HIGH RESOLUTION USG OF ROTATOR CUFF PATHOLOGIES IN CORRELATION WITH MRI

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ABSTRACT

BACKGROUND

Rotator cuff disease is one of the most common causes of shoulder pain. In addition to history and physical examination, several radiological techniques have been used to detect tears of the rotator cuff. Each has limitations and no clear consensus on the optimum diagnostic study has emerged. The radiological diagnosis of rotator cuff tears has traditionally been performed with arthrography and more recently with non-invasive techniques like ultrasonography and MRI.

Aims and Objectives-

1. To characterise the rotator cuff pathologies on high-resolution Ultrasound.
2. Confirm and correlate the Ultrasound and MRI findings.

MATERIALS AND METHODS

Study was done in Dept. of Radiology, Shri Siddhartha Medical College, Tumkur.

Study period- 30 months. From May 2015 to October 2017. No. of cases- 30.

Inclusion- OP and IP patients referred for ultrasound examination with the clinical diagnosis of rotator cuff pathology.

Exclusion- Patients who do not undergo MRI examination.

Methodology and Technique- High resolution ultrasound using 12 MHz probe was done using standard protocol for rotator cuff evaluation. Findings were noted, and images were saved for the study. MRI was performed using Philips MR scanner 1.5 tesla machine. Standard protocol was followed. Scan was done in all three planes using T1, T2 and FAT-SAT sequences. The images were studied, and findings were co-related.

RESULTS

Mean age was 46.6 years (range 23 - 76). Maximum patients were above 50 years (33.6%). 20 were males and 10 were females. 18 patients had rotator cuff disorders, 18/30 (60%). Out of 18 patients with rotator cuff disorders, 15 patients had rotator cuff tears 12/20 (60%) and 8 patients had tendinosis 8/20 (40%). The supraspinatus muscle was involved in all cases (100%) without a significant comparable difference between U/S and MR. In our study, diagnostic accuracy of ultrasound in rotator cuff pathologies was 61%. 58.33% for partial thickness tears. The diagnostic accuracy of ultrasound in detection of complete tear of the supraspinatus muscle was 92.14%, while that of MRI was 100%.

CONCLUSION

U/S and MRI are valid diagnostic modalities in detecting, characterising and discriminating the rotator cuff disorders with no significant comparable difference in detecting full thickness supraspinatus tears. U/S has many challenges in patients with partial thickness and interstitial tears. MRI is more sensitive and has highest diagnostic accuracy in detecting rotator cuff tears as compared to USG and clinical diagnosis.

KEYWORDS

Rotator Cuff, Ultrasound, MRI.

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BACKGROUND

Shoulder pain is a common musculoskeletal complaint that may be due to either intrinsic disorders of the shoulder or referred pain. The former includes injuries and acute or chronic inflammation of the shoulder joint, tendons, surrounding ligaments or periarticular structures. Rotator cuff disorders is the third most prevalent musculoskeletal disorder after low back and neck pain and accurate diagnosis is essential for appropriate management.

Apart from acute traumatic lesions such as fractures, dislocations, contusions, sprains and ruptured tendons, most of the painful shoulder are due to adhesive capsulitis, acute or chronic calcific tendinitis, bursitis, bicipital tendinitis and lesions of musculotendinous cuff. Arthritis is the least cause of painful shoulders.

The shoulder joint is an incongruous ball and socket joint without any fixed axis of rotation, which has a wide range of motion in multiple planes; hence, stability is compromised for mobility. To compensate for the unstable bony anatomy the shoulder is protected anteriorly, posteriorly and superiorly by a capsule and the tendons that form the rotator cuff.

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The tendon is subject to "wear and tear" during the day-to-day activities. Spectrum of aetiologies that can give rise to shoulder pain are acute trauma to a gamut of degenerative disorders associated with impingement syndrome.

Repetitive active and passive forces render these tendons susceptible to degeneration leading to swelling of the tendon and a minor degree of subluxation. The space between the humeral head and the acromion is sufficiently restricted that mild swelling of the interposed tendon with or without minor superior subluxation of the humeral head leads to impingement syndrome and rotator cuff tears.

Patients presenting for imaging fall broadly into one of the following categories: Specific pain and restricted movements on abducting the arm and symptoms of instability.

