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ORIGINAL ARTICLE

Assessment of Shoulder Pain in Rheumatoid Arthritis Patients by using High Resolution Musculoskeletal Ultrasound

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ABSTRACT

Background: *Shoulder pain is a common complaints encountered in rheumatoid arthritis (RA) patients. Through the first two years of RA, nearly 50% of patients have shoulder symptoms, and 90% complain of shoulder pain at some time during the course of the disease.* ***Objectives:*** *to identify the ultrasound (US) abnormalities in RA patients with shoulder pain and to correlate them with clinical and laboratory parameters of the disease.* ***Methodology:*** *A case control cross sectional study was performed on 50 RA patients with shoulder pain satisfying the 2010 ACR/EULAR criteria, and 30 age and sex matched volunteers complain of shoulder pain serving as controls. US assessment was performed bilaterally in RA patient's shoulder and control's shoulder.* ***Results:*** *The most common shoulder image abnormalities in RA patients were subacromial-subdeltoid (SASD) chronic bursitis and glenohumeral joint (GHJ) effusion in 38% of patients' shoulders, acromioclavicular joint (ACJ) irregularity in 35% of patients' shoulders, and supraspinatus tendinopathy in 34% of patients' shoulders. There was a significant relation between shoulder pain and US detected full thickness tear of supra-spinatus tendon (p=0.025), SASD chronic bursitis (p=0.033), humeral bone irregularity (p=0.049), ACJ irregularity (p=0.002) and GHJ effusion (p=0.033). There was a significant relation between disease activity and US-detected humeral bone erosions (p=0.002), ACJ synovitis (p=0.021), and ACJ osteophytes (p=0.025).* ***Conclusion:*** *US imaging is an important additional tool that supplements conventional radiography of the shoulder joints in RA.*

INTRODUCTION

Shoulder pain a common complaints encountered in rheumatoid arthritis (RA) patients. Through the first two years of RA, nearly 50% of patients have shoulder symptoms, and 90% complain of shoulder pain at some time during the course of the disease [1].

In addition to the synovitis of the glenohumeral joint (GHJ), shoulder pain in RA arises from pathologies involving diverse periarticular soft tissues, and the involvement of more than one anatomical structure is common. Because it is difficult to recognize the site of anatomical changes by clinical examinations even in non-RA shoulders [2], accurate diagnosis and management of painful RA shoulder with clinical examination alone is frequently problematic.

Radiographic evaluation of peripheral joints has used as an objective standard for the assessment of RA progression. However, it is difficult to assess complicated anatomical structures such as the shoulder joint by using conventional radiography alone. Ultrasonographic (US) assessment is beneficial in diagnosing a variety of regional pain syndromes and soft tissue rheumatism and has been increasingly employed in the rheumatologic practice [3].

Given the notable improvement in resolution attained by high frequency ultrasound, it is predicted to serve as an important technique for precise assessment of RA shoulders. US examination detected more erosions in the GHJ in comparison with conventional radiography. In addition, US examination detected synovitis, tenosynovitis, and bursitis in a significant number of patients, demonstrating its role in the diagnosis of shoulder pain in RA patients [4].

The aim of the present work is to identify the US abnormalities in RA patients with shoulder pain and to correlate them with clinical and laboratory parameters of the disease.

METHODOLOGY

A randomized case control cross sectional study was performed on 50 RA patients with shoulder pain satisfying the 2010 ACR/EULAR criteria attending the Outpatient Clinics and Inpatient of Rheumatology Department of Ain Shams University Hospitals, and 30 age and sex matched volunteers complain of unilateral or bilateral shoulder pain serving as controls group.

Patients with other rheumatologic disorders (SLE, Spondyloarthropathy) endocrine disorders and traumatic diseases affecting the shoulder were excluded from the study.

All participants were subjected to full history taking, rheumatological examination, calculation of body mass index (BMI) laboratory, radiological investigations and

assessment of disease activity by using DAS28 ESR (for RA patients only) and Visual analogue scale model (VAS) after informed written consent approved by the Research Ethics Committee of the Faculty of Medicine, Ain Shams University were obtained.

