European Journal of Molecular & Clinical Medicine

ISSN 2515-8260 Volume 09, Issue 09, 2022

Original Research Article

ROLE OF ULTRASONOGRAPHY AND MAGNETIC RESONANCE IMAGING IN EVALUATION OF MUSCULOTENDINOUS PATHOLOGY OF SHOULDER JOINT

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Abstract:

Background & Method: The aim of this stud is to study role of ultrasonography and magnetic resonance imaging in evaluation of musculotendinous pathology of shoulder joint. The patients were then briefed about the procedure for the USG and MRI studies. All the USG scans of the shoulder were performed on GE S8 USG machine using a high density, multi frequency (6-15 MHz) linear array transducer. MRI scans of the shoulder in this study were performed using GE Signa 1.5 tesla explorer.

Result: Amongst the patients with tendonitis, USG could detect the condition in 75.0% patients. Amongst the patients with partial thickness tear, USG could detect the condition in 80.0% patients. Amongst the patients with full thickness tear, USG could detect the condition in 100.0% patients. There was a statistically significant strong agreement between findings of MRI and USG. The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of USG as compared to standard (MRI) in detecting musculoskeletal pathologies/conditions of shoulder joint have been presented in above table. USG was found to have good sensitivity, specificity, and negative predictive value and predictive accuracy in detecting musculoskeletal pathologies/conditions of shoulder joint. The negative predictive value of USG was good for all the component except for supraspinatus.

Conclusion: Musculotendinous pathologies are common clinical problem, however their clinical presentation can be mimicked by other pathologies in the shoulder which may be present in isolation or in association with tendon pathologies. Clinical evaluation does not provide adequate insight into the patients‟ problem and hence is a poor guide to management protocols. Imaging evaluation is mandatory for the diagnosis and management of the patients. Ultrasound evaluation provides extensive information in patients with clinically suspected musculotendinous pathologies and shows a good correlation to MRI. As USG is a dynamic study, cost effective , and easily available so can be used as the initial imaging modality in these patients..MRI evaluation in patients with clinically suspected musculotendinous pathologies provides a more complete evaluation of all components of the shoulder joint. But due to its limitations like less availability, high cost and low patient compliance UGS overcomes all these limitations.

Keywords: ultrasonography, MRI, musculotendinous, pathology & shoulder.

Study Designed: Observational Study.

1. INTRODUCTION

The shoulder joint is most mobile joint among other joints in the human body. This mobility provides the upper extremity with tremendous range of motion such as adduction, abduction, flexion, extension, internal rotation, external rotation, and 360° circumduction. Furthermore, the shoulder allows for scapular protraction, retraction, elevation, and depression[1]. Shoulder joint with its multi-directional movement, has the widest range of movements as compare to other joints in the body, yet under most circumstances, it is stable. Joint stability is provided by surrounding muscle tendons forming the rotator cuff, the tendon of the long head of biceps brachii muscle, a skeletal arch formed superiorly by the coracoid process, the acromion and the extracapsular ligaments.

The rotator cuff muscles are supraspinatus, infraspinatus, subscapularis and teres minor. Tendons of these muscles blend with the joint capsule to form a musculotendinous collar that surrounds the posterior, superior, and anterior aspects of the glenohumeral joint. This cuff of muscles stabilizes and holds the head of the humerus in the glenoid cavity of the scapula without compromising the arm‟s flexibility and range of motion[2].

Rotator Cuff muscle strain, impingement syndrome and rotator cuff tears make up a group of lesions that produce 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-ionizing modality with good sensitivity in detecting both rotator cuff disorders. It can be used as a focused examination providing rapid, real-time diagnosis in desired clinical situations. The reported accuracy, sensitivity and specificity of high resolution ultrasound in detecting any tear, whether partial or full thickness are all greater than 90%. It serves as a complementary role to MRI in shoulder imaging. High resolution USG can also reveal the presence of other abnormalities that may mimic rotator cuff tear at clinical examination including tenosynovitis, tendinosis, subacromial-subdeltoid free fluid, greater tuberosity fracture, etc. ultrasonography is as accurate as MRI, these combined with low cost for ultrasound suggests that ultrasound may be the most cost effective imaging method of screening for rotator cuff disorders. Sonography has the advantage of dynamic real time assessment[4].

2. MATERIAL & METHOD

The study population included 100 patients with clinically suspected musculotendinous pathologies who referred from orthopaedics department underwent USG and MR imaging of the shoulder in department of Radiodiagnosis, Index medical college hospital and research centre .This dissertation evaluates various pathologies of the rotator cuff and long head of biceps tendons on USG and its correlation with MRI. Department of Radiodiagnosis Index medical college hospital and research centre from Jan-2021 to Aug-2022.