Several radiological techniques have been used to detect tears of the rotator cuff. Each has limitations and no clear consensus on the optimum diagnostic study has emerged.[1]

The radiological diagnosis of rotator cuff tears has traditionally been performed with arthrography and more recently with ultrasonography and MRI.[2]

Rotator cuff disease is one of the most common causes of shoulder pain. In addition to history and physical examination, evaluation of a patient with shoulder pain often involves assessment of the rotator cuff with a diagnostic test such as high resolution ultrasonography or MRI.[3]

High resolution ultrasound is non-invasive, less expensive and non-ionising modality with good sensitivity in detecting both rotator cuff and non-rotator cuff disorder.[4]

Ultrasonography is an effective imaging modality in the evaluation of both rotator and non-rotator cuff disorders because of low cost, less time consuming and availability for the diagnosis of painful shoulder conditions.[5]

The high resolution ultrasonography (USG) of shoulder is cost effective, non-invasive and allows multiple joints to be assessed in a multiplanar, dynamic and interactive manner over a reasonably short time span and it is a sensitive tool to diagnose the rotator cuff tear. High resolution ultrasonography will help in early detection of rotator cuff changes, which is useful for early intervention for better therapeutic outcome.

On ultrasonography, the size of the tears can be classified, and the findings used as a basis for management decisions. Ultrasonography can also reveal the presence of other abnormalities that may mimic rotator cuff tear including tendinosis, calcific tendinitis, subacromial-subdeltoid bursitis, greater tuberosity fracture and adhesive capsulitis.[5]

Over the last two decades, musculoskeletal USG has established itself as a versatile imaging modality in the fields of radiodiagnosis, sports medicine and rheumatology. It has gained its rightful place in literature along with MRI. Cost effectiveness and ready availability are its biggest advantages in several clinical settings. The real time capability of ultrasound in conducting dynamic studies in areas like the shoulder is a very big asset. It helps to do quick comparison with the contralateral side, which is of great help in many difficult situations. It has its own limitations such as high operator dependency, long learning curve and problems of anisotropy. It has limited utility in evaluation of labrum, rotator cuff interval and in demonstrating subtle bony lesions.

Ultrasonography of rotator cuff is quick and painless. There is no risk of infection and in contrast to arthrography. There is no discomfort following the procedure.[6] The simplicity, rapidity, low cost and accuracy of the examination make it especially attractive as a screening and pre-surgical staging study.[1]

MRI has become the "gold standard" for detecting both subtle and obvious internal derangement and assessing overall joint structure.[4]

MRI can provide information about rotator cuff tears such as tear dimensions, tear depth or thickness and tear shape, involvement of adjacent structures (eg. rotator interval, long head of biceps brachii tendon etc.) and muscle atrophy, all of which have implications for rotator cuff treatment and prognosis. Information about coracoacromial arch and impingement as it relates to rotator cuff tears can also be obtained with MRI.[7]

Although non-invasive, MRI is considerably more expensive than ultrasonography and will probably not replace it as a screening procedure for those trained in its use. For those cases in which the sonogram yields indeterminate results or in those institutions in which no one is trained to do sonography of the shoulder, MRI may be a useful screening test.[2]

The major disadvantages of MRI are the long examination time, expense and that the study may be unsuccessful in very large or claustrophobic patients.[8]

Arthrography appears to be more accurate in diagnosing rotator cuff injuries than either MRI or ultrasound, but that benefit must be set against the invasiveness and potential discomfort to patients. Ultrasonography is as accurate as MRI for both full thickness and partial thickness tears. These results combined with low cost for ultrasound suggests that ultrasound may be the most cost effective imaging method of screening for rotator cuff injuries, provided that the examiner is trained in this operator dependent technique. For practitioners without ultrasound expertise, MRI can be used. Arthrography can be performed in those cases, in which ultrasound and MRI are not definitive.[9]

MATERIALS AND METHODS

This is a descriptive study. Proportional analysis of 30 patients referred to the Department of Radiodiagnosis at Shri Siddhartha Medical College, Tumkur with clinically suspected rotator cuff injuries were subjected to undergo USG and MRI after thorough history taking-

- Study period- 30 months from May 2015 to October 2017.
- No. of cases- 30.
- Inclusion- OP and IP patients referred for ultrasound examination with the clinical diagnosis of rotator cuff pathology.
- Exclusion- Patients who do not undergo MRI examination.
- Methodology and Technique:
  USG was carried out on Voluson 22 machine using a high frequency transducer of 5 - 17 MHz. High resolution ultrasound using 12 mHZ probe was done using standard protocol for rotator cuff evaluation. Findings were noted and images were saved for the study. Comparison with opposite shoulder was also done.

MRI was performed using Philips MR scanner 1.5 tesla machine using a dedicated surface coil for shoulder scan was done in all three planes using T1, T2 and FAT-SAT sequences.

Statistical Methods[10,11,12,13,14]

Data was entered into Microsoft Excel sheet and was analysed using Epi Info 7 version software. Qualitative data was represented in the form of Frequency and Proportions. Chi-square was the test of significance to find the association between qualitative data. Validity of the diagnostic test was measured by Sensitivity, Specificity, Positive predictive value, Negative predictive value and Diagnostic accuracy. Kappa statistics was computed to find the degree of agreement between two diagnostic tests. P value < 0.05 was considered as statistically significant.

