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The Role of Magnetic Resonance Imaging and Ultrasound for Evaluating a Painful Shoulder in Rotator Cuff Tears

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Abstract:-

➢ ***Aims and Objectives:***

To study the value of USG and MRI in evaluating shoulder pain of all patients with suspected rotator cuff injury. There by, to study the disease pattern on imaging involving soft tissue and bony lesions as a cause of shoulder pain. To establish the value and limitations of common imaging techniques in studying shoulder pain related to rotator cuff injury.

➢ ***Method:***

The study was prospectively conducted in 30 patients with pain in shoulder joint referred to Radiology Dept. at from June 2012 to July 2014. All patients were subjected to X-ray, USG and MRI.

➢ ***Results:***

High resolution USG examination of the shoulder has a high sensitivity and specificity and accurate in the assessment of rotator cuff and ACJ pathologies. It is also cheap, can be done bed side and easily available. USG is useful in diagnosis of fluid, partial thickness tears and full thickness tears. MRI is useful in exact diagnosis of fluid, marrow edema, cartilage, ligament, tendons and labral injuries.

➢ ***Conclusion:***

USG is as good as MRI in identifying rotator cuff injuries.

I. INTRODUCTION

The shoulder joint is an incongruous ball and socket joint has a wide range of motion in multiple planes; hence stability is compromised for mobility. Shoulder pain is one of the most common complaint encountered in the orthopaedic practice. Imaging dilemmas often leads to considerable disability. High resolution ultrasound is non invasive, less expensive and non ionizing modality with good sensitivity in detecting both rotator cuff and non rotator cuff disorders.(1) It serves as a complementary role to the magnetic resonance imaging of the shoulder. Magnetic resonance imaging is an excellent modality for imaging pathological processes of the shoulder joint. It allows high-resolution imaging of all anatomic structures, including the glenoid, the humeral head, the articular cartilage, the acromion, the muscles and tendons of the rotator cuff, bursae, the labrum, the biceps tendon, and the glenohumeral ligaments, in multiple orthogonal planes. Numerous technical options and several pulse sequences can be utilized for the performance of magnetic resonance imaging of the shoulder.

➢ *Aims*

To study the value of various imaging modalities in evaluating shoulder pain with suspected rotator cuff injury.

➢ *Objectives*

1. To study the disease pattern on imaging involving soft tissue and bony lesions as a cause of shoulder pain
2. To evaluate the diagnostic features in shoulder pain.
3. To establish the value and limitations of common imaging techniques in studying shoulder pain related to rotator cuff injury.

II. MATERIAL AND METHODS

➢ *Sources of Data*

The study was conducted in all the patients with pain in shoulder joint referred to Radiology Dept. at Subharti Hospital from June 2012 to May 2014. The study will include:

Study design : Observational, Descriptive study
Sample size : at least 30
Sample design : Purposive sampling
Study place : Dept. of Radio-diagnosis, Subharti Hospital.
Study period : June 2012 to July 2014.

➢ *Method of collection of Data*

The patient of shoulder pain requiring imaging were identified from outpatient clinical Department of Orthopaedics at Subharti Medical College, Meerut. Detailed history was taken in all the patients followed by clinical examination.

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Patient were subjected to X-ray AP and Axial as initial investigation. On viewing the X-ray next modality was decided. All those cases where no obvious bony lesion is seen will be further evaluated by USG. A provisional diagnosis will be arrived and further MRI imaging was done.

III. RESULTS

Age in years	No. of patients	%
40-50	18	60
51-60	8	26.7
>60	4	13.3
Total	30	100

Table 1:- Age distribution of patients studied.

Gender	No. of patients	%
Male	16	53.3
Female	14	46.7
Total	30	100.0

Table 2:- Gender distribution of patients studied

Duration of symptoms	No. of patients	%
Upto 1 month	13	43.3
1-6 months	13	43.3
6- 12 months	4	13.3
Total	30	100.0

Table 3:- Duration of symptoms

Affected shoulder	No. of patients	%
Left	9	30.0
Right	21	70.0
Total	30	100.0

Table 4:- Affected shoulder

Dominant hand	No. of patients	%
Left	0	0
Right	30	100.0
Total	30	100.0

Table 5:- Dominant hand

Presenting complaints	No. of patients	%
Trauma	5	16.67
Diabetics	9	30.0
Tenderness	5	16.67

