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ORIGINAL ARTICLE

Role Of High-Resolution Ultrasound In Diagnosis Of Rotator Cuff Tendinopathies And Tears.

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ABSTRACT

Keywords: Rotator Cuff tear, MRI, US, tendinopathy

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Background - A rotator cuff tear (RCT) is a common source of shoulder pain Imaging modalities commonly used for the detection of RCTs include magnetic resonance imaging (MRI) and ultrasound (US).**Purpose** - to assess the efficacy of US in the diagnosis of rotator cuff tendinopathies and tears, by using ultrasound in comparison to MRI .**Material and Methods** - This study was conducted on 30 patients with shoulder pain They underwent ultrasound and MRI of the affected shoulder . **Results** - MRI was used as a reference test and found that; (53.3%) among the cases had tendinopathy, (36.7%) had a partial thickness tear and (10%) had a full thickness tear. We used US as an Index test and found that , (50%) among the cases had tendinopathy, (40%) had partial thickness tears and (10%) had full thickness tears. There was a significant relation between the findings of ultrasound and MRI in the diagnosis of rotator cuff tendinopathy and tears. **Conclusion** - Ultrasonography is a cost-effective imaging modality for screening rotator cuff disorders because it is non-invasive, non- ionizing, widely available , and has the advantage of dynamic real-time assessment

INTRODUCTION

Imaging plays a vital role in diagnosing musculoskeletal disease or injury. Concerning to rotator cuff injuries, ultrasound (US) and magnetic resonance imaging (MRI) are the two most commonly used modalities.(1)

Rotator cuff diseases are the most common cause of shoulder symptoms, accounting for 65% to 70% of cases and leading to approximately 4.5 million physician visits per year in the United States.(2)

US and MRI have been commonly used for the characterization of rotator cuff disorders. With the advent of high-end US machines, the accuracy rates of the US are comparable to that of MRI in the evaluation of rotatorcuff pathologies. (3) MRI provides excellent soft-tissue detail and has the multiplanar capability. (4)

The US of the shoulder was done in both static and dynamic positions. The rotator cuff was assessed for integrity, thickness, and echo pattern. Tendinopathy has an inhomogeneous appearance with thickened tendons or abnormally thin tendon**s.** (5) US agreement to MRI for the supraspinatus tendon assessment was90% for full-thickness tears and 85.5% for partial-thickness tears so that the US can be used to rule out complete supraspinatus tears. (6) There was good agreement between the

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US and MRI for the diagnosisof rotator cuff pathologies. [7]

Therefore, this study aims to assess the efficacy of the US in the diagnosis of rotator cuff tendinopathies and tears, by using ultrasound as a rapid, available, cheap, and dynamic modality in comparison to MRI.

MATERIAL AND METHODS

prospective study was conducted on 30 patients who present with shoulder pain and/or disability suspected of rotator cuff tendon tears or tendinopathies and were referred to the radiology department of Aswan University hospital for ultrasonography and magnetic resonance imaging. Patients with any age group of either gender with pain and/or disability involving the shoulder were included in the study whether had a traumatic history or not. Patients with contraindications to MRI are as follows: Absolute: Ferromagnetic or electronically operated stapedial implants. Relative: Electronically, magnetically, and mechanically activated implants, Non-ferromagnetic stapedial implants. Cochlear implants. Prosthetic heart valve and Hemostatic clips (body) were excluded

After taking the informed, and written consent of each patient, detailed clinical history was recorded and general physical and local examinations were done. After the shoulder ultrasound was done, the shoulder MRI was done as a gold standard scan to correlate the ultrasound results

Ultrasonography technique and patient position: Imaging was done with GE LOGIQ S8 and GE LOGIQ P7 machines using a linear high-frequency probe. A high-resolution real-time ultrasound examination of the involved shoulder was done with an examination of the contralateral normal shoulder for comparison. Shoulder ultrasound examinations were performed in a standardized fashion, with the subject in a seated position.

Magnetic Resonance Imaging technique: Examinations were performed with a 1.5 Tesla magnet MRI (Toshiba Vantage Titan, Japan) with the patient lying in a supine position and shoulder placed in the shoulder coil . The protocol used was coronal proton density (field of view, 16-17 cm; matrix, 512×384; repetition time/echo time range, 1500-3000/20-30); sagittal protondensity (field of view, 16-17 cm; matrix range, 256-512×224-384; repetition time/echo time range, 1500-3000/20-30); axial T2 fat-suppressed (field of view, 16-19 cm; matrix range, 256-304×224-235; repetition time/echo time range, 2685-2839/60-100); and coronal T2 fat-suppressed (field of view, 16-18 cm; matrix range, 256×192-224; repetition time/echo time range, 2800-3643/60-75)

Data management and Statistical Analysis

Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0). P-value: level of significance $P > 0.05$: Non-significant (NS).$P < 0.05$: Significant (S), $P < 0.01$: Highly significant (HS). Mean, Standard deviation (± SD) and range for parametric numerical data, while Median and Inter-quartile range (IQR) for non- parametric numerical data. Kruskal-Wallis test was used to assess the statistical significance ofthe difference of a non-parametric variable between more than two study groups.