Laboratory investigations:

- Complete blood count (CBC) performed on automated cell counter performed on coulter® LH 750 cell counter
- Serum c-reactive protein (CRP) done on the dimension® clinical chemistry system (cutoff value 3.0 mg/L)
- Erythrocyte sedimentation rate (ESR) according to westergren's method
- Alanine aminotransferase (ALT) and Aspartate aminotransferase (AST) done on Beckman coulter AU 480 system
- Rheumatoid Factor (RF) by latex agglutination done by AVITEX RF latex kit (cut off value 15 IU/mL)
- Anti-cyclic citrullinated peptide (anti-CCP) determined using the method of enzyme linked immunosorbant assay (ELISA) with titer and considered positive (cutoff value 20 IU/mL)

Radiological investigations:

X-ray: plain radiography of the shoulder joint in the postero-anterior view for the presence of

- Periarticular osteopenia
- Erosion
- Joint space abnormality
- Osteophyte
- Calcification

High resolution Ultrasonographic (HRUS): US examination of the shoulder by using a linear array 6-18 MHz transducer Investigations included both static and dynamic evaluation in both transverse and longitudinal planes of

- Long head of the biceps
- Supraspinatus, infraspinatus, and subscapularis tendons
- SASD bursa and sub-coracoid bursa
- GHJ and ACJ

Tendon thickness, echogenicity, homogeneity of the fibrillar pattern, and the presence of calcification was noted. In all subjects, images of both shoulders were obtained to compare US findings between two shoulders when there was unilateral shoulder pain. Synovitis, erosions and tenosynovitis were defined according to the OMERACT definitions: Synovitis appears as an abnormal hypoechoic (relative to subdermal fat, but sometimes may be isoechoic or hyperechoic) intra-articular tissue that is non-displaceable and poorly compressible, and which may exhibit Doppler signal. Erosion appears as an intra-articular discontinuity of the bone surface that is visible in two perpendicular planes. Tenosynovitis appears as hypoechoic or anechoic thickened tissue with or without fluid within the tendon sheath, which is seen in two perpendicular planes and which may exhibit Doppler signal. Tendinosis appears as tendon enlargement and heterogeneity. US diagnostic criteria of shoulder abnormality are: Biceps sheath effusion: Thickness of the hypoechoic halo of fluid surrounding the biceps tendon >2 mm. Glenohumeral effusion: Distance from the posterior labrum to the posterior infraspinatus tendon >2 mm. Full thickness tear: Non-visualization of tendon or complete fiber discontinuity. Partial thickness tear: Partial fiber discontinuity. Subdeltoid effusion: Hypoechoic fluid filled bursa >2 mm.

Statistical Methods:

Data were collected, revised, coded and entered to the statistical package for social sciences (SPSS) version 17 and the following were done. So the p-value was considered as the following: P> 0.05= non-significant, P<0.05= significant, P<0.01= highly significant.

RESULTS

A randomized case control cross sectional study was performed on 50 RA patients were 44 (88%) females and 6 (12%) males. Their ages 42. 92 ± 11.36 years. Their BMI 28.22 ± 4.97 kg/m^2, the duration of shoulder pain 6.48 ± 7.11 months, 31 patients have unilateral shoulder pain while 38 patients have bilateral shoulder pain and 30 matched volunteers complain of unilateral or bilateral shoulder pain serving as controls group 23 (76.7%) females and 7 (23.3%) males. Their ages 37.70 ± 11.44 years. Their BMI 26.98 ± 4.80 kg/m^2, the duration of shoulder pain 10.70 ± 11.88 months.

Comparison between patients and controls group as regard laboratory data shows that there were a high statistical significant difference in the mean ESR, CRP, RF, anti-CCP (p<0.01) (Table 1).