Table 6:- Associated complaints and tenderness

Range of motion	No. of patients	%
Normal	13	43.3
Restriction	17	56.7
• **<30º**	5	16.7
• **30-45º**	5	16.7
• **>45º**	7	23.3
Total	30	100.0

Table 7:- Range of motion

X-ray findings	Criteria	No. of patients(n=30)	%
Cystic changes of the tuberosities of the humerus	Absent	25	83.3
	Present	5	16.7
Erosions of the tuberousities of the humerus	Absent	29	96.7
	Present	1	3.3
Acromio-clavicular lesions	Absent	22	73.3
	Present	8	26.7
Degenerative changes of the humeral head	Absent	25	83.3
	Present	5	16.7
Degenerative changes of the glenoid	Absent	30	100
	Present	0	0
Calcification of the rotator cuff	Absent	29	96.7
	Present	1	3.3
Hachet deformity	Present	1	3.3%

Table 8:- X-ray findings

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Tendons (n=30)	Ultrasound findings				
	Partial thickness tear	Full thickness tear	Tendinosis	Intrasubstance tear	Normal
Subscapularis	2(6.7%)	0	1(3.3%)	0	27(90%)
Supraspinatus	11(36.7%)	4(13.3%)	7(23.3%)	0	8(26.7%)

Table 9:- Ultrasound findings: pathology (tears)

USG findings : calcification.	Criteria	Number of patients (n=30)	%
Subscapularis	Absent	29	96.7
	Present	1	3.3
Supraspinatus	Absent	27	90
	Present	3	10
Infraspinatus	Absent	29	96.7
	Present	1	3.3
Teres minor	Absent	30	100
	Present	0	0
Biceps tendon	Absent	30	100
	Present	0	0

Table 10:- USG findings : Calcification.

	Criteria	Number of patients (n=30)	%
Peribicipital tendon fluid	Absent	19	63.3
	Present	11	36.7

Table 11:- USG findings of Peribicipital tendon fluid.

Bursa	Criteria	Number of patients (n=30)	%
Subacromial-subdeltiod bursa	Absent	23	76.7
	Present	7	23.3
Subcoracoid bursa	Absent	30	100
	Present	0	0
Joint fluid	Present	23	76.7
	Absent	7	23.3

Table 12:- Ultrasound findings : Bursal fluid / Bursitis.

	Criteria	Number of patients (n=30)	%
ACJ hypertrophy	Absent	28	93.3
	Present	2	6.7

Table 13:- USG findings : ACJ hypertrophy

Impingement Dynamic USG	Criteria	Number of patients (n=30)	%
Subacromial	Absent	23	76.7
	Present	1	3.3
	NA	6	20
Subcorocoid	Absent	23	76.7
	Present	1	3.3
	NA	6	20

Table 14:- Ultrasound findings: Impingement- Dynamic USG

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Tendon	MRI findings of tears				
	Partial thickness tear	Full thickness tear	Tendinosis	Intrasubstance tear	Normal
Subscapularis	2(6.7%)	0	0	0	28(93.3%)
Supraspinatus	14(46.7%)	3(10%)	9(30%)	0	4(13.3%)
Infraspinatus	1(3.3%)	0	0	0	29(96.7%)
Teres minor	0	0	0	0	30(100%)
Biceps tendon	0	0	0	0	30 (100%)

Table 15:- MRI findings of tendon tears

	Criteria	Number of patients(n=30)	%
Peribicipital tendon fliud	Absent	6	20
	Present	24	80

Table 16:- MRI findings : Peribicipital tendon Fluid.

Bursal fluid / Bursitis	Criteria	Number of patients (n=30)	%
Subacromial-subdeltoid bursa	Absent	7	23.3
	Present	23	76.7
Subcoracoid bursa	Absent	14	46.7
	Present	16	53.3

Table 17:- MRI finding : Bursal Fluid

ACJ Hypertrophy	Number of patients	%
Absent	13	43.3
Present	17	56.7
Total	30	100

Table 18:- MRI findings : ACJ Hypertrophy

Acromion type	Number of patients	%
Type I	13	43.3
Type II	15	50
Type III	2	6.7
Total	30	100

