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PREVALENCE AND CHARACTERIZATION OF ROTATOR CUFF TEAR IN PATIENTS HAVING FROZEN SHOULDER BY ULTRASOUND AND MAGNETIC RESONANCE IMAGING

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Abstract

Background: Clinical examinationof shoulder alone does not provide all diagnostic information required for treatment. Evaluation of patient with shoulder pain often involves assessment of the rotator cuff with a diagnostic test such as high-resolution ultrasonography or MRI. Sensitivity and specificity for both USG and MRI for diagnosis of rotator cuff tear are almost similar but they are strongly correlated with detection of partial thickness tear and full thickness tear.

Methods: A Prospective study of thirty patients undergoing Ultrasonography and Magnetic resonance imaging for patients having Frozen shoulder at SCB Medical college hospital after ethical clearance from Institutional Ethics committee and consents taken from patients. Detailed history, clinical examinations and routine investigations were done prior to radiological investigations.

Results: Partial thickness tear (PTT) as detected by USG were 11 out of 30 with sensitivity, specificity, PPV, NPV, Likelihood+ve, Likelihood-ve, disease prevalence,diagnostic accuracy and diagnostic odds ratio being 58.3%,100%,100%,78.2%,58.3,0.42,60%,83.3% and 138.8 respectively whereas that of MRI were 65%,78%,100%,60%,2.95,0.44,59.7%,80% and 6.7. ROC Curve of USG and MRI for diagnosis of PTT revealed AUC as 0.4 and 0.6 respectively which has no discrimination for USG but MRI with AUC 0.6 had discrimination for PTT. Similarly for Full thickness tear(FTT), the diagnostic accuracy tests of USG and MRI were compared. The ROC curve and AUC which revealed 0.5 for USG and 0.5 for MRI which proves no discrimination for the tests

Conclusion: Disease prevalence for rotator cuff tear in ultrasonography differs from MRI as sensitivity, specificity and diagnostic accuracy were more in MRI. Partial thickness tear diagnosed by USG were confirmed by MRI which had revealed more sensitivity, specificity, disease prevalence and diagnostic accuracy. Most of the diseases /pathologies significantly correlated with the diagnosis by MRI.

Keywords: Rotator cuff tear, frozen shoulder, PTT(partial thickness tear), FTT(full thickness tear).

INTRODUCTION

Frozen shoulder is a clinical condition involving the glenohumeral joint characterised by progressive inflammation of the joint capsule causing stiffness of shoulder. It is also referred as adhesive capsulitis or periarthritis shoulder. Shoulder pain is the most common presentation associated with global restriction of range of movement [1]. It mimics several other painful shoulder disorders like rotator cuff tear, calcific tendinitis, glenohumeral arthritis, sub-acromial impingement etc [2]. MRI is good at imaging the shoulder joint for acute and residual pathological changes due to inflammation and trauma [3]. Ultrasonography has been established as an effective imaging method in the evaluation of rotator cuff. Specific USG criteria have been used to correctly diagnose rotator cuff tears [4]. Non visualisation of the rotator cuff or focal tendon defect diagnose full thickness tear and flattening of the bursal surface and a distinct hypoechoic or mixed hypoechoic defect at the articular surface indicate bursal side partial tear or articular side partial thickness tear respectively [5]. Clinical examination alone does not provide all diagnostic information required for treatments. Evaluation of patient often involves assessment of the rotator cuff with a diagnostic test such as high-resolution ultrasonography or MRI [6]. The common tendon affected are supraspinatus, subscapularis and infraspinatus tendons [7]. Frequent pathologies findings of tendinosis and partial tears which can be best diagnosed by ultrasonography and also confirmed by MRI [8]. Partial or full thickness tears of the rotator cuff tendons are commonly associated with fluid in SA-SD bursa or sub coracoid bursa [9]. USG is low cost & effective than MRI for screening of rotator cuff disorders [10]. MRI is also capable of assessing other aetiologies such as labral and ligamentous capsular pathologies [11]. Sensitivity and specificity for both USG and MRI diagnosis for rotator cuff tear are almost similar but they are strongly correlated with the detection of partial thickness tear and full thickness tear [12].