Table 1: Comparison between patients and controls as regard laboratory data

Variables	Patients (Mean±SD)	Controls (Mean±SD)	P
RBCs (10^{12}/L)	4.17 ± 0.53	4.38 ± 0.54	0.083
HB (g/dl)	11.88 ± 1.36	12.18 ± 1.38	0.344
WBCs (10^9/L)	7.14 ± 2.12	7.22 ± 2.49	0.878
Platelets (10^9/L)	305.50 ± 98.02	273.43 ± 63.26	0.113
ESR (mm/h)	35.98 ± 21.67	23.17 ± 12.76	**0.003**
CRP (mg/L)	14.74 ± 17.36	2.35 ± 3.19	**0.000**
RF (IU/ml)	93.29 ± 201.25	22.23 ± 22.76	**0.002**
Anti-CCP (IU/ml)	136.64 ± 148.07	9.79 ± 7.15	**0.000**

Comparison between the RA patients and controls group as regard shoulder x-ray shows a statistically significant osteophytes and joint space narrowing more in the patients' shoulders than in controls' shoulders ($p<0.05$) (Table 2).

Table 2: Comparison between shoulders of patients and controls as regard presence of abnormal shoulder x-ray findings

X-ray findings	Patients (100 shoulders) (%)	Controls (60 shoulders) (%)	P
Osteopenia	5 (5.0)	0 (0.0)	0.158*
Narrowing (GHJ & ACJ)	12 (12.0)	1 (1.7)	**0.021**
Osteophytes	7 (7.0)	0 (0.0)	**0.046***
Erosions	6 (6.0)	0 (0.0)	0.084*
Peri articular calcification	5 (5.0)	0 (0.0)	0.158

* Fisher exact test

Comparison between patients and controls group as regards shoulder US shows that there were a statistically significant more humeral bony erosions, ACJ erosions ($p<0.01$), and ACJ synovitis and ACJ bone irregularity ($p<0.05$) in patients' shoulders than in controls' but on the other hand there were a statistically significant more supra-spinatus tendon calcification, ACJ effusion, and ACJ osteophytes ($p<0.01$) and supra-spinatus muscle atrophy and infra-spinatus tendinopathy ($p<0.05$) in controls' shoulders than in patients' (Table 3).

Table 3: Comparison between shoulders of patients and controls as regard presence of abnormal US findings

US findings		Patients (100 shoulders) No (%)	Controls (60 shoulders) No (%)	P
Biceps tendon and sheath	Tendinopathy	9 (9.0)	9 (15.0)	0.245
	Tenosynovitis	10 (10.0)	8 (13.3)	0.518
	Sub laxation	4 (4.0)	3 (5.0)	1*
	Full thickness tear	1 (1.0)	0 (0.0)	1*
	Partial thickness tear	3 (3.0)	1 (1.7)	1*
Sub-scapularis tendon	Tendinopathy	6 (6.0)	6 (10.0)	0.352
	Calcification	1 (1.0)	3 (5.0)	0.149*
	Full thickness tear	2 (2.0)	4 (6.7)	0.198*
	Partial thickness tear	6 (6.0)	3 (5.0)	0.790
Supra-spinatus tendon and muscle	Tendinopathy	34 (34.0)	26 (43.3)	0.238
	Calcification	9 (9.0)	15 (25.0)	**0.006**
	Muscle atrophy	13 (13.0)	17 (28.3)	**0.016**
	Full thickness tear	10 (10.0)	4 (6.7)	0.470
	Partial thickness tear	14 (14.0)	14 (23.3)	0.133
Infra-spinatus tendon and muscle	Tendinopathy	2 (2.0)	7 (11.7)	**0.01**
	Calcification	17 (17.0)	17 (28.3)	0.09
	Muscle atrophy	0 (0.0)	1 (1.7)	0.375*
	Full thickness tear	3 (3.0)	0 (0.0)	0.292*
	Partial thickness tear	2 (2.0)	1 (1.7)	1*
SASD and Sub-coracoid bursae	SASD-Acute Bursitis	3 (3.0)	0 (0.0)	0.292*
	SASD-Chronic Bursitis	38 (38.0)	21 (35.0)	0.703
	Sub coracoid	13 (13.0)	5 (8.3)	0.366
Impingement	Sub acromion	29 (29.0)	15 (25.0)	0.583
	Sub coracoid	16 (16.0)	6 (10.0)	0.286
Humeral bony abnormality	Osteophytes	5 (5.0)	0 (0.0)	0.158*
	Erosions	27 (27.0)	4 (6.7)	**0.002**
	Irregularity	33 (33.0)	19 (31.7)	0.862
	Avulsion	0 (0.0)	3 (5.0)	0.051*
Acromioclavicular joint	Effusion	2 (2.0)	23 (38.3)	**0.000**
	Synovitis	20 (20.0)	5 (8.3)	**0.049**
	Erosions	21 (21.0)	3 (5.0)	**0.006**
	Osteophytes	34 (34.0)	33 (55.0)	**0.009**
	Irregularity	35 (35.0)	10 (16.7)	**0.013**
Glenohumeral joint	Effusion	38 (38.0)	23 (38.3)	0.966
	Synovitis	2 (2.0)	0 (0.0)	0.528*

