

Role of Ultrasound in Diagnosis of Common Shoulder Lesions

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Abstract

Background: The advantages of USG include low cost, accessibility, and capability for real-time high-resolution imaging that enables a dynamic assessment. Dynamic examination of shoulder can be carried out in multiple planes and areas of concern can be focused promptly to make a diagnosis. **The aim of this study** was to evaluate the role of ultrasound in diagnosis of common shoulder joint lesions. **Methods:** Our cross-sectional study was carried on 36 patients who were referred from outpatient clinics to the radiology department with shoulder complain. The first assessment was done by US and finally confirmed by MRI as a gold standard. **Results:** US predicted patients with SSP tendinopathy, with accuracy, sensitivity, specificity, PPV and NPV was 55.6%,100%, 72.7%, 70% and 100% respectively ($p < 0.001$). US was able to predict patients with SSP partial tear, with accuracy, sensitivity, specificity, PPV and NPV was 88.9%,80%, 100%, 100% and 80% respectively ($p < 0.001$). US was able to predict patients with SSP full thickness tear, with accuracy, sensitivity, specificity, PPV and NPV was 100%,100%, 100%, 100% and 100% respectively ($p < 0.001$). US was able to predict patients with Biceps long head tenosynovitis with accuracy, sensitivity, specificity, PPV and NPV was 94.4%,100%, 91.7%, 85.7% and 100% respectively ($p < 0.001$). **Conclusion:** USG can be used as an initial line of investigation for evaluation of all patients who are clinically suspected to have rotator cuff disorders which are the most common cause of shoulder pain.

Keywords: Ultrasound; Diagnosis; Shoulder; Lesions

Introduction

Shoulder movement is controlled by static and dynamic stabilizers. The static stabilizers are joints (glenohumeral, acromioclavicular, sternoclavicular and the scapulothoracic unit, ligaments and glenoid labrum (1).

The dynamic stabilizers are the muscles and tendons of rotator cuff and the biceps and coracobrachialis, and deltoid scapulothoracic unit. Ultrasound is particularly effective in assessing the dynamic stabilizers of the rotator cuff (1).

Rotator cuff disease, shoulder impingement syndrome and subacromial bursitis are the most common diagnoses reported on shoulder ultrasonography. The most common rotator cuff abnormality is found to be supraspinatus full thickness tear, supraspinatus partial thickness tear and supraspinatus tendinosis (2).

Musculoskeletal ultrasound has become an attractive and effective modality to image the musculoskeletal system and for some conditions has established itself the first line examination technique (3).

Advantages of US include lower cost, easy access, and high degree of accuracy in

expert hands, ease of comparison with the opposite side, dynamic real time examination, ability to focus on the exact site of the patient. The main disadvantage of musculoskeletal ultra-sound is a high degree of operator dependency with a steep and prolonged learning curve. This drawback is minimized by the introduction of a new generation of ultrasound scanners coupled with great advances in transducer technology and graded compression availability (4).

The study was done to evaluate the role of ultrasound in diagnosis of common shoulder joint lesions

Patients and methods

This cross-sectional observational study was carried on 36 patients who were referred from outpatient clinics to the radiology department of Elhelal hospital at Shebin Elkom, during the period from May 2019 to January 2021.

After approval from ethical committee of Benha faculty of Medicine, an informed consent was obtained from all patients in this research. All data of patients had been confidential with secret codes and private file for each patient. Every patient received

an explanation for the purpose of the study. All given data were used for the current medical research only.

Patient inclusion criteria:

Patients with any shoulder complain and the clinician suggested shoulder U/S examination as a primitive evaluation and US diagnosis correlated with MRI examination.