AIM

To determine the prevalence and characterization of Rotator cuff tear in patients having frozen shoulder by Ultrasound and Magnetic resonance imaging.

MATERIALS AND METHODS

A Prospective study of Thirty patients undergoing Ultrasonography and Magnetic resonance imaging for patients having frozen shoulder at SCB Medical college hospital after ethical clearance from Institutional Ethics committee and consents taken from patients. Detailed history, clinical examinations and routine investigations were done prior to radiological investigations. All the patients were evaluated with ultrasonography and magnetic resonance imaging for proper treatment. The positive findings were recorded for all the thirty patients. Patients of age group 40 to 60 years and painful stiff shoulder with restricted movements were included.

Statistical analysis

Demographics and clinical characteristics of the patients were noted. Continuous variables were noted in the form of mean and median and categorical variables were noted as percentage. The difference of mean and percentage were compared by independent t test and chi square test respectively in both the groups of investigations. The Sensitivity, Specificity and diagnostic Odds ratio for the diagnosis of rotator cuff tear were compared between USG and MRI groups. The high-resolution USG findings for partial tear and full thickness tear were correlated with the MRI findings. The statistical evaluation was done with the help of SPSS20.

RESULTS

Thirteen patients with supraspinatus pathologies had tears as diagnosed by USG and 8 patients (26.6%) among them were having as partial tear as confirmed by MRI. MRI confirmed four patients with tear by USG as normal supraspinatus tendon. Partial thickness tear diagnosed by USG were

confirmed by MRI (Table-1). Twelve patients were normal shoulder status both by USG and MRI. Twenty-eight patients had no infraspinatus tendon abnormality diagnosed on USG and MRI. A patient with partial thickness tear diagnosed by USG was confirmed by MRI . Subscapularis tendon among 30 patients, 27 patients had no abnormality in both USG and MRI but three patients had full thickness tear diagnosed by MRI . USG diagnosed no cases of Biceps tendon pathology with MRI confirming 1 case.

USG had sensitivity 75% specificity of 66.7%, PPV 90%, NPV 90% for supraspinatus pathologies, sensitivity 66.7%, specificity 95.8% PPV 80%, NPV 92% for subscapularis tendon pathologies, Sensitivity of 50%, specificity of 100%, PPV 100%, NPV 96.6% for infraspinatus tendon pathologies and Bicep tendon had a specificity of 96.7% and NPV of 100% (Table-2). MRI confirmation for different pathologies had revealed sensitivity, specificity, disease prevalence and diagnostic accuracy as shown in the [Table-3]. Most of the diseases /pathologies significantly correlated with the diagnosis by MRI. Sensitivity, specificity, accuracy are improved and Likelihood Ratio more towards MRI Tests. Partial thickness tear (PTT) as detected by USG were 11 out of 30 with sensitivity, specificity, PPV, NPV, Likelihood+ve, Likelihood-ve, disease prevalence ,diagnostic accuracy and diagnostic odds ratio were 58.3%,100%,100%,78.2%,58.3,0.42,60%,83.3% and 138.8 respectively whereas that of MRI were 65%,78%,100%,60%,2.95,0.44,59.7%,80% and 6.7 as shown in the [Table-4]. ROC Curve of USG and MRI for diagnosis of PTT revealed AUC were 0.4 and 0.6 respectively which has no discrimination for USG but MRI with AUC 0.6 had discrimination for PTT [Fig-1] and [Table-6] Similarly for FTT(full thickness tear) the diagnostic accuracy tests of USG and MRI were compared as in the Table-5 and the ROC curve and AUC which revealed 0.5 for USG and 0.5 for MRI which proves no discrimination for the tests as in [Fig-2] and [Table-7].