* Fisher exact test

Comparison between RA patients as regard DAS activity score showed that there were a statistical significant high number and percent of shoulders with humeral bony erosions, ACJ synovitis, and ACJ osteophytes in patients with severe versus those with moderate disease activity since ($p<0.01$, $p<0.05$,$p<0.05$ respectively) while there were a statistical significant high number and percent of shoulders with biceps tendinopathy and GHJ effusion in patients with moderate versus those with severe disease activity since ($p<0.05$) for both (Table 4).

Table 4: Relation between shoulder US abnormalities and disease activity (DAS-28 subgroups).

Shoulder US findings		Moderate activity (48 shoulders) No (%)	Severe activity (52 shoulders) No (%)	P
Biceps tendon and sheath	Tendinopathy	8 (16.7)	1 (1.9)	**0.013***
	Tenosynovitis	6 (12.5)	4 (7.7)	0.423
	Sub laxation	2 (4.2)	2 (3.8)	0.660*
	Full thickness tear	1 (2.1)	0 (0.0)	0.480*
	Partial thickness tear	2 (4.2)	1 (1.9)	0.470*
Sub-scapularis tendon	Tendinopathy	2 (4.2)	4 (7.7)	0.378*
	Calcification	1 (2.1)	0 (0.0)	0.480*
	Full thickness tear	2 (4.2)	0 (0.0)	0.228*
	Partial thickness tear	3 (6.3)	3 (5.8)	0.662*
Supra-spinatus tendon and muscle	Tendinopathy	12 (25.0)	22 (42.3)	0.068
	Calcification	4 (8.3)	5 (9.6)	1*
	Muscle atrophy	6 (12.5)	7 (13.5)	0.886
	Full thickness tear	5 (10.4)	5 (9.6)	0.894
	Partial thickness tear	8 (16.7)	6 (11.5)	0.460
Infra-spinatus tendon and muscle	Tendinopathy	2 (4.2)	0	0.228*
	Muscle atrophy	8 (16.7)	9 (17.3)	0.932
	Full thickness tear	2 (4.2)	1 (1.9)	0.606*
	Partial thickness tear	2 (4.2)	0 (0.0)	0.228*
SASD and Sub coracoid bursae	SASD-Acute Bursitis	3 (6.3)	0	0.107*
	SASD-Chronic Bursitis	18 (37.5)	20 (38.5)	0.921
	Sub coracoid	4 (8.3)	9 (17.3)	0.182
Impingement	Sub acromion	12 (25.0)	17 (32.7)	0.397
	Sub coracoid	9 (18.8)	7 (13.5)	0.471
Humeral bony abnormality	Osteophytes	2 (4.2)	3 (5.8)	1*
	Erosions	6 (12.5)	21 (40.4)	**0.002**
	Irregularity	17 (35.4)	16 (30.8)	0.621
Acromioclavicular joint	Effusion	1 (2.1)	1 (1.9)	1*
	Synovitis	5 (10.4)	15 (28.8)	**0.021**
	Erosions	8 (16.7)	13 (25.0)	0.307
	Osteophytes	11 (22.9)	23 (44.2)	**0.025**
	Irregularity	16 (33.3)	19 (36.5)	0.737
Glenohumeral joint	Effusion	23 (47.9)	15 (28.8)	**0.049**
	Synovitis	0 (0.0)	2 (3.8)	0.496*