The patients were then briefed about the procedure for the USG and MRI studies. All the USG scans of the shoulder were performed on GE S8 USG machine using a high density, multi frequency (6-15 MHz) linear array transducer. Protocol for USG shoulder: Images of

the Supraspinatus, Infraspinatus, Subscapularis, Long head of biceps tendons and teres minor insertion were acquired. Additional image acquisition was tailored to the patient. Dynamic evaluation for impingement was carried out. MRI scans of the shoulder in this study were performed using GE Signa 1.5 tesla explorer. Protocol for MRI shoulder: Oblique coronal T1, Oblique sagittal T1, Oblique coronal T2 FSE FS , Oblique sagittal T2 FSE, Oblique coronal FSE PD with FS, Oblique sagittal FSEPD with FS, Axial FSE PD with FS, Axial T2* Merge,

Inclusion Criteria:
1) Subjects with shoulder pain suspected to be arising from the musculotendinous tissue of shoulder joint.
2) Subject of all gender & age will be between 12 to 60 years.

Exclusion Criteria:
1) Known cases of any tumour, arthritis, periarthritis of shoulder/ frozen shoulder
2) Cases those who had already undergone shoulder surgery or prosthesis of shoulder.
3) Patients with contraindications for MRI (claustrophobia, patient with metallic implant and cardiac pacemaker)
4) Patient not willing to be part of the study
5) Age of subject below 12 years and above 60 years.

3. RESULTS

Table 1. Distribution of the study subjects based on age group.

Age groups	Frequency	Percentage
12-20 years	11	11.0
21-30 years	22	22.0
31-40 years	24	24.0
41-50 years	28	28.0
51-60 years	15	15.0
Total	**100**	**100.0**

Majority of the subjects belonged to the age group of 21-50 years. Table 1. Distribution of the study subjects based on age group.

Table 2 .Distribution of subjects on the basis of tendon affected in my study

Tendon affected	Tendinosis	Partial thickness tear	Full thickness tear
Supraspinatus	38	29	23
Infraspinatus	16	10	1
Subscapularis	8	5	2
Teres Minor	5	0	0

Table 3. Agreement between the findings of MRI and USG for assessment of Supraspinatus

	Supraspinatus		MRI findings				Total
			Tendinosis	Partial thickness tear	Full thickness tear	Normal	
USG	Tendinosis	Count	29	1	0	1	31
		Percentage	76.3%	3.4%	0.0%	10.0%	31.0%
	Partial thickness tear	Count	0	26	2	0	28
		Percentage	0.0%	89.7%	8.7%	0.0%	28.0%

findings	Full thickness tear	Count	0	0	21	0	21
		Percentage	0.0%	0.0%	91.3%	0.0%	21.0%
	Normal	Count	9	2	0	9	20
		Percentage	23.7%	6.9%	0.0%	90.0%	20.0%
Total		**Count**	**38**	**29**	**23**	**10**	**100**
		Percentage	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Kappa correlation coefficient- .802, p value = .001
Amongst the patients with tendonitis, USG could detect the condition in 76.3%. Amongst the patients with partial thickness tear, USG could detect the condition in 89.7% patients. Amongst the patients with full thickness tear, USG could detect the condition in 91.3% patients. There was a statistically significant strong agreement between findings of MRI and USG.

Table 4. Agreement between the findings of MRI and USG for assessment of Infraspinatus

Infraspinatus		**MRI findings**				**Total**
		Tendinosis	**Partial thickness tear**	**Full thickness tear**	**Normal**	
	Tendinosis Count	12	0	0	1	13
	Tendinosis Percentage	75.0%	0.0%	0.0%	1.4%	13.0%

	Partial thickness tear	Count	0	8	0	1	9
		Percentage	0.0%	80.0%	0.0%	1.4%	9.0%
USG findings	Full thickness tear	Count	0	0	1	0	1
		Percentage	0.0%	0.0%	100.0%	0.0%	1.0%
	Normal	Count	4	2	0	71	77
		Percentage	25.0%	20.0%	0.0%	97.3%	77.0%
Total		Count	16	10	1	73	100
		Percentage	100.0%	100.0%	100.0%	100.0%	100.0%

Kappa correlation coefficient- .804, p value = .000. Amongst the patients with tendonitis, USG could detect the condition in 75.0% patients. Amongst the patients with partial thickness tear, USG could detect the condition in 80.0% patients. Amongst the patients with full thickness tear, USG could detect the condition in 100.0% patients. There was a statistically significant strong agreement between findings of MRI and USG.