Clinical and demographic characters	**USG (30)**	**MRI (30)**	**P=value**
Age (mean age)	52 years	52 years	0.50
Male	73%	73%	0.50
Female	27%	27%	0.50
Supraspinatus tear	12(40%)	13(43.33)	0.40
Partial thickness	8(26.6%)	8(26.6%)	0.50
Full thickness tear	4(13.3%	5(16.6%)	0.36
Infraspinatus	1(3.3%)	1(3.3%)	0.50
Partial thickness	1(3.3%)	1(3.3%)	0.50
Full thickness	0	0	-
Teres minor	0	0	-
Subscapularis	3(10%)	3(10%)	0.50
Partial thickness	2(6.6%)	3(10%)	0.31
Full thickness	1(3.3%)	0	0.16
Biceps tendon	0	1(3.3%)	0.16
Partial thickness	0	0	-
Full thickness tear	0	1(3.3%)	0.16

Table-1: Prevalence and clinical demographic characteristics of rotator cuff tear on USG and MRI

Pathological findings	PPV	NPV	Sensitivity	specificity	Likelihood+	Likelihood-	Disease prevalence	Diagnostic accuracy	DOR	P-Value
Supraspinatus	90%	40%	75%	66.7%	2.25	0.37	80%	73.3%	4.0	0.33

Infraspinatus	100%	96.6%	50%	100%	50	0.50	7.6%	96.7%	0.08	<0.01
Teres Minor	-	100%	-	100%	-	-	9.09%	-	0.09	<0.01
Subscapularis	80%	92%	66.7%	95.8%	15.8	0.34	20.31%	90%	46.47	<0.01
Biceps tendon	-	100%	-	96.7%	-	-	0.8%	95.9%		0.03
Subacromial-deltoid bursitis	80%	85%	45.5%	89.5%	4.3	0.60	12.1%	84,1%	7.16	0.10
Subcoracoid bursitis	90%	95%	22.2%	100%	22.2	0.77	80%	37.7%	28.8	<0.01
Bicep tendon sheath fluid	78%	90%	12.5%	95.5%	2.77	0.91	56%	49%	3.04	0.04
ACJ pathology	72%	94.5%	17.6%	100%	17.6	0.82	4.1%	96.6%	21.46	<0.01

Table 2: Diagnostic accuracy of USG correlated to pathological findings in Frozen shoulder

Pathological findings	PPV	NPV	Sensitivity	specificity	Likelihood+	Likelihood-	Disease prevalence	Diagnostic accuracy	DOR	P-Value
Supraspinatus	88.3%	96%	92.3%	100%	1.06	0.07	6.8%	99.4%	15.1	0.01
Infraspinatus	91%	93.3%	100%	100%	1.0	0.01	9.09%	100%	100	0.01
Teres Minor	0%	100%	-	100%	-	-	-	-	-	0.01
Subscapularis	83%	76.7%	100%	100%	1.01	0.01	4.6%	100%	100	0.01
Biceps tendon	100%	100%%	52.63%	96.7%	13	0.5	85.7%	59.3%	26	0.03
Subacromial-deltoid bursitis	80%	85%	45.5%	89.5%	4.33	0.60	48.2%	87.3%	7.21	0.11
Subcoracoid bursitis	90%	95%	22.2%	100%	22.2	0.78	28.12%	78.1%	28.46	0.01
Biceps tendon sheath fluid	78%	90%	12.5%	95.5%	2.7	0.91	55.6%	49%	2.96	0.04
ACJ pathology	72%	94.5%	17.6%	100%	17.6	0.83	4.1%	96.6%	21.2	0.01

Table3: Diagnostic accuracy of MRI correlated to pathological findings in frozen shoulder

	USG	**MRI**
SENSITIVITY	58.3%	65%
SPECIFICITY	100%	78%
PPV	100%	100%
NPV	78.2%	60%
Likelihood+	58.3	2.95
Likelihood-	0.42	0.44
Disease prevalence	60%	59.7%
Diagnostic accuracy	83.3%	80%
Diagnostic odds ratio	138.8	6.70
p-value	0.31	0.02

Table-4: Correlation between PTT with USG and MRI findings

	USG	MRI
SENSITIVITY	100%	95%
SPECIFICITY	96.4%	90%
PPV	75%	80%
NPV	100%	96%
Likelihood+	27.7	9.5
Likelihood-	0.01	0.05
Disease prevalence	9.81%	29.6%
Diagnostic accuracy	96.75%	91.48%
Diagnostic odds ratio	2770	190
p-value	0.31	0.03