* Fisher exact test

Then the 50 patients were subdivided according to the frequency of painful and non- painful (100) shoulders to 69 painful shoulders and 31 non painful shoulders. Then the comparison between shoulder pain and Shoulder US abnormalities showed that there were significant more full thickness tear of supraspinatus tendon ($p=0.025$), SASD chronic bursitis ($p=0.033$), humeral bone irregularity ($p=0.049$), ACJ irregularity ($p=0.002$), and GHJ effusion ($p=0.033$) in painful shoulders than in non painful shoulders (Table 5).

Table 5: Relation between shoulder pain and shoulder findings (by US)

US findings		Painful (69 shoulders) No (%)	Non painful (31 shoulders) No (%)	P
Biceps tendon and sheath	Tendinopathy	8 (11.6)	1 (3.2)	0.176
	Tenosynovitis	8 (11.6)	2(6.4)	0.428
	Sub laxation	4 (5.8)	0 (0)	0.308*
	Full thickness tear	1 (1.4)	0 (0)	1*
	Partial thickness tear	2 (2.8)	1 (3.2)	1*
Sub-scapularis tendon	Tendinopathy	6 (8.7)	0 (0)	0.173*
	Calcification	1 (1.4)	0 (0)	1*
	Full thickness tear	2 (2.8)	0 (0)	1*
	Partial thickness tear	5 (7.2)	1 (3.2)	0.663*
Supra-spinatus tendon and muscle	Tendinopathy	25 (36.2)	9 (29)	0.482
	Calcification	6 (8.7)	3 (9.7)	0.874
	Muscle atrophy	9 (13)	4 (12.9)	0.985*
	Full thickness tear	10 (14.5)	0 (0)	**0.025**
	Partial thickness tear	10 (14.5)	4 (12.9)	0.832
Infra-spinatus tendon and muscle	Tendinopathy	2 (2.9)	0 (0)	1*
	Calcification	0 (0)	0 (0)	
	Muscle atrophy	13 (18.8)	4 (12.9)	0.465
	Full thickness tear	3 (4.3)	0 (0)	0.552*
	Partial thickness tear	2 (2.9)	0 (0)	1*
SASD and Sub coracoid bursae	SASD-Acute Bursitis	3 (4.3)	0 (0)	0.550*
	SASD-Chronic Bursitis	31 (44.9)	7 (22.6)	**0.033**
	Sub coracoid	10 (14.5)	3 (9.7)	0.508
Impingement	Sub acromion	24 (34.8)	5 (16.1)	0.057
	Sub coracoid	13 (18.8)	3 (9.7)	0.248
Humeral bony abnormality	Osteophytes	5 (7.2)	0 (0)	0.320*
	Erosions	21 (30.4)	6 (19.4)	0.248
	Irregularity	27 (39.1)	6 (19.4)	**0.049**
	Avulsion	0 (0)	0 (0)	
Acromioclavicular joint	Effusion	1 (1.4)	1 (3.2)	0.526*
	Synovitis	16 (23.2)	4 (12.9)	0.234
	Erosions	16 (23.2)	5 (16.1)	0.423
	Osteophytes	27 (39.1)	7 (22.6)	0.106
	Irregularity	31 (44.9)	4 (12.9)	**0.002**
Glenohumeral joint	Effusion	31 (44.9)	7 (22.6)	**0.033**
	Synovitis	2 (2.8)	0 (0)	1*

* Fisher exact test

DISCUSSION

RA commonly involves the shoulders and is manifested by tenderness, nocturnal pain, and limitation of movement. Inflammation caused by RA may also cause rotator cuff tendinitis and bursitis and may result in frozen shoulder. The location of shoulder pain is a poor indicator of its origin, and the value of clinical examination alone is often limited with regard to making a decision for further management with certainty. The results of shoulder imaging affect the decision to proceed with surgery or to continue conservative management depending on the extent of the lesion [5].