Table 5. Agreement between the findings of MRI and USG for assessment of Subscapularis.

Subscapularis	**MRI findings**				**Total**
	Tendinosis	**Partial thickness tear**	**Full thickness tear**	**Normal**	

USG findings	Tendinosis	Count	5	0	0	1	6
		Percentage	62.5%	0.0%	0.0%	1.2%	6.0%
	Partial thickness tear	Count	0	5	0	0	5
		Percentage	0.0%	100.0%	0.0%	0.0%	5.0%
	Full thickness tear	Count	0	0	2	0	2
		Percentage	0.0%	0.0%	100.0%	0.0%	2.0%
	Normal	Count	3	0	0	84	87
		Percentage	37.5%	0.0%	0.0%	98.8%	87.0%
Total		Count	8	5	2	85	100
		Percentage	100.0%	100.0%	100.0%	100.0%	100.0%

Kappa correlation coefficient- .842, p value = .000*
Amongst the patients with tendonitis, USG could detect the condition in 62.5% patients. Amongst the patients with partial thickness tear, USG could detect the condition in 100.0% patients. Amongst the patients with full thickness tear, USG could detect the condition in 100.0% patients. There was a statistically significant strong agreement between findings of MRI and USG.

Table 6. Agreement between the findings of MRI and USG for assessment of Teres minor

	Teres minor		MRI findings				Total
			Tendinosis	Partial thickness tear	Full thickness tear	Normal	
USG findings	Tendinosis	Count	4	0	0	1	5
		Percentage	80.0%	0.0%	0.0%	1.1%	5.0%
	Partial thickness tear	Count	0	0	0	0	0
		Percentage	0.0%	0.0%	0.0%	0.0%	0.0%
	Full thickness tear	Count	0	0	0	0	0
		Percentage	0.0%	0.0%	0.0%	0.0%	0.0%
	Normal	Count	1	0	0	94	95
		Percentage	20.0%	0.0%	0.0%	98.9%	95.0%
Total		Count	5	0	0	95	100
		Percentage	100.0%	0.0%	0.0%	100.0%	100.0%

Kappa correlation coefficient- .801, p value = .000*

Amongst the patients with tendonitis, USG could detect the condition in 80.0% patients. None of the patient had partial thickness or full thickness tear. There was a statistically significant strong agreement between findings of MRI and USG.

Table 7. Agreement between the findings of MRI and USG for assessment of Biceps tendon

	Biceps tendon		MRI findings				Total
			Tendinosis	Partial thickness tear	Full thickness tear	Normal	
USG findings	Tendinosis	Count	8	0	0	0	8
		Percentage	88.9%	0.0%	0.0%	0.0%	88.9%
	Partial thickness tear	Count	0	0	0	0	0
		Percentage	0.0%	0.0%	0.0%	0.0%	0.0%
	Full thickness tear	Count	0	0	0	0	0
		Percentage	0.0%	0.0%	0.0%	0.0%	0.0%
	Normal	Count	1	0	0	91	92
		Percentage	11.1%	0.0%	0.0%	100.0%	92.0%

Total	Count	9	0	0	91	100
	Percentage	100.0%	0.0%	0.0%	100.0%	100.0%

Kappa correlation coefficient- .828, p value = .001*
Amongst the patients with tendonitis, USG could detect the condition in 88.9% patients. None of the patients had partial thickness tear and full thickness tear. There was a statistically significant strong agreement between findings of MRI and USG.

Table 8. Sensitivity, specificity, positive predictive value and negative predictive value of USG considering MRI as gold standard

	Sensitivity	**Specificity**	**Positive predictive value**	**Negative predictive value**	**Accuracy**
Supraspinatus	87.8%	90.0%	98.7%	45.0%	88.0%
Infraspinatus	77.8%	97.2%	91.3%	92.2%	92.0%
Subscapularis	80.0%	98.9%	92.3%	96.5%	96.0%
Teres minor	80.0%	98.9%	80.0 %	98.9%	98.0%
Biceps tendon	88.9%	100.0%	100.0%	98.9%	99.0%
Fluid in bursae (Sub-acromion subdeltoid)	86.8%	98.4%	97.0%	92.4%	94.0%
Fluid in bursae (Sub-coracoid)	80.0%	100.0%	100.0%	93.8%	95.0%
Peribicipital tendon fluid	90.0%	97.5%	90.0%	97.5%	96.0%

Acromioclavicular joint	70.3%	100.0%	100.0%	90.1%	92.0%

The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of USG as compared to standard (MRI) in detecting musculoskeletal pathologies/conditions of shoulder joint have been presented in above table. USG was found to have good sensitivity, specificity, and negative predictive value and predictive accuracy in detecting musculoskeletal pathologies/conditions of shoulder joint. The negative predictive value of USG was good for all the component except for supraspinatus.