All patients were subjected to the following:

- Full history taking
- Full clinical examination
- Ultrasound examination

Ultrasound examination is correlated with the final diagnosis based on clinical and other imaging modalities

Scanning technique

Patients start by sitting position with 90° flexion of the elbow joint and the hand supinated on top of the patient's thigh. For a dynamic examination, active and / or passive external and internal rotation of the humerus over the full range of motion with 90° flexed elbow is recommended. High frequency (7.5–20 MHz), linear transducers are generally best for demonstrating superficial structures such as tendons,

ligaments and joints. Color and power Doppler imaging provide color maps of tissues which may be of use in assessment of vascular tissues as may occur in soft tissue inflammation.

Standard scans

- Anterior transverse and longitudinal scan in neutral position for BLH
- Anterior transverse and longitudinal scan in maximal internal rotation for supraspinatus muscle
- Anterior longitudinal scan in external rotation position for subscapularis muscle
- Posterior transverse scan for infraspinatus and teres minor muscles
- Acromioclavicular joint scan (5).

Image interpretation

Assessment occurred according to tendons findings as (thickness, echotexture, calcification vascularity, partial or full thickness tear with gap or no), bony findings as (irregularities, osteophytes, lesions, joint space widening) and bursal effusion and inflammation

Statistical analysis

This study is a combination of individual diagnostic tests for each of the target

findings. The collected data was revised, coded, tabulated and introduced to a PC using Statistical package for Social Science (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.). Data were presented and suitable analysis was done according to the type of data obtained for each parameter. Descriptive statistics: Frequency and percentage of non-numerical data.

Results

Patients' age ranged between 39 years to 60 years with mean \pm SD= 50.94 \pm 5.99 years. In grouping of the ages, 32 (88.9%) patients were less than 60 years and only 4 (11.1%) patients were more than 60 years. 16 (44.4%) patients were males and 20 (55.6%) of them were females with male to female ratio of 1:1.25. 20 (55.6%) of the lesions were on the left side. 20 (55.6%) patients had SSP tendinopathy, 16 (44.4%) patients had SSP partial tear, 6 (16.7%) patients had SSP full thickness tear, 14 (38.9%) patients had Biceps long head tenosynovitis, 32 (88.9%) patients had SASD bursitis and 8 (22.2%) patients had ACJ arthritis. 8 (22.2%) patients had history of trauma. 12 (33.3%) patients had sub coracoid bursitis

and 4 (11.1%) patients had supraspinatous calcifica tendinopathy. table 1

By using ROC-curve analysis, US predicted patients with SSP tendinopathy, with accuracy, sensitivity, specificity, PPV and NPV was 55.6%,100%, 72.7%, 70% and 100% respectively ($p < 0.001$) (Fig. 1).

By using ROC-curve analysis, US was able to predict patients with SSP partial tear, with accuracy, sensitivity, specificity, PPV and NPV was 88.9%,80%, 100%, 100% and 80% respectively ($p < 0.001$) (Fig. 2).

By using ROC-curve analysis, US was able to predict patients with SSP full thickness tear, with accuracy, sensitivity, specificity, PPV and NPV was 100%,100%, 100%, 100% and 100% respectively ($p < 0.001$) (Fig. 3).

By using ROC-curve analysis, US was able to predict patients with Biceps long head tenosynovitis with accuracy, sensitivity, specificity, PPV and NPV was 94.4%,100%, 91.7%, 85.7% and 100% respectively ($p < 0.001$) (Fig. 4).

In our study, 36 (100%) patients showed SASD bursitis on MRI whereas on ultrasonography examination out of 36

patients 32 (88.9%) patients showed SASD bursitis.

By using ROC-curve analysis, US predicted patients with ACJ arthritis with accuracy, sensitivity, specificity, PPV and NPV was 94.4%,80%, 100%, 100% and 92.9% respectively ($p < 0.001$) (Fig. 5).

By using ROC-curve analysis, US was able to predict patients with Sub coracoid bursitis with accuracy, sensitivity, specificity, PPV and NPV was 83.3%,80%, 84.6%, 66.7% and 91.7% respectively ($p < 0.001$) (Fig. 6).