RESULTS

		Frequency
Age	<40 yrs.	7
	41 to 50 yrs.	10
	>50 yrs.	13
	Total	30

Table 1. Age distribution of the Subjects

The age of the patients with rotator cuff pathologies studied ranged from 23 to 76 years with a mean of 46.6+/- 2.08. Majority of Rotator cuff injures were observed after 50 yrs. of age in 40% of subjects, 30% at < 40 yrs. and 41 to 50 yrs. of the 30 patients studied. 10 (33%) were females and 20 (67%) were males. The mean age among females was 54 +/- 1.98 and the mean age among males was 45.12 +/- 2.2.

Status of Rotator Cuff Tendon	Age Range in Years		
	<40	41-50	>50
Normal	3	2	1
Tendinosis	2	3	4
Partial tear	1	3	5
Full thickness tear	1	2	3
Total	**7**	**10**	**13**

Table 2. The following Chart shows the various Abnormalities in the Rotator Cuff Tendons and the Age Range of occurrence in our Study Group

In patients with age more than 50 yrs., 8 (26.7%) patients show tears as compared to less than 50 years, where 5 (16.6%) patients show tear in the rotator cuff tendons. Thus in this study, tears appear to be common in older age groups than in younger patients with tears being more common than tendinosis in older age groups.

		Affected Side	
		Left	Right
Dominant Hand	Left	3	0
	Right	5	22
Total		**8**	**22**

Table 3. Association between Dominant Side and Affected Side

$\chi 2 = 10.76$, df= 1, p= 0.001**

Majority of the patients were right handed, i.e. 90% and 10% were left handed. All the 3 left handers (100%) had rotator cuff injuries on left side and 80% of right handers had injuries on right side. This association was statistically significant.

Clinical Presentation

Majority of the patients with rotator cuff injuries presented with pain (33.3%) followed by inability to do overhead abduction in 23.3%, stiffness in 13.3%, pain and stiffness in 20%, pain and weakness in 6.7% and weakness in 3.3%.

In our study, 26.7% of patients had history of trauma and 76.6% of patients had decreased range of movements.

Clinical Examination

70% patients showed positive clinical test for supraspinatus muscle, 6.7% for infraspinatus injuries and 10% for subscapularis. 20% of patients showed positive clinical test for more than one muscle.

		SS	IP	SUB	TM
Tendons	No tear	17	29	22	30
	Articular surface partial tear	5	0	2	0
	Bursal surface partial tear	2	0	0	0
	Full thickness tear	3	1	2	0
	Intrasubstance tear	1	0	0	0
	Tendinosis	2	0	6	0
	Total	30	30	30	30

Table 4. USG findings in Tendon Injuries

In USG it was observed that 11 patients had tendon tear of supraspinatus muscle, 1 patient had infraspinatus tear, 4 patients had subscapular tear and there was no tear in teres minor and biceps tendon. 2 patients had tendinosis of supraspinatus muscle.

		SS	IP	SUB	TM
Tendons	No tear	8	28	20	30
	Articular surface partial tear	10	1	4	0
	Bursal surface partial tear	2	0	0	0
	Full thickness tear	3	1	2	0
	Intrasubstance tear	1	0	0	0
	Tendinosis	6	0	4	0
	Total	**30**	**30**	**30**	**30**

Table 5. MRI findings in Tendon Injuries

In MRI it was observed that 16 patients had tendon lesions of supraspinatus muscle, 2 patients had infraspinatus tear, 6 patients had subscapular tear and there was no tear in teres minor and biceps tendon. 6 patients had tendinosis of supraspinatus muscle.

	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Diagnostic Accuracy	Kappa Degree of Agreement
SS	59.09%	100%	100%	47.06%	70%	0.43
IP	50%	100%	100%	96.55%	96.67%	0.65
SUB	66.67%	100%	100%	92.31%	93.33%	0.76

TM	-	100%	-	100%	100%	-
BT	-	100%	-	100%	100%	-

Table 6. Validity of USG findings with MRI findings in Tendon Injuries

USG findings in comparison to MRI findings showed that sensitivity of USG was low in detecting the tendon injuries at all the sites. Highest sensitivity was observed for subscapular tendon injuries. Specificity was 100% at all the sites.

Calcification in Tendon

Only one patient in the study had supraspinatus tendon. Calcification with tendinosis, which was diagnosed both on Ultrasound and MRI. USG had similar sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy as MRI in identifying calcifications in rotator cuff injuries.