MSUS has been confirmed to be a helpful imaging technique that aids in the correlation between clinical and anatomical findings, thus offering relevant information that might impact the management. MSUS is able to detect synovial inflammation as well as structural damage lesions. Moreover, the use of power Doppler (PD) has enhanced the sensitivity of US in detecting active inflammation through the identification of pathologically increased hematic perfusion. It has been applied in several rheumatic inflammatory diseases, particularly RA [6].

In the present study, we aimed to identify the shoulder US abnormalities in RA patients with shoulder pain and to correlate them with clinical and laboratory parameters of the disease.

This study was carried out at Ain Shams University Hospital where we studied 50 patients satisfying the ACR/ EULAR classification of RA with 69 painful and 31 non-painful shoulders. And 30 age and sex matched volunteers complaining of unilateral or bilateral shoulder pain serving as controls.

In the current study, 88% of patients were female. These results were similar to those reported by *Courvoisier et al*. [7], and *Benbouazza et al*. [8] as females represents 80.3% of 112 rheumatoid patients and 88.2% of 51 rheumatoid patients respectively of their studied patients.

In the present study, the mean age of rheumatoid patients was (42. 92 ± 11.36) years, this agreed with a study reported by *Benbouazza et al*. [8] who found that data on the profile of patients with RA in North Africa (Morocco and Egypt) in the QUEST-RA (Quantitative Standard Monitoring of Patients with RA), showed that patients in North Africa are younger than patients in other countries.

RF was found to be positive in (74%) of the patients in our study and this agree with a study of ultrasonographic findings of the shoulders in Egyptian patients with RA by *Fuda et al.* [5] who found RF to be positive in (70%) of the studied patients, but it was higher than another study conducted in Korea by *Kim et al.* [9] who found RF to be positive in (50%) of the studied patients. This variation might be due to regional and racial variations.

In our study the number and percent of patients' shoulders with US detected erosions was 2 (27%) shoulders versus 6 (6%) shoulders using conventional radiography, the previous findings are in accordance with those of *Wakefield et al.* [10] who documented that US is a reliable technique that detects more erosions compared with conventional radiography, especially in early RA. Moreover, the study by *Amin et al.* [11] found that erosions of the ACJ were detected using conventional radiography in 15 patients versus 41 patients by US in 50 patients with a high statistical significant difference (P<0.001).

In the present study, we found that the most common image abnormalities in shoulder US in RA patients were SASD chronic bursitis and GHJ effusion in 38% of patients' shoulders, ACJ irregularity in 35% of patients' shoulders, and supraspinatus tendinopathy in 34% of patients' shoulders. This finding agreed with the study by *Alasaarela et al.* [12] which evaluating 44 hospitalized RA patients with a mean disease duration of 12 yr, subacromial bursitis was the most frequent finding in 69% of patients' shoulders, followed by GHJ synovitis in 58% of patients' shoulders, bicipital tendinitis in 57% of patients' shoulders and abnormalities in the supraspinatus tendon in 33% of patients' shoulders.

In the present study, we found that the most common image abnormalities in shoulder US in controls were ACJ osteophytes and supraspinatus tendinopathy in 55% and 43.3% of controls' shoulders respectively; this disagree to that reported by *Tran et al.* [13] who conducted study on 3000 US reports of people with shoulder pain referred from primary care, sub-acromial impingement in 69% and bursitis in 68% were the most common abnormalities, followed by ACJ degeneration in 40% and tendinopathy in 36% These variations might be due to different sample sizes, different patients' ages, variable pain durations and regional and racial variations.

On comparing RA patients and controls as regard the presence of erosions (in humeral bone and ACJ) by US, patients had higher erosions than controls with significant difference (p<0.01) and this agreed with the study by *Fuda et al.* [5] and the study by *Hermann et al.* [4] in which erosions were higher in patients than controls with significant difference (p<0.01).

In the current study, the mean RA disease duration was found to be (7.04± 8.78) years, and this was found to be comparable to the study by *Kim et al.* [9] whose mean disease duration was (6.4±7.6) years.