Table-5: Correlation between FTT with USG and MRI findings

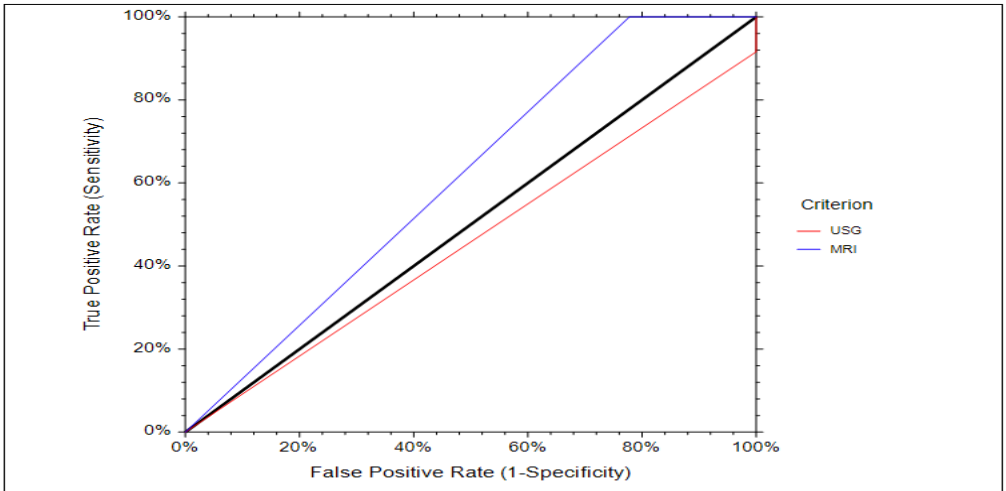

Figure 1: ROC Curve of USG and MRI For PTT

Z-Value			99% Confidence Limits				
Criterion	**Count**	**AUC**	**Standard Error**	**To Test AUC ≠ 0.5**	**2-Sided P-Value**	**Lower**	**Upper**
USG	30	0.4583	0.0417	-1.000	0.3173	0.3446	0.5588
MRI	30	0.6111	0.0504	2.204	0.0275	0.4648	0.7249

Table 6: Partial thickness tear (PTT) discrimination using tests by USG and MRI

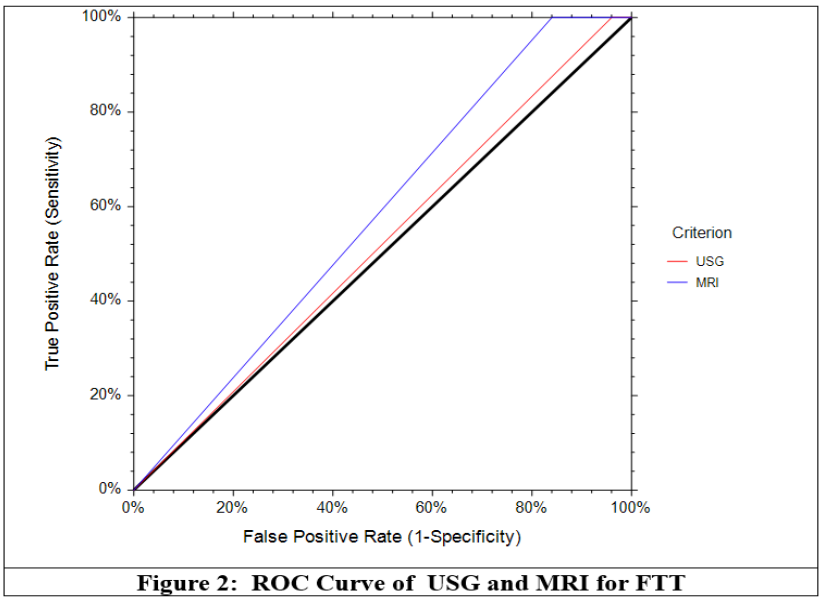

Figure 2: ROC Curve of USG and MRI for FTT

Z-Value			99% Confidence Limits				
Criterion	Count	AUC	Standard Error	To Test AUC ≠ 0.5	2-Sided P-Value	Lower	Upper
USG	30	0.5200	0.0200	1.000	0.3173	0.4666	0.5696
MRI	30	0.5800	0.0374	2.138	0.0325	0.4756	0.6683