On ultrasonography examination out of 36 patients, 8 (22.2%) patients showed history of trauma, and out of 36 patients, all of them (100%) patients showed supraspinatus calcifica tendinopathy on MRI whereas on ultrasonography examination 4 (11.1%) patients showed supraspinatus calcifica tendinopathy.

Case 1(fig. 7) Clinical data: Male patient 41 years old presented with left shoulder severe pain which occurred suddenly after lifting heavy weight. **U/S ex:** Showed supraspinatus full thickness tear with gap 35mm, sub-acromial sub deltoid bursitis mild. **Final diagnosis:** Avulsed supraspinatus muscle tear and mild sub-acromial sub deltoid bursitis based on MRI

Case 2 (f. 8) Clinical data: Female patient 39 years old presented with right shoulder progressive pain and progressive decrease shoulder movement one month after falling to the ground rigidly on his left shoulder. **U/S ex:** Showed supraspinatus muscle full thickness tear with retracted fibers and long head biceps tenosynovitis. **Final diagnosis:** supraspinatus muscle full thickness tear, long head biceps muscle tenosynovitis, mild sub-acromial sub deltoid bursitis and mild sub coracoid bursitis based on MRI

Table 1: clinical data of the studied group

	No (36)	%
Sex		
Male	16	44.4
Female	20	55.6
Age mean \pmSD (range)	50.94 \pm 5.99 (39.0-60.0)	
<60	32	88.9
\geq 60	4	11.1
Side		
Rt	16	44.4
Lt	20	55.6
SSP tendinopathy		
Yes	20	55.6
No	16	44.4
SSP partial tear		
Yes	16	44.4
No	20	55.6
SSP full thickness tear		
Yes	6	16.7
No	30	83.3
Biceps long head tenosynovitis		
Yes	14	38.9
No	22	61.1
SASD bursitis		
Yes	32	88.9
No	4	11.1
ACJ arthritis		
Yes	8	22.2
No	28	77.8
History of trauma		
Yes	8	22.2
No	28	77.8
Sub coracoid bursitis		
Yes	12	33.3
No	24	66.7
Supraspinatous calcifica tendinopathy		
Yes	4	11.1
No	32	88.9

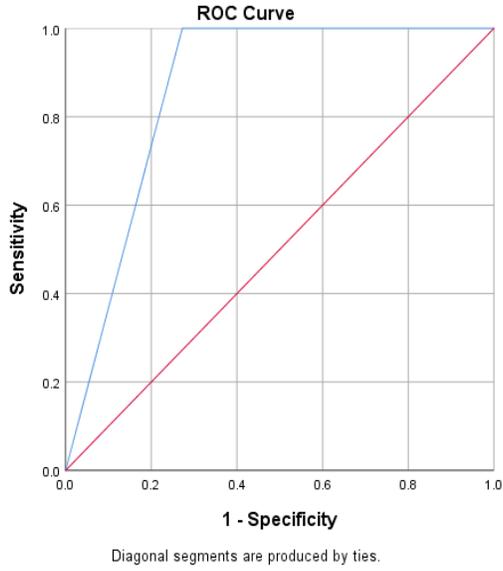


Figure 1: ROC curve of U/S in prediction of SSP tendinopathy.

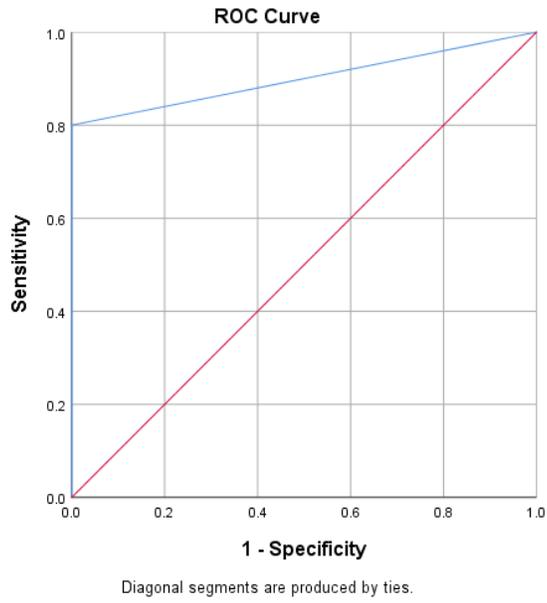


Figure 2: ROC curve of U/S in prediction of SSP partial tear.