In the present study, long head of biceps (LHB) tenosynovitis (by US) was detected in 8 /69 (11.6%) of painful shoulders and in 2/31 (6.5%) of non-painful shoulders of the studied patients. This was less than *Kim et al.* [9] who found LHB tenosynovitis in 13/35 (37.1%) of painful shoulders and in 9/25 (36%) of non-painful shoulders of included patients. The frequency of abnormal US findings of rheumatoid shoulder joints differs depending on the patient population studied. Also, among the rotator cuff tendons (sub-scapularis, supra-spinatus, infra-spinatus, teres minor), except for the teres minor which was not included in our US examination, subscapularis tendon tear observed in 10.1% of painful shoulders. For supraspinatus and infraspinatus tendons, tendon tear was observed in 29% and 7.2% of the painful shoulders respectively. It is of note that tendon tear was also common among non-painful shoulders, with 3.2% and 12.9% of non-painful shoulders showing tear in the sub-scapularis and supra-spinatus tendons, respectively. GHJ effusion was noted in 22.6% and 44.9% of non-painful and painful shoulders, respectively. Humeral cortical irregularity was detected in 19.4% and 39.1% of non-painful and painful shoulders, respectively. This agreed with the study by *Kim et al.* [9] who found that many non-painful RA shoulders also revealed frequent US abnormalities.

The mean shoulder pain duration of RA patients included in the current study was (6.48 ± 7.11) months. This finding was found to be comparable to that recorded by *Fuda et al.* [5] as the mean shoulder pain duration of the patients was (5.97±4.05) months.

In the present study, supra-spinatus tendinopathy (by US) was detected more in painful shoulders than non-painful shoulders of the studied patients with no significant difference (p>0.05). However, *Fuda et al.* [5] who found that supra-spinatus tendinopathy was higher in painful shoulders but with significant difference (p-value <0.05).

In the present study, we found insignificant relation between US detected erosion and shoulder pain; this is similar to that reported by *Gill et al.* [14] who detected that MRI shoulder pathology is visible in both painful and non painful shoulders and clinical symptoms may not match radiological findings and to *Fuda et al.* [5] who found insignificant relation between erosion and shoulder pain.

In the present study, we found insignificant relation between US-detected SASD acute bursitis and shoulder pain; this agreed to that reported by *Fuda et al.* [5] who detected that there was insignificant relation between US-detected acute bursitis and shoulder pain. On the other hand, there was statistical significant relation between chronic SASD bursitis and shoulder pain in RA patients.

The patients were subdivided into 2 subgroups according to DAS-28. The present study revealed statistically significant relation between US-detected shoulder ACJ synovitis and DAS28 score; this is in agreement with the findings of *Hameed et al.* [15] who conducted study on 50 patients with RA and with *Fuda et al.* [5] which both found a significant relation between US-detected synovitis and DAS28 score. Also, there were a statistically significant relation between US-detected shoulder erosion and DAS28 score; this is in agreement with the findings of *Shereen et al.* [16] while this disagree with the findings of *Fuda et al.* [5] who found that there was no significant relation between US-detected erosion in shoulder joint and DAS28 score, a possible explanation for this variation is the striking heterogeneity in clinical pattern of RA, where in patients with joint erosive disease might never have a high acute phase response, whereas others remain non erosive in spite of persistently high joint counts. On the other hand, there was insignificant relation between US-detected shoulder bursitis or LHB tenosynovitis and DAS28 score; this is in agreement with the findings of *Fuda et al.* [5].

CONCLUSION

The most common shoulder image abnormalities (by US) in RA patients were SASD chronic bursitis and GHJ effusion followed by ACJ irregularity and supraspinatus tendinopathy. US imaging is an important additional tool that supplements conventional radiography of the shoulder joints in RA.

Conflicts of interest: The authors declare that they have no financial or non financial conflicts of interest related to the work done in the manuscript.

- Each author listed in the manuscript had seen and approved the submission of this version of the manuscript and takes full responsibility for it.
- This article had not been published anywhere and is not currently under consideration by another journal or a publisher.

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