Table 19:- MRI finding : Acromion type

Labral pathology	Number of patients	%
Absent	24	80
Present	6	20
Total	30	100

Table 20:- MRI findings : labral tears / pathology

Findings	TP	FP	FN	TN	USG pick up rate(%)	MRI pick up rate (%)	Total
1.Subscapularis	1	2	1	26	10	6.7	30
2.Supraspinatus	20	2	6	2	73.3	86.7	30
3.infraspinatus	0	0	1	29	0	3.3	30
4.Teres Minor	0	0	0	30	0	0	30
5.Biceps Tendon	0	0	1	29	0	3.3	30
6.peribicipital tendon fluid	10	1	14	5	36.7	80	30
7.subacromial subdeltoid bursitis	6	1	17	6	23.3	76.7	30
8.subcoracoid bursitis	0	0	16	14	0	53.3	30

Table 21:- Correlation of USG findings with MRI findings : an observation

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Findings	Sensitivity	Specificity	PPV	NPV	Accuracy	P value
1.Subscapularis	50	92.86	33.33	96.3	90	0.051
2.supraspinatus	76.92	50	90.91	25	73.33	0.257
3.Infraspinatus	0	100	50	96.67	96.67	NS
4.Teres Minor	0	100	50	100	100	NS
5.Biceps Tendon	0	100	50	96.67	96.67	NS
6.peribicipital tendon fluid	41.67	83.33	90.91	26.32	50	0.255
7.subacromial-subdeltoid bursitis	26.09	85.71	85.71	26.09	40	0.519
8.Subcoracoid bursitis	0	100	50	46.67	46.67	NS

Table 22:- Correlation of USG findings with MRI findings : An evaluation.

Tendon	USG/MRI	Tears				
		Partial thickness tear	Full thickness tear	Tendinosis	Intrasubstance tear	Normal
Subscapularis	USG	2(6.7%)	0	1(3.3%)	0	27(90%)
	MRI	2(6.7%)	0	0	0	28(93.3%)
Supraspinatus	USG	11(36.7%)	4(13.3%)	7(23.3%)	0	8(26.7%)
	MRI	14(46.7%)	3(10%)	9(30%)	0	4(13.3%)
Infraspinatus	USG	0	0	0	0	30(100%
	MRI	1(3.3%)	0	0	0	29(96.7%)
Teres minor	USG	0	0	0	0	30(100%)
	MRI	0	0	0	0	30(100%)
Biceps tendon	USG	0	0	0	0	30(100%)
	MRI	0	0	0	0	30(100%)

Table 23:- Detailed correlation of USG findings with MRI findings : Pathology

Tendon	USG/MRI	Clacifications	
		Present	Absent
Subscapualris	USG	1(3.3%)	29
	MRI	0	30
Supraspinatus	USG	3(10%)	27
	MRI	1(3.3%)	29
Infraspinatus	USG	1(3.3%)	29
	MRI	0	30
Teres minor	USG	0	30
	MRI	0	30
Biceps tendon	USG	0	30
	MRI	0	30

Table 24:- USG vs MRI : Calcifications

Findings	TP	FP	FN	TN	USG pick up rate	MRI pick up rate	Total
1.Partial thickness	13	0	1	16	100	92.9	30
2.Full Thickness	3	1	0	26	75	100	30

Table 25:- Correlation of USG findings with MRI findings : An observation

Findings	Sensitivity	Specificity	PPV	NPV	Accuracy	P value
1.Partial thickness	92.86	100	100	94.12	96.67	<0.001
2.Full thickness	100	96.3	75	100	96.67	<0.001

Table 26:- Correlation of USG findings with MRI findings : An evaluation

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IV. DISCUSSION

Our study group comprised of 30 patients with mean age of 49.77 (S.D±10.27) years which is corresponding to the study of Worland RL et al (2003) who found average age to be 42.28 years[2] . The gender distribution in our study showed a male preponderance, of 16 males (53.3%) and 14 female (46.7%). Males were affected more common than females in contrast to the females outnumbering males in a study done by Zwart BCH et al(2003).[3] This variability could be due to different study population. Right shoulder was the affected side in 21 (70%) of our cases, while the left side was affected in only 9 (30%) of our patients. All the patients in our study had right hand dominance.