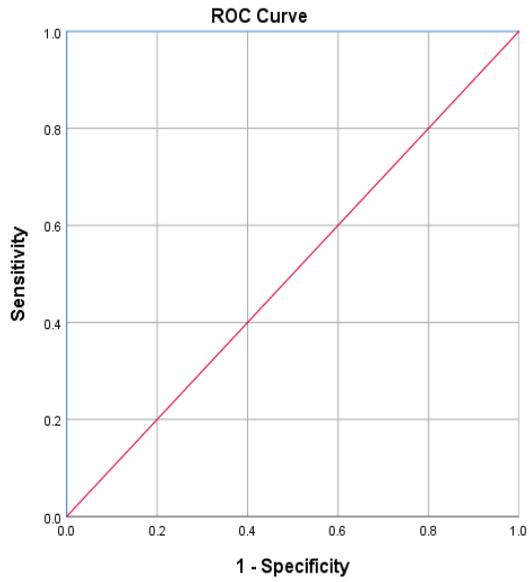


Figure 3: ROC curve of U/S in prediction of SSP full thickness tear.

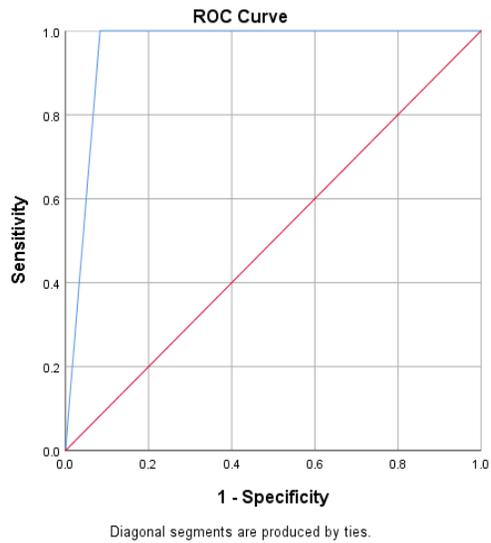


Figure 4: ROC curve of U/S in prediction of Biceps long head tenosynovitis

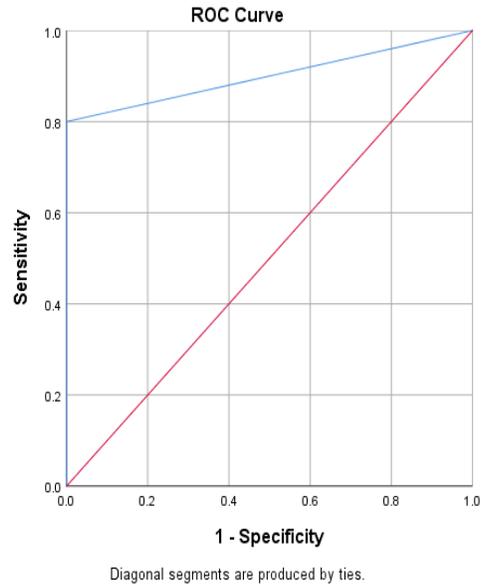


Figure 5: ROC curve of U/S in prediction of ACJ arthritis.