		PTF in MRI		Total
		Absent	Present	
PTF in USG	Absent	14	1	15
	Present	0	15	15
Total		**14**	**16**	**30**

Table 7. Association between USG findings and MRI findings in Peribicipital Tendon Fluid (PTF)

MRI showed 16 patients positive for PTF out of 30, whereas USG detected 15 out of 30 cases and did not detect PTF in one case. There was significant association between USG and MRI findings, i.e. MRI was better in detecting PTF than USG.

		MRI Findings		Total
		Absent	Present	
Subacromial-subdeltoid bursal fluid (SA-SD) in USG	Absent	15	1	16
	Present	0	14	14
Total		**15**	**15**	**30**
Subcoracoid bursal fluid (S-C) in USG	Absent	20	2	22
	Present	0	8	8
Total		**20**	**10**	**30**

Table 8. Association between USG findings and MRI findings in detecting Bursal Fluid

MRI showed 15 cases to be positive for SA-SD bursal fluid out of 30, whereas USG detected 14 cases and did not detect SA-SD in one case. There was significant association between USG and MRI findings, i.e. MRI was better in detecting SA-SD bursal fluid than USG. Similarly, MRI showed 10 positive for SC bursal fluid out of 30, whereas USG detected 8 cases and did not have SC in two cases. There was significant association between USG and MRI findings, i.e. MRI was better in detecting SC bursal fluid than USG.

		Joint Effusion in MRI		Total
		Absent	Present	
Joint effusion in USG	Absent	14	3	17
	Present	0	13	13
Total		**14**	**16**	**30**

Table 9. Association between USG findings and MRI findings in detecting Joint Effusion

MRI showed 16 positive for joint effusion out of 30, whereas USG detected in 13 cases and did not detect joint effusion in three cases. There was significant association between USG and MRI findings, i.e. MRI was better in detecting joint effusion than USG.

		ACJH in MRI		Total
		Absent	Present	
ACJH in USG	Absent	21	0	21
	Present	0	9	9
Total		**21**	**9**	**30**

Table 10. Association between USG findings and MRI findings in detecting Acromioclavicular Joint Hypertrophy (ACJH)

MRI showed 9 positive for ACJH out of 30. USG also detected all the 9 cases of ACJH. There was significant association between USG and MRI findings, i.e. USG was equivalent to MRI in detecting ACJH.

		MRI Findings		Total
		Absent	Present	
Subacromial impingement (SA) in USG	Absent	25	2	27
	Present	0	3	3
Total		**25**	**5**	**30**
Subcoracoid impingement (SC) in USG	Absent	29	0	29
	Present	0	1	1
Total		**29**	**1**	**30**

Table 11. Association between USG findings and MRI findings in detecting Impingement Lesions

MRI showed 5 cases to be positive for SA impingement out of 30, whereas USG detected 3 cases and did not detect SA impingement in two cases. There was significant association between USG and MRI findings, i.e. MRI was better in detecting SA impingement than USG.

Similarly, MRI showed 1 positive for SC impingement out of 30. USG also detected 1 case of SC impingement. There was significant association between USG and MRI findings, i.e. USG was equivalent to MRI in detecting SC impingement.

		Sensitivity	Specificity	PPV	NPV	Diagnostic Accuracy	Kappa Degree of Agreement
	PTF	93.75%	100%	100%	93.33%	96.67%	0.93
Bursal	SA-SD	93.33%	100%	100%	96.67%	100%	0.93
	SC	80%	100%	100%	90.91%	93.33%	0.84
	Joint Effusion	81.25%	100%	100%	82.35%	90%	0.81
	ACJH	100%	100%	100%	100%	100%	1
Impingement	SA	60%	100%	100%	92.59%	93.33%	0.71
	SC	100%	100%	100%	100%	100%	1

Table 12. Validity of USG findings with MRI findings in detecting PTF, Bursal Fluid, Joint Effusion, ACJH and Impingement

In our study, it was observed that USG had 100% specificity and negative predictive value in detecting PTF, SA-SD bursal fluid, SC bursal fluid, joint effusion, ACJH and impingement in SA and SC. USG had highest sensitivity for ACJH and SC impingement diagnosis. Least sensitivity was observed for SC bursal fluid detection. Diagnostic accuracy was 100% for SA-SD bursal fluid, ACJH and SC impingement. Kappa statistics showed that PTF and SA-SD bursal fluid has highest degree of agreement between USG and MRI.