Only 5 patients (16.67%) had a history of trauma to the affected shoulder. A history of diabetes was present in 9 (30%) of our patients as seen in a previous study done by Codman EA (1911) who found 35% of patients had diabetes.[4] On clinical examination tenderness was present in 5 (16.67%) of the patients. 13 patients (43.3%) had normal range of motion, whereas restricted range of motion was seen in 17 patients (56.7%).[5]

Various techniques are used for evaluating patients with shoulder pain including clinical examination, X-ray, arthrography, USG, CT scan and MRI. The most accurate is MR arthrography. Conventional MRI is sensitive and specific, but cannot be used as a first line of investigation. However, USG is a non-invasive, relatively inexpensive modality that can be used.

This was a prospective study of 30 patients who presented with shoulder pain. A detailed history and clinical examination was done initially, following which an x-ray (AP) of the affected shoulder was done. An USG examination of the affected shoulder with comparison to the opposite side was done. These findings were correlated with MRI.

In our study, positive X-ray findings were seen in 11 (36.67%) patients and the rest of the 19 patients had normal x-ray findings. Cystic changes in the tuberosities of the humeral head were present in 5 (16.7%) patients in our study, erosion of the humeral head was present in only 1 case (3.3%), acromio-clavicular joint lesions were present in 8 (26.7%) of our patients, degenerative changes in the humeral head were present in 5 (16.7%) of the patients in our study, calcification of the rotator cuff tendon was present in 1 (3.3%), but none had degenerative changes of the glenoid. Ostlere S (2003) who studied plain films as a useful screening modality in patients with shoulder pain found similar results with degenerative changes of 20%, cystic changes of tuberosity head to be 16.7%.[6]

The USG criteria for detection of partial thickness tears were focal discontinuity of the tendon either at the bursal or articular margin. USG criteria for full thickness tears were recognised by complete absence of the tendon. The space over the humeral head is filled by the deltoid muscle and a thickened subacromial-subdeltiod bursa.

Rotator cuff pathologies were the commonest cause of painful shoulder in our study. The pathologies included partial, full thickness tears and tendinosis. Supraspinatus tendon was the commonest tendon to be involved in our study. Where in USG detected 22 patients and MRI detected 26 patients with supraspinatus tendon involvement was present in around 80% of their cases.

Soble MG (1989) showed that ultrasound enabled detection of 92% of rotator cuff tears with a specificity of 84% and a negative predictive value of 95%. In our study the Supraspinatus pathologies the USG pick up rate was 73.3%. Subscapularis pathologies the USG pick up rate was 73.3%. Subscapularis tendon pathologies 50% sensitivity, 92.6% specificity, a PPV of 33.33%, a NPV of 96.3%, with an accuracy of 90% and significance of P = 0.051+. The supraspinatus tendon pathologies showed 76.92% sensitivity, 50% specificity, a PPV of 90.91%, a 25% NPV, with an accuracy of 73.33% and a significance of P= 0.257. For partial thickness tears USG had a sensitivity of 92.7%, specificity of 100%. In cases with full thickness tears, 100% sensitivity and 96.3% specificity was achieved.[8]

MRI, in particularly the STIR sequences are informative in detecting cuff tears. We found that Axial sections are useful for showing the rotator cuff muscles, bicipital groove and anterior & posterior labrum. The rotator cuff tendon structures, superior labrum and axillary recess were best seen on coronal sections. The morphological abnormalities of acromion, long head of biceps, coracoacromial ligament, and superior glenohumeral ligament were best visualized on sagittal sections. MRI is better in picking up labral and ligamentous pathologies, bony abnormalities, glenohumeral joint arthritis and muscle atrophy as stated by Jana et al (2011). All our 30 cases were in concordance with the study done Jana et al (2011).[9]

MRI criteria for detection of partial thickness tears are characterized by a focal region of fiber discontinuity that is filled with fluid signal. Beside a focal tendon defect, additional findings included surface fraying or changes in tendon calibre, such as attenuation or thickening. MRI criteria for full thickness tears were characterized by tendon discontinuity. Tendon retraction was another sign to detect full thickness tears. The presence of fluid in the subacromial-subdeltoid bursa, although not specific for a full-thickness tear, to be another indirect sign and we found it in 76.6% as also seen in a study done by Zlankin MB (1998).[10]

Supraspinatus pathologies the MRI pick up rate was 86.7%. Subscapularis pathologies the MRI pickup rate was