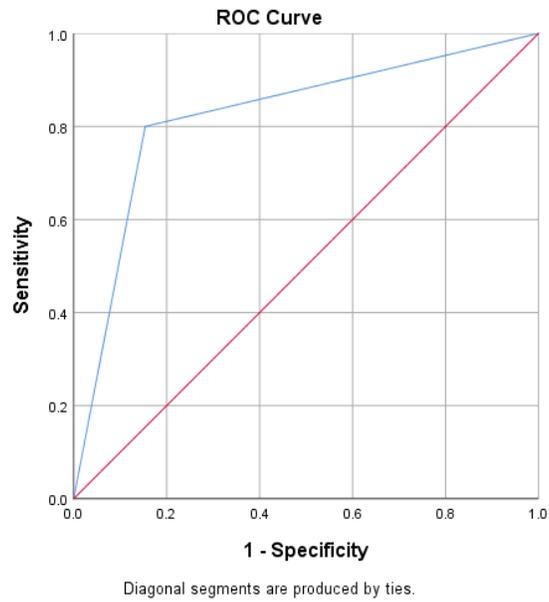


Figure 6: ROC curve of U/S in prediction of Sub coracoid bursitis.

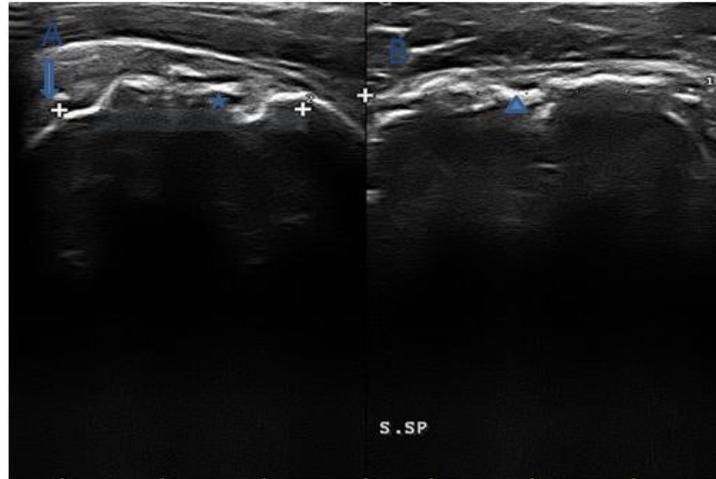


Figure (7 A ,B) longitudinal view (A) of Supraspinatous showed irregular outline of of retracted Supraspinatous tendon (arrow) with gap35mm and irregular detached bony cortex (star) at its humeral attachment. (B)Transverse view showed effusion (arrow head) around features of complete Supraspinatous full thickness tear with Mild Sub acromial sub deltoid bursitis

