

Original Research Article

Correlation of clinical examination, ultrasound, magnetic resonance imaging and arthroscopy as diagnostic tools in shoulder pathology

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ABSTRACT

Background: Shoulder pathologies can cause significant pain, discomfort, and affect the activity of daily living. The aim of this study was to compare the efficacy of clinical examination, ultrasound, magnetic resonance imaging (MRI) with shoulder arthroscopy in diagnosing various shoulder pathologies, considering shoulder arthroscopy as the gold standard tool.

Methods: This was a prospective, comparative study conducted over 35 patients, between 18-75 years of age presenting with chronic shoulder pain or instability of more than 2 months duration. All patients were examined clinically, followed by high resolution ultrasound, MRI, arthroscopy of the affected shoulder.

Results: The sensitivity and specificity of ultrasonography (USG) for diagnosing full thickness tear was 100% each and for MRI was 88% and 100% respectively. For subacromial impingement USG had sensitivity of 66.67%, specificity of 94.12%, positive predictive value of 50% and negative predictive value of 88.89%. For rotator cuff tear USG had sensitivity of 92.86%, specificity of 50%, positive predictive value of 81.25% and negative predictive value of 75% considering shoulder arthroscopy as gold standard.

Conclusions: USG and MRI both are sensitive techniques for diagnosing of rotator cuff pathologies. USG has high accuracy in diagnosing partial thickness tears as compare to MRI. MRI proved to be superior in estimation of site and extent of tear. Considering shoulder arthroscopy as gold standard, it can be reserved for patients with suspicious of USG/MRI findings or those who may need surgical intervention simultaneously.

Keywords: Arthroscopy, MRI, Shoulder joint, USG

INTRODUCTION

Shoulder pain is third most common presenting complaints to an orthopedic surgeon after spine and knee pain.¹ Rotator cuff pathologies specially tears constitutes most common cause of shoulder pain.^{2,3} Various pathologies of rotator cuff include tear, inflammation, impingement and instability. The rotator cuff is a group of four muscles and tendons that help to stabilize the shoulder joint. These are supraspinatus (superiorly), subscapularis (anteriorly), teres minor and infraspinatus

(posteriorly).⁴ Rotator cuff failure occurs from tendinopathy that transforms from partial to complete thickness tears involving supraspinatus, infraspinatus and/or subscapularis tendon.⁵ Clinical examination provides less information in terms of diagnosis and treatment planning, hence imaging forms an integral part in evaluating these patients. Various imaging modalities includes high resolution ultrasound, magnetic resonance imaging (MRI), MR arthrogram. The advent of shoulder arthroscopy, in addition to the progress made in understanding the shoulder anatomy and biomechanics,

has provided assistance to detect previously undiagnosed lesions.⁶

ultrasonography (USG) and MRI both are widely used to assess rotator cuff pathology. The positive predictive value to diagnose shoulder pathology varies among USG and MRI. Thus, considering shoulder arthroscopy as gold standard our study aim to correlate efficacy of clinical examination, ultrasound, MRI with shoulder arthroscopy as a diagnostic tool in shoulder pathology. Many diagnoses can be made upon clinical examination only, but to identify cause factor, type and extent of injury in rotator cuff tears, decision making in treatment whether conservative or surgical (open/arthroscopic) has made the imaging modalities superior to clinical examination.

USG of the shoulder is widely used as non-invasive, inexpensive, real time imaging modality. It is beneficial in the dynamic examination of the tendons during the movement of the shoulder.⁷ Limitations are operator dependent, long learning curve. MRI is also non-invasive providing superior soft tissue resolution and considered as imaging of choice in detecting rotator cuff pathologies.⁸⁻¹⁰ MR arthrography is superior in delineating intra-articular pathologies, but being invasive not preferred over plain MRI. Limitations include expensive, availability, time consuming, and absolute contraindications as cardiac pacemakers, aneurysmal clips, defibrillators etc.

The goal of the study was to correlate the clinical examination, ultrasound, MRI and arthroscopy as diagnostic tools in managing shoulder pathology.

METHODS

Study design and patients

This was a prospective, comparative study conducted over 35 patients, between 18-75 years of age presenting with chronic shoulder pain or instability of more than 2 months duration from December 2012 to October 2015 in department of orthopedic surgery, G.S.V.M. medical college, Kanpur. All patients were examined clinically, followed by imaging of the symptomatic shoulder. Patients with clinical diagnosis of shoulder instability (recurrent dislocation of shoulder), impingement syndrome (pain on lifting the arm), rotator cuff tear, tendinitis, superior labral (SLAP) tear, tear of long head of biceps tendon were included in the study. Patients with fracture/dislocation, infection, inflammatory arthritis were excluded from the study. Approval for the study was granted by the Institute Ethics Committee and was conducted according to the principles established in the Declaration of Helsinki. Consent for the publication of clinical, radiological details and photograph was obtained from the patients. High resolution USG and MRI were done by senior radiologist.