86.7% which is in accordance to the Iannotti JP et al (1991) study.[11]

Subacromial-subdeltoid bursitis had a USG pickup rate of 23.3% and a MRI pickup rate of 76.6%. In our study, SA-SD, 26.09% sensitivity, 85.71% specificity, showing that MRI being a better modality than USG in picking up SA-SD bursitis as seen in a study by Zlankin MB (1998).[10,12] 5 patients had rotator cuff tendon calcification on ultrasound, whereas MRI picked up only 1 case of calcification.[10]

In our study, all the patients underwent X-ray, USG findings were correlated with MRI findings. However, MRI additionally picked up labral tears, IGHL thickening and muscle atrophy and were co-related clinically as published by the first article about the use of USG in the assessment of the rotator cuff was published in 1979 by Seltzer SE, Finberg HJ and Weussman BN , that for MRI, 1986 by Keenland JB, Carren GF and Middleton WD.

V. CONCLUSION AND SUMMARY

In our study of clinic-radiological correlation of shoulder pain 30 patients, those were referred from the department of orthopaedics. These patients underwent X-ray (AP) of the affected shoulder, followed by USG of the affected shoulder with comparison of the opposite side and correlated with MRI of the shoulder in question.

Since clinical examination does not provide adequate diagnosis to the underlying pathology, radiological diagnosis is more sort after.

The X-ray (AP) of the shoulder joint has a limited role, which is restricted to bony changes like cystic appearance, sclerosis and erosion or calcific tendinitis and periarthritis.

High resolution USG examination of the shoulder has a high sensitivity and specificity and accurate in the assessment of rotator cuff and ACJ pathologies. It is also cheap, can be done bed side and easily available. USG is useful in diagnosis of fluid, partial thickness tears and full thickness tears.

MRI is useful in exact diagnosis of fluid, marrow edema, cartilage, ligament, tendons and labral injuries.

For acute shoulder pain initial USG examination will be able to establish a cause. This should be followed by an MRI to localise detailed pathologies.

In chronic shoulder pain x-rays are helpful in initial screening examination followed by USG and MRI.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests regarding the publication of this paper.

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REFERENCES

[1]. Kinare A. Musculoskeletal Ultrasound Symposium. Indian J Radiol and Imaging 2007;17(3):194-200.
[2]. Worland RL, Lee D, Orozco CG, Sozarex F, Keenan J. Correlation of age, acromial morphology, and rotator cuff tear pathology diagnosed by ultrasound in asymptomatic patients. J South Orthop Assoc. 2003;12:23-6.
[3]. Zwart BCH de, Fings MHW et al. Gender differences in upper extremity musculoskeletal complaints in working population. Int arch occup environ health 2001;74:21-30.
[4]. Codman EA. Complete rupture of the supraspinatus tendon: operative treatment with report of two successful cases. Boston Med Surg J 1911;164:708-710.
[5]. Smith JG. Pathological appearances of seven cases of injury of the shoulder-joint: with remarks. *London Medical Gazette* 1834;14:280–285.
[6]. Ostlere S. Imaging the shoulder. Imaging 2003;15:162-173.
[7]. Vlychou M, Dailiana Z, Fotiadou A, Papanagiotou M, Fezoulidis IV, Malizos K. Symptomatic Partial Rotator cuff Tears: diagnostic Performance of Ultrasound and Magnetic Resonance Imaging with surgical Correlation. Acta Radio. 2009;50:101-105.
[8]. Soble MG, Kaye AD and Guay RC. Rotator cuff tears: clinical experience with sonographic detection 1989;173:319-21.
[9]. Jana M: MRI in glenohumeral instability. World J Radiol 2011;3:224-232.
[10]. Zlatkin MB. Rotator cuff tears, diagnostic performance of MRI. Radiology 1989;172:223-229.
[11]. Iannotti JP, Zlatkin MB, et al. MRI of the shoulder: Sensitivity, specificity and predictive value. J Bone Joint Surg Am. 1991;73:17-29.
[12]. Robertson PL, Schweitzer ME, Mitchell DG, Schlesinger F, Epstein RE, Frieman BG and Fenlin JM. Rotator cuff disorders: interobserver and intraobserver variation in diagnosis with MR imaging. Radiology 1995;194:831-835.