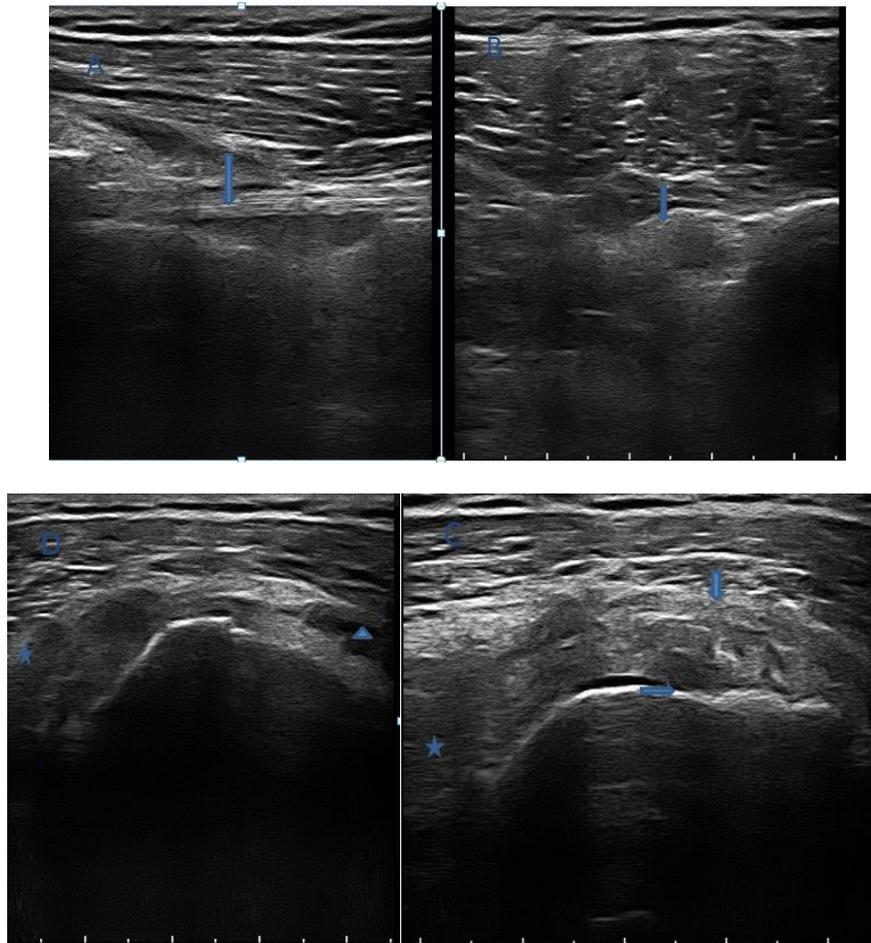


Figure (8 a,b,c,d) Longitudinal view(a) of Biceps long head muscle show tendon irregularitis and loss of its fibrillar structure (b)transverse view showed distention of its synovial sheath by fluid (arrow), Longitudinal view (c) view of Supraspinatous muscle showed retracted muscle from its insertion with gap 9mm(transverse arrow) ,preserved muscle bulk with irregular

borders (star)herniated Deltoid muscle and fibrous tissue(short arrow) (d)Transverse views showed the same features plus SASD effusion

Discussion

The aim of this study was to evaluate the role of ultrasound in diagnosis of common shoulder joint lesions. A cross sectional study was carried on patients with shoulder complain who were referred from outpatient clinics to the radiology department first assessment by US and finally evaluated by MRI as a gold standard The duration of the study ranged from 6-12 months.

Our results were supported by a previous study (6), as they included 50 patients, 32 females and 18 males, with an age range from 26 to 64 years (mean age 45 years); they all complained from painful shoulder; and 42 of them complaining from a limitation of movement. However, the frequency and the percentage of affection of the right and left shoulder side were 34 patients (68%) and 16 patients (32%), respectively.

The present study showed that 55.6% of the studied group had SSP tendinopathy, 44.4% of them had SSP partial tear and 16.7% had SSP full thickness tear. 38.3% of them had biceps long head tenosynovitis, 88.9% of them had SASD bursitis and 22.2 % of them

had ACJ arthritis. 22.2% of them had history of trauma, 33.3% had sub-coracoid bursitis and 11.1% of them had supraspinatus calcific tendinopathy.

However, another study (7), showed that sonographic alteration were found in a total of 28 (93.33%) patients, 14 (46.67%) had only one pathology, 12 (40%) had two pathologies and 2 (6.67%) had more than two pathologies. A total of 45 pathologies were detected. Supraspinatus tendon assessment revealed 6 cases of tendinosis (13.3%), 8 findings of at least a single calcification (17.78%) and 2 cases of tear (4.44%). Twelve (26.67%) patients had acromioclavicular (AC) joint osteoarthritis (OA). Bicipital synovitis and tendinosis were detected in 8 cases (17.78%). Infraspinatus tendinopathy, subscapularis tendinopathy and sub-caromial bursitis were present in small percentage.

In another study (8), rotator cuff disease was present in 81% of the patients, and 50% of them had multiple disorders. Calcific tendonitis was the most frequently diagnosed specific disorder. An age of 40 years or older was most strongly related to

rotator cuff disease. In another study (9), a total of 380 shoulders were assessed using musculoskeletal US imaging.