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RESULTS

The age of the studied group ranged from 22 – 70 years with mean±SD of 41.37±14.04 years. The studied group included 12 females (40%) and 18 males (60%).

Table (1): Socio-demographic data of the studied group (n =30).

		n =30
Age (years)	Mean±SD Range	41.37±14.04 22 – 70
Gender	Male Female	12 (40%) 18 (60%)

Table (2): Clinical history of the studied group (n =30)

		n =30
Etiology of pain	Traumatic Non traumatic	10 (33.3%) 20 (66.7%)
Affected muscle	Supraspinatus Infraspinatus Subscapularis Teres minor	22 (73.3%) 4 (13.3%) 4 (13.3%) 0
Affected side	Right Left	25 (83.3%) 5 (16.7%)

(Table 2) shows that 33.3% of pain is due to traumatic cause while 66.7% of it is due to non-traumatic cause. 83.3% among patients have affected right side

Table (3): Ultrasound findings among the studied group (n =30).

		n =30
	No.	**%**
Tendinopathy	15	50
Partial tear	12	40
Full thickness tear	3	10
Gap	3	10
No gap	27	90
Associated injuries **Biceps tenosynovitis** **ACJ osteoarthritis**	 7 5	 23.3 16.67

ACJ: acromio-clavicular joint

Table (4): MRI findings among the studied group (n =30).

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		n =30
	No.	**%**
Tendinopathy	16	53.3
Partial tear	11	36.7
Full thickness tear	3	10
Associated injuries Biceps tenosynovitis ACJ osteoarthritis	 7 5	 23.3 16.7

Table (1): US findings with reference to MRI findings among the studied group (n=30

	MRI findings n =30			
Us findings	**Tendinopathy (n =16)**	**Partial tear (n =11)**	**Full thickness tear (n =3)**	
Tendinopathy	14 (87.5%)	0	1 (33.3%)	**<0.0001***
Partial tear	2 (12.5%)	10 (90.9%)	0	
Full thickness tear	0	1 (9.1%)	2 (66.7%)	

Table (5) shows a significant relation between the findings of ultrasound and MRI in the diagnosis of Rotator cuff tendinopathy and tendon tear (p-value <0.0001)

Table (6): Accuracy of ultrasound in the detection of Rotator cufftendinopathy with reference to MRI (n =30).

	MRI findingsn =30		
Tendinopathy	15 (TP)	1 (FP)	16
No tendinopathy	1 (FN)	13 (TN)	14
Partial tear	10 (TP)	2 (FP)	12
No tear	1 (FN)	17 (TN)	18

TP: true positive FP: false positive TN: true negative FN: false negative

Table (7): Accuracy of ultrasound in the detection of Rotator cuffcomplete tear with reference to MRI (n =30).

	MRI findingsn =30		
US findings	**Full thickness tear**	**No tear**	**Total**
Full thicknesstear	3 (TP)	0 (FP)	3
No tear	0 (FN)	27 (TN)	27
Total	3	27	30

TP: true positive FP: false positive TN: true negative FN: false negative

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Table (7) shows that the sensitivity of ultrasound to detect partial tear with reference to MRI is 90.9% (10/11*100), the specificity is 89.5% (17/19*100), the positive predictive value is 83.3% (10/12*100) and the negative predictive value is 94.4% (17/18*100).

Fig.1. US and MRI of 41 y Male patient presented with trauma to the right shoulder 1 month ago, now presented to the orthopedic outpatient clinic with shoulder pain and limitation of movement.

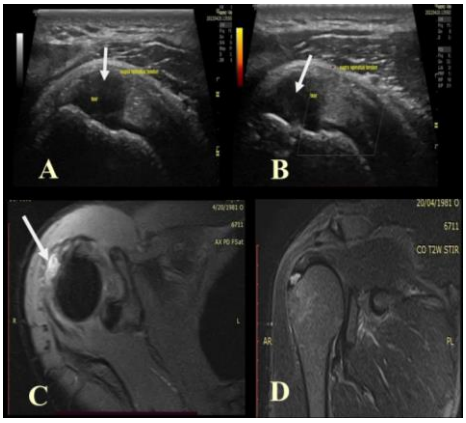

Fig.1. (A,B) Transverse section in right shoulder in crass position revealed evidence of full thickness tear of the supraspinatus tendon (white arrows) with 1 cm gap filled with fluid collection . (C, D) Coronal and axial MRI of the right shoulder revealed a 1cm fullthickness tear of the supraspinatus tendon (white arrows)

Fig.2. US and MRI of 22 y Male patients with history of motor car accident 2weeks ago and no fractures detected.