4. DISCUSSION

Musculotendinous pathologies was the most common cause of shoulder pain in my study. MRI is the investigative modality of choice used to assess the Musculotendinous pathologies and is sensitive and specific, but it cannot be used as a first line of investigation due to cost factor and availability. Ultrasonography being relatively inexpensive and non- invasive can be used as a first line imaging modality to assess Musculotendinous pathologies.

This is a prospective study of 100 patients who presented with shoulder pain or restricted movements. The patients were subjected to USG examination of the shoulder joint and then MRI examination of the affected shoulder joint was performed. Findings of USG were compared with MRI findings.

The patients included in this study were between 12 and 60 years of age, with a mean age of $37.35^{+/-}$ 12.023 years. Musculotendinous pathologies were more commonly found in patient's age between 21-50 years. Many studies have concluded that rotator cuff degeneration and subsequent musculotendinous pathologies increase with age. Tempelhof et al J Shoulder Elbow Surg 1995;4;409-15 showed that degenerative changes in rotator cuff tendons increase with increasing age and tears were more commonly found in patients in the fourth and fifth decades[5]. In our study, 80 (80%) were male patients and only 20 (20%) patients were female.

Various Musculotendinous pathologies were studied. The pathologies include tendinosis, partial thickness tear and full thickness tear of the rotator cuff tendons. Supraspinatus is the commonest tendon to be affected in this study group (90 %) of the patient presented with shoulder joint pain, followed by the infraspinatus (27%) and subscapularis tendon (15%). These results were consistent, in which supraspinatus abnormalities occurred in 78% of the cases and no tear was noted without the involvement of supraspinatus tendon[97]. Zlatkin et al2nd ed. Philadelphia: Lippincott Williams and Wilkins; 2003 also showed that complete and full thickness tears are more frequent in supraspinatus tendon[6].

M Vlychou et al[7] Acta Radiol concluded in their study of 56 patients with symptomatic impingement syndrome who underwent USG and MRI scans prior to surgical intervention, that both imaging modalities successfully detected 44 cases of partial tears of the supraspinatus tendon. USG imaging had a sensitivity of 95.6%, a specificity of 70%, an accuracy of 91% and a positive Predictive value of 93.6%.

In Infraspinatus tendon pathologies amongst the patients with tendonitis, USG could detect the condition in 75.0% patients (12 patients out of 16 patients diagnosed with tendinosis on MRI). Amongst the patients with partial thickness tear, USG could detect the condition in

80.0% patients (8 patients out of 10 patients diagnosed with partial thickness tear on MRI). Amongst the patients with full thickness tear, USG could detect the condition in 100.0% patients (1 patients out of 1 patients diagnosed with full thickness tear on MRI). There was a statistically significant strong agreement between findings of MRI and USG. Overall USG in Infraspinatus tendon pathologies showed 77.8 % sensitivity, 97.2 % specificity, 91.3 % PPV, 92.2 % NPV and an accuracy of 92 %.

In subscapularis tendon pathologies amongst the patients with tendonitis, USG could detect the condition in 62.5% patients (5 patients out of 8 patients diagnosed with tendinosis on MRI). Amongst the patients with partial thickness tear, USG could detect the condition in 100.0% patients (5 patients out of 5 patients diagnosed with partial thickness on MRI). Amongst the patients with full thickness tear, USG could detect the condition in 100.0% patients (2 patients out of 2 patients diagnosed with full thickness on MRI). There was a statistically significant strong agreement between findings of MRI and USG. Overall Subscapularis tendon pathologies showed 80 % sensitivity, 98.9 % specificity, 92.3 % PPV, 96.5 % NPV and an accuracy of 96% and significance of P value <.05.