The most common pathology was due to subacromial disorders (83.8%), including rotator cuff tendinopathy (48.5%), calcific tendinitis (16.3%), partial- or full-thickness tear (15.5%), and subacromial bursitis (59.5%). Both US and MRI show high diagnostic accuracy in the evaluation of RC diseases. US are low cost, available and real time imaging modality with absence of contraindications such as pacemakers, which prevent the use of MRI. However, MRI is a gold standard and a unique imaging modality, as it allows better depiction of soft tissue structures. Conventional US sometimes cannot detect RC tendinopathy as the pathological tissue presents with same echogenicity as normal surrounding healthy tissue. SON elastography is a new US imaging technique that allows noninvasive estimation of tissue stiffness and elasticity. It is based on the fact that tissue compression produces displacement within the tissue, which is less in hard than in soft tissue (10).

Studies have shown that musculoskeletal US imaging has good sensitivity and specificity in diagnosing shoulder pathology.

Compared with MRI, musculoskeletal US imaging provides further advantages such as portability and offers real-time images, which are helpful in observing small and occult lesions. Therefore, musculoskeletal US has been widely used in the diagnosis of shoulder pain in developed countries (11).

USG gives clarification to the patient complaints and advises physicians regarding prognosis. For example, intermittent excruciating episodes are characteristic of calcific tendonitis. In day-to-day practice, it is necessary to always weigh the USG results and other findings from the clinical setting, as asymptomatic discoveries might be noted. USG might be helpful to inform treatment strategies for multiple causes of rotator-cuff disorders (12).

The current study showed that the use of US in prediction of SSP tendinopathy, is more valid than the use of MRI as there was highly statistically significant difference between it and that of MRI with sensitivity 100% and specificity 72.7%. As regard validity of US in prediction of SSP partial tear, there was highly significant difference between it and that of MRI sensitivity 80% and specificity 100%. As regard validity of US in prediction of SSP full thickness tear, there was highly significant difference

between it and that of MRI sensitivity 100% and specificity 100%.

As regard validity of US in prediction of biceps long head tenosynovitis, there was highly significant difference between it and that of MRI sensitivity 100% and specificity 91.7%. As regard validity of US in prediction of ACJ arthritis, there was highly significant difference between it and that of MRI sensitivity 80% and specificity 100%. As regard validity of US in prediction of sub-coracoid bursitis, there was highly significant difference between it and that of MRI sensitivity 80% and specificity 84%.

Our results were supported by a previous study (13) as they reported that comparing MRI, US sensitivity for tendinopathy detection was 81.3% with 95% specificity and 88.9% accuracy while for partial tears, its sensitivity, specificity and accuracy were 80%, 92.3% and 88.9% respectively. In full thickness tears its sensitivity, specificity, accuracy was 90%, 100% and 97.2% respectively. Compared to MRI, sono elastography sensitivity for tendinopathy detection was 93.8%, 95% specificity and 94.4% accuracy while for partial tears, its sensitivity, specificity and accuracy were 90%, 92.3% and 91.7% respectively and in

full tears were 90%, 100%, 97.2% respectively.

Other researchers (6) reported in their study that US was effective imaging modality for detection of Rotator cuff tears with an US agreement to MRI was 90% for full thickness tears and 85.5% for partial-thickness tears. This is in agreement to the present results.

In another study (14), the sensitivity and specificity of point-of-care ultrasonography for identifying dislocations were 100% (95% confidence interval [CI] 87% to 100%) and 100% (95% CI 87% to 100%), respectively. Point-of-care USG was 92% sensitive (95% CI 60% to 99.6%) and 100% specific (95% CI 92% to 100%) for non-Hill-Sachs/ Bankart's fractures of the humerus.

Conclusion

Our study proved that dynamic USG is a highly accurate, highly sensitive diagnostic modality in different types of the shoulder complains. USG can be used as an initial line of investigation for evaluation of all patients who are clinically suspected to have rotator cuff disorders which are the most common cause of shoulder pain. Dynamic examination and ability to compare findings

with contralateral shoulder were added advantages. It is proved to have high sensitivity and specificity for full thickness tears with relatively less sensitivity and specificity in detection partial thickness tear.

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