Ultrasonography of the shoulder was done using high resolution ultrasound machine with a high frequency 10 MHz linear ultrasound transducer [SonoSite™, Inc., Bothell, WA 98021, USA]. MRI was done by 1.5 tesla PHILIPS with sequences including axial T2WI, T2WI, PD fat saturation and coronal T2WI and T1WI with a wide range of MRI indices.

Arthroscopy was considered when conservative treatment failure for 6 months, or when rotator cuff was indicated.

Ultrasonography technique

USG of the shoulder was done using high frequency 10 MHz linear ultrasound transducer using musculoskeletal USG technical guidelines for shoulder of European society of musculoskeletal radiology. Position of the patient differs among institutions and examiners. USG of the shoulder was done in both static and dynamic positions.

Long head of biceps tendon

Arm was placed in internal rotation with 90 degrees flexed elbow and hand supinated. The bicipital groove was identified and tendon was seen between greater and lesser tuberosity. Normal tendon was seen as a uniform fibrillary structure.¹¹

Subscapularis tendon

Arm was externally rotate with elbow resting on iliac crest, with palm facing upwards. This tendon was identified in transverse and sagittal planes with passive internal and external rotation. The subscapularis tendon is visible when entering medially to the groove.¹¹

Supraspinatus tendon

The dorsum of hand was kept on the back with elbow opposed to the lateral wall of the chest. This position made tendon project anteriorly. Evaluation was done in both transverse and longitudinal planes.¹¹

Infraspinatus tendon

The hand was kept at opposite shoulder. Supraspinous and infraspinous fossae were identified using spine as landmark. Probe was moved toward greater tuberosity in sagittal plane where teres minor and infraspinatus tendons are examined.¹¹

Subacromial impingement

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

Rotator cuff was assessed for the integrity, thickness and echo pattern. Following classification of rotator cuff tears

was used no tear, partial thickness tear– articular side/bursal side and full thickness tear– with/without retraction.

USG findings in partial thickness tear- focal discontinuity/or focal thinning. USG findings in complete thickness tear can be lack of visualization of the tendon/ complete discontinuity/ or focal thinning.

On MRI increased signal intensity in platelet distribution width (PDW) images shows tendinopathy. Partial thickness tear was defined as focal increased signal intensity or discontinuity of fibers on T1W, PDW, T2W images. Complete tear is considered when discontinuity involves from bursal surface to articular surface with retraction of torn ends.

Clinical, USG and MRI diagnosis were placed into one of the four categories considering arthroscopy as gold standard and MRI superior over USG (categories are - true positive, true negative, false positive, false negative). Collected data was presented in the form of tables. We calculated sensitivity, specificity, negative predictive value (NPV), positive predictive value (PPV).

Statistical analysis

Data was analyzed for the significant correlation between MRI of shoulder and USG by kappa coefficient. Sensitivity, specificity, PPV, NPV were calculated using cross tabulations. Chi square test were used to find the significance of MRI and USG findings. The p value<0.05 was considered as statistically significant.

RESULTS

In this study, 35 patients were included. All of them were subjected to clinical evaluation, ultrasonography, MRI, arthroscopic examination of shoulder. The age of the patient ranged from 18-65 years. The mean age was 40.11 years. Maximum number of patients i.e., 10 (26.47%) were of 21 to 30 years age group range. Out of 35 patients there were 31 males and 4 females. In the present study 22 (61.76%) patients had right shoulder involvement. 29% (10) patients had spontaneous development of symptoms without history of trauma, while rest of 71% (24) patients had history of trauma around shoulder region.

Out of 35 patients, 27 patients were found to have rotator cuff tear on USG, 28 were found on MRI and 26 were positive in arthroscopy. Out of 27 patients, 17 patients were diagnosed with full thickness tear, 10 patients with partial thickness tear on USG. In MRI out of 28 patients, 15 were diagnosed with full thickness and 13 were diagnosed with partial thickness tear. 26 patients were found positive of rotator cuff tear on arthroscopy 17 patients were diagnosed with full thickness and 9 were diagnosed with partial thickness tear.

Percentage of false negative diagnosis by MRI when compared to clinical examination and arthroscopy was found to be 16.67%. None of the patient was encountered to have any complications following arthroscopy.

Table 1: Total number of rotator cuff tear diagnosed on USG, MRI, arthroscopy.

Rotator cuff pathology	USG	MRI	Arthroscopy
	N (%)	N (%)	N (%)
Full thickness tear	17 (63)	15 (53.5)	17 (65)
Partial thickness tear	10 (37)	13 (46.5)	9 (35)
Total patients	27 (100)	28 (100)	26 (100)

Table 2: Comparison between USG and clinical examination as a diagnostic tool in both arthroscopy and MRI group.