In Teres minor tendon pathologies amongst the patients with tendonitis, USG could detect the condition in 80.0% patients (4 patients out of 5 patients diagnosed with tendinosis on MRI). None of the patient had partial thickness or full thickness tear. There was a statistically significant strong agreement between findings of MRI and USG. Overall Teres minor tendon pathologies showed 80 % sensitivity, 98.9 % specificity, 80 % PPV, 98.9 % NPV and an accuracy of 98 % and significance of P value <.05. In a study conducted by Gilles et al The Journal of Bone and Joint Surgery 1998;80B(4):624-8 which included 2436 shoulder examinations, teres minor abnormality was noted in only 0.8% of the patients[8].

In Biceps tendon pathologies amongst the patients with tendonitis, USG could detect the condition in 88.9% patients (8 out of 9 patients with tendinosis on MRI). None of the patients had partial thickness tear and full thickness tear[9]. There was a statistically significant strong agreement between findings of MRI and USG.

By USG, tendinosis is detected by focal thickening of the tendon and altered echopattern. In MRI, tendinosis presents as moderately increased signal intensity in short TE sequences such as T1 weighted and PD sequences while this increased signal intensity is not as high as fluid signal in T2 weighted sequence. These signal changes are seen along the long axis of the tendon, which may be focal or diffuse[10]. On fat saturated sequences, the increased signal of tendinosis is as high as fluid and it should be differentiated from fluid signal seen in cases of tear. Severe tendinosis presents as diffuse thickening.

Partial thickness tear is detected by USG as focal discontinuity/ hypoechogenicity at the bursal or articular surfaces of the tendon. In MRI, partial thickness tears presents as a focal tendon fiber discontinuity with focal areas of hyperintensity on both short and long TE sequences on the articular or bursal surfaces. The hyperintensity does not extend through the entire thickness of the tendon. Articular surface tear are more common than the bursal surface tear. The articular surface is hypovascular compared to the bursal surface, this in conjunction with decreased tendon cellularity and collagen fragmentation with increasing age results in more articular surface tear than bursal surface tear.

5. CONCLUSION

Musculotendinous pathologies are common clinicalproblem, however their clinical presentation can be mimicked by other pathologies in the shoulder which may be present in isolation or in association with tendon pathologies. Clinical evaluation does not provide adequate insight into the patients‟ problem and hence is a poor guide to management

protocols. Imaging evaluation is mandatory for the diagnosis and management of the patients. Ultrasound evaluation provides extensive information in patients with clinically suspected musculotendinous pathologies and shows a good correlation to MRI. As USG is a dynamic study, cost effective , and easily available so can be used as the initial imaging modality in these patients..MRI evaluation in patients with clinically suspected musculotendinous pathologies provides a more complete evaluation of all components of the shoulder joint. But due to its limitations like less availability, high cost and low patient compliance UGS overcomes all these limitations.

6. REFERENCES

1. Quillen DM, Wuchner M, Hatch RL. Acute shoulder injuries. Am Fam Physician 2004 Nov 15;70(10):1947-54.
2. Susan Standring. Gray‟s Anatomy: The anatomical basis of clinical practice. 39th ed. Spain: Elsevier; 2008. pp.625-35.
3. Sharlene A. Teefey, William D. Middleton, William T. Payne, Ken Yamaguchi. Detection and measurement of rotator cuff tears with sonography: Analysis of diagnostic errors. AJR 2005 Jun;184:1768-73.
4. Joseph O De Jesus, Laurence Parker, Andrea J Frangos, Levon N Nazarian. Accuracy of MRI, MR Arthrography, and Ultrasound in the diagnosis of rotator cuff tears: A Meta-analysis. AJR 2009 Jun;192:1701-7.
5. Tempelhof S, Rupp S, Seil R. Age related prevalence of the rotator cuff tears. J Shoulder Elbow Surg 1995;4;409-15.
6. Zlatkin MB. Rotator cuff disease. MRI of the Shoulder. 2nd ed. Philadelphia: Lippincott Williams and Wilkins; 2003.
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 Radiol. 2009; 50(1):101-5.
7. Jerosch J, Muller T, Castro WHM. The Incedince of Rotator cuff rupture: An Anatomic Study. Acto orthopaedica Belgca 1991;57(2):124-9.
8. Kang CH, Kim SS, Kim JH, Chung KB, Kim YH, Oh YW, Jeong WK, Kim BH. Supraspinatus tendon tears: comparison of 3D US and MR arthrography with surgical correlation. Skeletal radiology. 2009 Nov 1;38(11):1063-9
9. Seeger LL. Magnetic resonance imaging of the shoulder. Clin Orthop 1989;244:48.
10. Kieft GJ, Dijkmans BA, Bloem JL. Magnetic resonance imaging of the shoulder in patients with rheumatoid arthritis. Ann Rheum Dis 1990;49:7.