	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Diagnostic Accuracy	Kappa Degree of Agreement
MRI vs Final diagnosis	92%	80%	95.83%	66.67%	90%	0.66
USG vs Final diagnosis	64%	100%	100%	35.71%	70%	0.37
Clinical diagnosis vs Final diagnosis	100%	0	83.33%	-	83.33%	0

Table 13. Comparison of Final Diagnosis with MRI, USG and Clinical Diagnosis

Final diagnosis was made by arthroscopy/ surgery. When MRI, USG and Clinical diagnosis was compared with final diagnosis, it was observed that diagnostic accuracy was highest for MRI and lowest diagnostic accuracy was seen in USG. Degree of agreement was highest for MRI, i.e. 0.66 (Good agreement) and lowest for Clinical diagnosis (0).

Image Plates

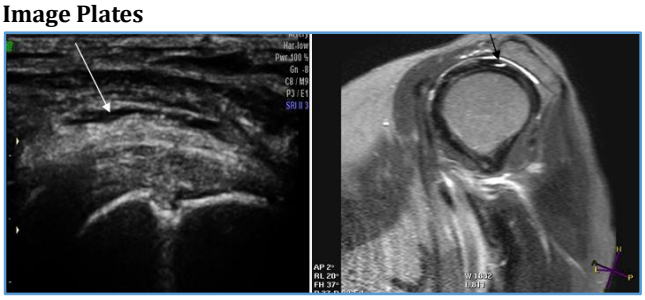

Illustration 1. Subacromial-Subdeltoid Bursitis and Supraspinatus Tendinosis

Ultrasound and MRI images depict fluid in subacromial-subdeltoid bursa (Arrows). Supraspinatus tendon is heterogeneous and thickened on ultrasound. On MRI PDFS image, it shows hyperintense signals.

Illustration 2. Complete Tear of Conjoint Tendon (Supraspinatus and Infraspinatus)

Ultrasound Image

Tear in the conjoint tendon and retraction, fluid is seen between retracted fibres (white arrow). On MRI PDFS images, there is complete tear in the conjoint tendon and arrows pointing fluid collection in the subacromial bursa.

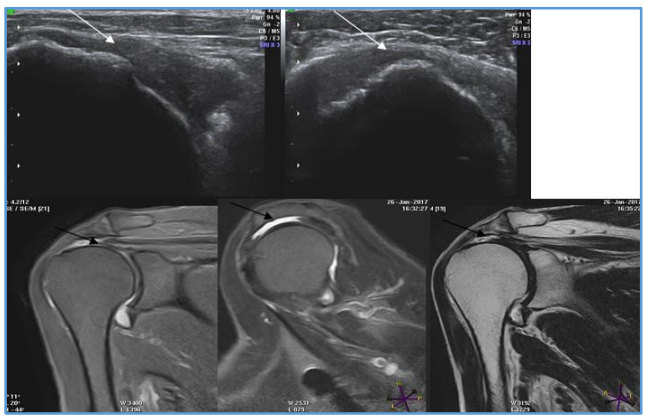

Illustration 3. Complete Tear of Supraspinatus Tendon

Complete full thickness full width tear of supraspinatus tendon pointed by white arrows in ultrasound images and black arrows in MRI PDFS and T2 weighted images.

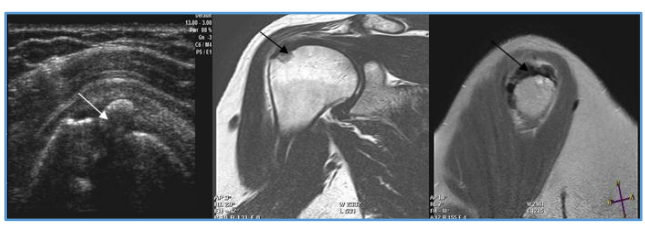

Illustration 4. Calcific Supraspinatus Tendinosis with Partial Thickness Tear

Case of calcific supraspinatus tendinosis, white arrow in ultrasound image and black arrows in MRI TWI and PDFS images showing calcifications in the tendon and there is an interstitial tear.

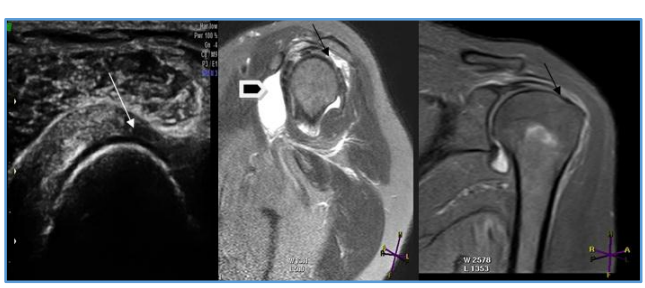

Illustration 5. Full Thickness Partial Width Tear of Supraspinatus Tendon

Ultrasound and MRI PDFS Images

Arrows pointing at the tear in the posterior fibres of supraspinatus tendon. Joint effusion is seen on sagittal MRI image (Arrow head).