Fig.2. (A) Transverse US plain on the right shoulder revealed a full thickness tear on supraspinatus tendon at its attachment site (white arrow).
Fig .2. (B, C) Coronal T2 images of MRI scan of the right shoulder revealed full thicknesstear of the supraspinatus tendon at its attachment site (white arrows) with gab measures 1.2 cm.

DISCUSSION

Rotator cuff disorders, which include partial and complete tendon tears as well as degenerative and inflammatory changes, are the most common causes of shoulder symptoms, accounting for more than half of all chronic shoulder diseases.[8]

In the present study, the age of the studied group ranged from 22 – 70 years**.** In consistence with many studies as ***Taljanovic et al, (2020)***[9] where the majority of patients with shoulder painin their

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research were between the ages of 41 and 50 (60%),as well as ***Allman, (2021)[10]*** study, the patients (66%) were between the ages of 41 and 60,in the same line ***Arce et al., (2018)[11]*** reported the distribution of patients with shoulder pain as per age group was 8 (20%) patients in 20–40 years of age group. The prevalence of shoulder pain increases with (36.7%) increasing The patients' ages with rotator cuff problems in ***Koganti et al., (2022)[12]*** study varied from 19 to 66 years.

Regarding gender in our study, we found male predominance represented 60% and females were 40%,in accordance with many studies as ***Koganti et al., (2022) [12]*** who enrolled total of 40 patients; 26 males [65%] and 14 female [35%], in addition ***Bashir et al., (2014)[13]*** who found that there were 28 (56%) males and 22 (44%) females.

Among our patients 83.3% had affected right side in harmony with ***Bashir et al., (2014)[13]*** where the majority of patients (70%) had involvement ofthe right shoulder,and with ***El-Shewi et al., (2019)[14]*** who reported the frequency and the percentage of affection of the right and left shoulder side were 34 patients (68%) and 16 patients (32%), respectively. It is suggested that dominant arm is more susceptible to wearing effects, leading to rotator cuff tears and tendinopathy ***(Ahmad et al., 2018)[16]***

In our study, supraspinatus muscle was the most affected muscle (73.3%) followed by infraspinatus and subscapularis (each 13.3%). In agreement with ***Ahmad et al., (2018)[16]*** with maximum number of patients had supraspinatus tears (86.7%), followed by subscapularis (6.7%) and infraspinatus (3.3%) tears and with ***Vijayvargiya et al., (2014)[17]*** who found out that Supraspinatus tendon was the commonest tendon to be involved in his study (90%).

In the present study; US and MRI show a significant relation between the findings in the diagnosis of Rotator cuff tendinopathy and tendon tear (p-value <0.0001). This relation was reported in many studies as ***Ahmad et al., (2018)[15]*** who reported the agreement between the two methods was assessed usingkappa coefficient (kappa = 0.714).As well as ***Bashir et al., (2014)[13]*** found the strength of agreement between US and MRI for the diagnosis of rotator cuff tears and ***Rutten et al., (2010)[17]*** reported that agreement between US and MRI was high (the kappa coefficient was calculated to be 0.78).

US had high sensitivity, specificity, the positive predictive value PPV and negative predictive value NPV with reference to MRI in the present study.

In harmony with ***Refaat et al., (2021)[18]*** study as US showed a sensitivity, specificity, PPV, NPV and accuracy of 100% for each in diagnosing full thickness tear of supraspinatus tendon using MRI as reference. The level of sensitivity and specificity seen in our study differs from ***Cullen et al., (2007)[19]*** study which reported a sensitivity of 79% and specificity of 94% in detection of partial thickness tears. These results are not in accordance with another study by ***Melanie and Grey, (2005)[20]*** that reported the very high sensitivity of ultrasonography in detection of different types of partial-thickness rotator cuff tears. According to previous study ***Narasimhan et al., (2016)[21]*** study found that ultrasound could be considered as a tool with high sensitivity in detecting rotatorcuff large size tears, but had no significant diagnostic sensitivity in detecting small tears.

In the present study, we detected associated injuries as bicepstenosynovitis among 7 cases (23%) and ACJ osteoarthritis in 5 cases(16.675%) by MRI. Illustrated the US sensitivity, specificity and accuracy of 100% for each, in accordance with ***El-Shewi et al., (2019)[14]*** study who reported high diagnostic value of US with sensitivity, specificity, and accuracy of 100% for each in detection of bicep tenosynovitis .

CONCLUSION

US is a good, rapid and cost effective modality in evaluation of the rotator cuff disorders. It demonstrated high sensitivity and specificity for full thickness tears while having lower sensitivity

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and specificity for partial thickness tears and tendinopathy. US may be the most cost-effective imaging method for screening rotator cuff disorders because it is non-invasive, non- ionizing, widely available, and has the advantage of dynamic real-time assessment.

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