Table 7: Full thickness tear (FTT) discrimination using tests by USG and MRI

DISCUSSION

In our study 73% are male patients and 27% patients are female. The age of patients included in the study were mean 52+/- sd 12 years. Many studies have included that rotator cuff degeneration and subsequent pathologies increases with age. The affected side was predominantly right side. Right shoulder complains were 76.7% and left side affected were 23.3% when 96.7% in our study were right hand dominant and 3.3% were left hand dominant. Supraspinatus was the commonest tendon affected in this study group followed by subscapularis tendon with pathologies Tendinosis, partial thickness tear and full thickness tear of rotator cuff tendons. Infraspinatus were affected in 3.3% of patients whereas Teres minor was not affected in any of the patients. MRI detected supraspinatus pathology in 80% of patients while USG detected in 60% of patients. Articular surface tear was more common than the bursal surface tear by Fritz LB et al [13]. The articular surface is hypo vascular compared to the bursal surface. This is in conjunction with decreased tendon cellularity and collagen fragmentation with increasing age resulting in more articular surface tear than bursal surface tear. Ultrasonography of shoulder was the best to report for the detection intra-articular loose bodies and fluid in the joint as studied by Bianchi S et al [14]. Rotator cuff tendons have been best assessed by USG with high frequency probe but use of MRI for detection of rotator cuff tendons was first reported by Hedtmann A et al [15]. Sensitivity for USG to detect partial thickness tear was 58.3% and for full thickness tear was 100% whereas that of MRI was 95%. Sensitivity for MRI for detection of tears were 91%, specificity 84%. PPV 92%, NPV 84% and overall accuracy was 95.26% whereas for USG sensitivity 88%, specificity 89%, PPV 88%, NPV 89%, overall accuracy 88.89% in our study. The sensitivity and specificity of indirect MR arthrography for detection of delaminated tears were 92% and 94%, respectively as studied by Choo HJ et al[16] .Full-thickness tears of the rotator cuff were detected in 32 subjects (7.6%). The prevalence increased with age as follows: 50 to 59 years, 2.1%; 60 to 69 years, 5.7%; and 70 to 79 years, 15%. The mean size of the tear was less than 3 cm and tear localisation was limited to the supraspinatus tendon in most cases (78%). The strength of flexion was reduced significantly in the group with tears ($p = 0.01$) as studied by Moosmayer S et al[17] There are no significant differences in either sensitivity or specificity between MRI and ultrasound in the diagnosis of partial- or full-thickness rotator cuff tears as studied by de Jesus JO et al[18]. In our study the prevalence of detection of rotator cuff tear by ultrasonography was confirmed by MRI in patients with frozen shoulder were similar without being statistically significant.

LIMITATIONS

Limitations of the study were patients with inflammatory arthritis, patients with history of recent articular injection in shoulder and patients having trauma. Limitation of USG are assessment of rotator cuff pathologies and associated fluid collections. Labral and ligamentous pathologies, bony abnormalities and muscle atrophy changes are not well appreciated by USG. Limitations of MRI are high effective cost , claustrophobia, metallic implants and pace makers.

CONCLUSION

Disease prevalence for rotator cuff tear in ultrasonography differs from MRI as sensitivity, specificity and diagnostic accuracy were more in MRI. Twelve patients with supraspinatus pathologies had tears as diagnosed by USG and 8 patients (26.6%) among them were having as partial tear as confirmed by MRI. MRI confirmed four patients with tears by USG having normal supraspinatus tendon. Partial thickness tear diagnosed by USG were confirmed by MRI which revealed more sensitivity, specificity,

disease prevalence and diagnostic accuracy. Most of the diseases /pathologies significantly correlated with the diagnosis by MRI.

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