DISCUSSION

Rotator cuff tears are evaluated with various techniques that include clinical examination, x-ray, arthrography, USG, CT

scan and MRI. The gold standard is arthrography, but has the disadvantage of being invasive. MRI is sensitive and specific but is expensive and cannot be used as a first line of investigation. However, USG is a non-invasive, relatively inexpensive modality that can be used as a first line of investigation.

This was a prospective study in which 30 patients referred to the Department of Radiodiagnosis, Shri Siddhartha Medical College with clinically suspected rotator cuff injuries were subjected to undergo USG and MRI after thorough history taking and clinical examination.

Age Wise distribution of Rotator Cuff Diseases

In our study, the age of the patients with rotator cuff disorders ranged from 23 to 76 years with the mean of 46.6+/- 2.08. Majority of rotator cuff injures were observed in patients above 50 yrs. of age (44%). Various literatures have pointed out that the incidence of rotator cuff tendon degeneration and injury increases with the age. Ozaki et al and Uhthoff believe that the pathogenesis of rotator cuff disorders is an intrinsic process[15,16,17] and the risk of rotator cuff disorder increases with aging.

In a study conducted by Needell et al[18] in 100 asymptomatic shoulders, a higher incidence of tendinosis was found among younger population against more tears in the older age group in the fifth and sixth decade of life. In our study, tears appeared to be more common in the age group more than 50 years (36.7%) compared with age group less than 50 years of age (30%). Tendinosis appeared to be more common in the age group less than 50 years (13.3%). Our study results are consistent with those of Needell et al.

Association between Dominant Side and Affected Side

In our study, majority were right-handed subjects, i.e. 90% and 10% were left-handed subjects. All the 3 left handers (100%) had rotator cuff injuries on the left side and 80.7% of right handers had injuries on right side showing statistically significant association between dominant hand and affected side correlating with study of Yamamoto et al[19] and Urwin M et al.[20]

USG findings in Tendon Injuries

In our study, most commonly involved tendon was supraspinatus (36.7%) followed by subscapularis (13.3%), infraspinatus (3.3%) with teres minor and biceps tendon least commonly affected (0%). This is consistent with the study conducted by Jerosch et al. It was a study conducted on the dissected specimen of shoulder joints of 122 patients. It was found that isolated supraspinatus involvement occurred in 78% cases.[21]

MRI findings in Tendon Injuries

In our study, most commonly involved tendon was supraspinatus (53.3%) followed by subscapularis (20%), infraspinatus (6.67%) with teres minor and biceps tendon least commonly affected (0%). This is consistent with literature.[22,23]

Correlation of USG findings with MRI findings in Tendon Injuries

USG findings in comparison to MRI findings showed that sensitivity of USG was low in detecting the tendon injuries of supraspinatus (59.09%), infraspinatus (50%) and subscapularis muscle (66.67%). Highest sensitivity was observed for subscapular tendon injuries (66.67%). Specificity was 100% at all the sites. Diagnostic accuracy was low in supraspinatus tears (70%) and highest for teres minor and biceps tendon injuries (100%). The agreement between USG and MRI findings was measured by Kappa and highest agreement was observed for subscapular tears (0.76).

This is consistent with study done by Martin-Hervas C and his associates have stated that the diagnosis of rotator cuff tears was highly specific on both imaging techniques (100% for USG), but was not as sensitive using USG (67.9%).[24]

Correlation of USG with MRI in detection of Calcification of Rotator Cuff Tendon

In our study 1 out of 30 patients (3.33%) had calcification of supraspinatus tendon, which was detected by both USG and MRI indicating that USG and MRI are equivalent to each other for detecting calcification of rotator cuff tendons.

Correlation of USG with MRI in detection of Peribicipital Tendon Fluid (PTF)

In our study MRI showed 16 cases to be positive for PTF out of 30 patients (53.33%), whereas USG detected 15 cases (50%) and did not detect PTF in one case. There was significant association between USG and MRI findings (p value< 0.0001), i.e. MRI was better in detecting PTF than USG.

Correlation of USG with MRI in detection of Bursal Fluid/ Joint Effusion

In our study MRI showed 15 (50%) positive for SA-SD bursal fluid out of 30 patients, whereas USG detected 14 cases (46.67%) and did not detect SA-SD in one case. There was significant association between USG and MRI findings (p-value < 0.0001), i.e. MRI was better in detecting SA-SD bursal fluid than USG.

Similarly, MRI showed 10 cases to be positive for SC bursal fluid out of 30 patients (33.33%), whereas USG detected 8 cases (26.67%) and did not have SC in two cases. There was significant association between USG and MRI findings (p value < 0.0001), i.e. MRI was better in detecting SC bursal fluid than USG.

