for detecting full-thickness rotator cuff tears increased by 14%, and the sensitivity for detecting partial-thickness rotator cuff tears increased by 3%.¹⁹ For practitioners without ultrasound expertise, MRI can be used.²⁰

These findings suggest that considering the higher sensitivity, specificity and accuracy of US comparable to that of MRI, it may be preferred in subsequent patients in future as it is an easily available and cost effective modality and will help to reduce financial burden and delay in patient management also.

Conclusion

The authors of the study conclude that diagnostic accuracy of ultrasonography for the evaluation of supraspinatus tear is high and comparable to gold standard magnetic resonance imaging.

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