S. no.	Diagnosis	Gold standard	Comparison	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
1.	Supraspinatous tear/tendinosis	MRI	USG	37.5	100	100	33.33
			Clinical diagnosis	75	100	100	56.56
		Arthroscopy	Clinical diagnosis	25	68.5	16.67	78.57
			diagnosis	33.33	64.29	28.57	69.23
2.	Subscapularis tear/tendinosis	MRI	USG	50	89.47	33.33	94.44
			Clinical diagnosis	100	89.47	50	100
		Arthroscopy	USG	30	60	42.86	46.15
			Clinical diagnosis	37.5	75	50	64.29

Continued.

S. no.	Diagnosis	Gold standard	Comparison	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
3.	Impingement syndrome	MRI	USG	20	93.75	50	78.95
			Clinical diagnosis	25	100	100	15
		Arthroscopy	USG	66.67	94.12	50	88.89
			Clinical diagnosis	100	83.33	40	100
4.	Shoulder instability	MRI	USG	16.67	93.33	50	73.68
			Clinical diagnosis	100	94.44	75	100
		Arthroscopy	USG	20	93.33	50	77.78
			Clinical diagnosis	100	93.33	83.33	100
5.	Long head of biceps tendinosis	MRI	USG	50	89.47	33.33	94.44
			Clinical diagnosis	100	89.47	50	100
		Arthroscopy	USG	25	81.25	25	81.25
			Clinical diagnosis	33.33	85.71	50	75

PPV- positive predictive value, NPV- negative predictive value.

DISCUSSION

USG and MRI have developed as new imaging techniques for shoulder pathologies in the past few decades.^{12,13} In patients presenting with shoulder pain complaints, the aim is to diagnose whether the rotator cuff is intact or not with necessity to identify the torn tendon and to find extent of the tear. And treatment to be planned by the surgeon is depending on the accurate diagnosis.⁷

With the development of new arthroscopic techniques for treating rotator cuff disorders, MRI has played an increasingly important role as a noninvasive test for determining which patients may benefit from surgery.^{4,9} A study by Lambert et al found the positive predictive value of 3.0T MRI to be 100% for the detection of rotator cuff tendon tears requiring surgery.¹⁴

With arthroscopy taken as gold standard for subacromial impingement USG had sensitivity of 66.67%, specificity of 94.12%, positive predictive value of 50% and negative predictive value of 88.89% in our study, while in study of Kiran et al ultrasonography had sensitivity of 79%, specificity of 80%, positive predictive value of 96% and negative predictive value of 76%.¹⁵

With arthroscopy taken as gold standard (Kiran et al, Burk et al) for subacromial impingement clinical examination had sensitivity of 100%, specificity of 83.33%, positive predictive value of 40% and negative predictive value of 100%.^{15,16}

With arthroscopy as gold standard for rotator cuff tear/tendinosis ultrasonography had sensitivity of 92.86%,

specificity of 50%, positive predictive value of 81.25% and negative predictive value of 75% in our study, while in study of Al-Shawi et al ultrasonography had sensitivity of 96.2%, specificity of 95.4%, positive predictive value of 96% and negative predictive value of 95.4% and in study of Read et al ultrasonography had sensitivity of 46%, specificity of 97%, positive predictive value of 54% and negative predictive value of 80%.¹⁷

With arthroscopy as gold standard Burk et al for unstable shoulder clinical examinations had sensitivity of 100%, specificity of 93.33%, positive predictive value of 83.33% and negative predictive value of 100%.¹⁶

The most common diagnosis was rotator cuff tear, the similar findings were made in the study of Read et al. Percentage of false negative diagnosis by MRI when compared to clinical examination and arthroscopy was found to be 16.67%.¹⁷

The sensitivity and specificity of USG for diagnosing full thickness tear was 100% each and for MRI was 88% and 100% respectively. Full thickness tears are accurately diagnosed on both MRI and USG. Partial thickness tears misdiagnosed more in MRI as compare to USG, as USG can provide real time imaging. Chronic partial thickness tear can be missed on both USG and MRI.

There have been few studies comparing clinical examination with imaging and arthroscopic findings. Norregaard et al has shown a poor correlation between clinical examination comparing with USG and arthroscopy.¹⁸ Our study has found that impingement that were diagnosed with clinical signs have high accuracy in diagnosis in imaging as well as arthroscopically.

CONCLUSION

Based on our results, it can be concluded that USG and MRI can be considered as an effective imaging modality in diagnosing the cause of shoulder pain and disability. USG and MRI both are sensitive techniques for diagnosing of rotator cuff pathologies. USG has high accuracy in diagnosing partial thickness tears as compare to MRI. Owing to its availability, cost and fast procedure USG can be used as a primary imaging method. MRI proved to be superior in estimation of site and extent of tear. Considering shoulder arthroscopy as gold standard, it can be reserved for patients with suspicious of USG/MRI findings or those who may need surgical intervention simultaneously.

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