In our study MRI showed 16 cases to be positive for joint effusion out of 30 patients (53.33%), whereas USG detected in 13 cases (43.33%) and did not detect joint effusion in three cases. There was significant association between USG and MRI findings (p value < 0.0001), i.e. MRI was better in detecting joint effusion than USG.

In a study by Hollister et al done on 97 patients with surgery proven rotator cuff tear, 52% had fluid in the joint, bursa or both. It was concluded in this study that fluid in the bursa (subacromial/ subdeltoid)/ joint effusion had strong association with rotator cuff tears.

Correlation of USG with MRI in detection of Impingement

In our study MRI showed 5 (16.67%) positive for SA impingement out of 30 patients, whereas USG detected 3 cases (10%) and did not detect SA impingement in two cases. There was significant association between USG and MRI findings (p value < 0.0001), i.e. MRI was better in detecting SA impingement than USG.

Similarly, MRI showed 1 (3.33%) positive for SC impingement out of 30, USG also detected 1 case of SC impingement. There was significant association between USG and MRI findings (p value < 0.0001), i.e. USG was equivalent to MRI in detecting SC impingement.

In our study, sensitivity of dynamic USG for detecting impingement was 66.67% as compared to MRI (100%). This was consistent with the study done by John W et al.[25]

Rotator Cuff Tears

Among our study of 30 patients, totally 20 patients had partial tear (66.67%) – 13 (65%) in the supraspinatus tendon, 5 (25%) in the subscapularis tendon and 2 (10%) in the infraspinatus tendon.

Jacobson et al in a study conducted in 50 patients with surgical correlation found among the partial tears, articular surface tears occurred in 70%.

In our study 20 patients had partial tear of the rotator cuff tendons, of these most common were articular surface tears in 85% followed by bursal tears in 10% and intrasubstance tears in 5%, which is consistent with literature.[26,27,28]

In our study full thickness tear was seen in 7 out of 30 patients (23.33%), of which 4 (57.14%) occurred in the supraspinatus tendon consistent with the available literature.[21]

Comparison of Final Diagnosis with MRI, USG and Clinical Diagnosis

Final diagnosis was made by arthroscopy/ surgery keeping them as gold standard. In our study clinical diagnosis had sensitivity of 100%, specificity of 0%, PPV of 83.33%, NPV of 0%, diagnostic accuracy of 83.33% with kappa degree of agreement 0. This is consistent with a meta-analysis (2012), which suggests that the diagnostic accuracy of orthopaedic shoulder exams is overestimated and that these exams are only rarely useful to differentiate RC tears.

In our study USG had a sensitivity of 64%, specificity of 100%, PPV of 100%, NPV of 35.71%, diagnostic accuracy of 70% and kappa degree of agreement of 0.37. This is consistent with study done by Cynthia L Miller et al, in which bilateral rotator cuff sonography was performed on 56 patients referred for shoulder arthrography to detect rotator cuff tears and showed that USG had a sensitivity of 58%, specificity of 93% and overall predictive value of 72%..

In our study MRI had a sensitivity of 92%, specificity of 80%, PPV of 95.83%, NPV of 66.67%, diagnostic accuracy of 90% and kappa degree of agreement of 0.66. This is consistent with study done by Vlychou M et al (2009).

CONCLUSION

Increasing age, male gender, dominant arm and history of trauma are predisposing factors for rotator cuff tears. Peribicipital tendon fluid, joint effusion, bursal fluid and acromioclavicular joint hypertrophy have significant association with rotator cuff tears. Pain is the most common presenting complaint with decreased range of motion, a common manifestation of rotator cuff tears.

Most commonly involved tendon is supraspinatus. Partial tears are more common than the full thickness tears. Among the partial tears, most common are articular surface tears.

No single clinical examination test has both a high specificity and a high sensitivity, therefore the diagnostic accuracy of shoulder examination is overestimated, and these exams are only rarely useful to differentiate rotator cuff tears.

USG is less reliable in detecting rotator cuff tears than previously reported and a positive sonographic reading is more reliable than a negative one.

MRI is more sensitive and has highest diagnostic accuracy in detecting rotator cuff tears as compared to USG and clinical diagnosis.

REFERENCES

[1] Wiener SN, Seitz WH Jr. Sonography of the shoulder in patients with tears of rotator cuff: Accuracy and value for selecting surgical options. AJR Am J Roentgenol 1993;160(1):103-7, discussion 109-10.

[2] Kneeland JB, Middleton WD, Carrera GF, et al. MR Imaging of the shoulder: diagnosis of rotator cuff tears. AJR Am J Roentgenol 1987;149(2):333-7.

[3] Teefey SA, Middleton WD, Payne WT, et al. Detection and measurement of rotator cuff tears with sonography: analysis of diagnostic errors. AJR Am J Roentgenol 2005;184(6):1768-73.

[4] Kinare A. Musculoskeletal Ultrasound Symposium: USG of normal musculoskeletal structures. Indian J of Radiol and Imaging 2007;17(3):194-200.

[5] Moosikasuwan JB, Miller TT, Burke BJ. Rotator cuff tears: clinical, radiographic and US findings. Radiographics 2005;25:1591-607.

[6] Crass JR, Craig EV, Bretzke C, et al. Ultrasonography of the rotator cuff. Radiographics 1985;5:941-53.

[7] Morag Y, Jacobson JA, Miller B, et al. MR imaging of rotator cuff injury: What the clinician needs to know. Radiographics 2006;26:1045-65.

[8] Burk DL, Karasick D, Kurtz AB, et al. Rotator cuff tears: prospective comparison of MR Imaging with arthrography, sonography and surgery. AJR Am J Roentgenol 1989;153(1):87-92.

[9] De Jesus JO, Parker L, Frangos AJ, et al. Accuracy of MRI, MR arthrography and ultrasound in the diagnosis of rotator cuff tears: a meta-analysis. AJR Am J Roentgenol 2009;192(6):1701-7.

[10] Rosner B. Fundamentals of biostatistics. 5th edn. Duxbury 2000: p. 80-240.

[11] Reddy VM. Statistics for Mental Health Care Research, NIMHANS Publication, India. 2002: p. 108-44.

[12] Rao SPSS, Richard J. An Introduction to Biostatistics, a manual for health sciences, New Delhi: Prentice hall of India 2006: p. 86-160.

[13] Griner PF, Mayewski RJ, Mushlin AI, et al. Selection and interpretation of diagnostic tests and procedures. Principles and applications. Ann Internal Med 1981;94(4 Pt 2):557-92.

[14] Roberts MC, Esterhai JC, Kressel HY. Spindler high resolution surface coil MRI of the joints. Radiographics 1983;176:37-8.

[15] Uhthoff HK, Sano H. Pathology of failure of the rotator cuff tendons. Orthop Clin North Am 1997;28(1):31-41.

[16] Ozaki J, Fujimoto S, Nakagawa Y, et al. Tears of the rotator cuff of the shoulder associated with pathological changes in the acromion. A study in cadavera. J Bone Joint Surg Am 1988;70(8):1224-30.
[17] Alasaarela E, Takalo R, Tervonen O, et al. Sonography and MRI in the evaluation of painful arthritic shoulder. Br J Rheumatol 1997;36(9):996-1000.
[18] Needell SD, Zlatkin MB, Sher JS, et al. MR Imaging of the rotator cuff: peritendinous and bone abnormalities in asymptomatic population. AJR 1996;166(4):863-7.
[19] Yamamoto A, Takagishi K, Osawa T, et al. Prevalence and risk factors of a rotator cuff tear in the general population. J Shoulder Elbow Surg 2010;19(1):116-20.
[20] Urwin M, Symmons D, Allison T, et al. Estimating the burden of musculoskeletal disorders in the community: the comparative prevalence of symptoms at different anatomical sites and the relation to social deprivation. Ann Rheum Dis 1998;57(11):649-55.
[21] Zlatkin MB. MRI of the shoulder. 2nd edn. Philadelphia: Lippincott Williams and Wilkins 2003: p. 50.
[22] Jerosch J, Muller T, Castro WHM. The incidence of rotator cuff rupture: an anatomic study. Acta Orthopaedica Belgca 1991;57(2):124-9.
[23] DePalma AFJ. Surgery of the shoulder. Philadelphia: JB Lippincott 1983: p. 211-31.
[24] Martin-Hervas C, Romero J, Navas-Acien A, et al. Ultrasonographic and MR Imaging of rotator cuff lesions compared with arthroscopy or open surgery findings. J Shoulder Elbow Surg 2001;10(5):410-5.
[25] Read JW, Perko M. Shoulder ultrasound: diagnostic accuracy for impingement syndrome, rotator cuff tear and biceps tendon pathology. J Shoulder Elbow Surg 1998;7(3):264-71.
[26] Iannotti JP. Rotator cuff disorders: evaluation and treatment monograph. AAOS Monograph Series, Rosemont: American Academy of Orthopaedic Surgeons 1991: p. 2-38.
[27] Lohr JF, Uhthoff HK. The microvascular pattern of supraspinatus tendon. Clin Orthop Relat Res 1990;(254):35-8.
[28] Traughber PD, Goodwin TE. Shoulder MRI: arthroscopic correlation with emphasis on partial tears. J Comput Assit Tomogr 1992;16(1):129-33.