Original article

Frequency of Elbow Joint Affection in Rheumatoid Arthritis Patients by Ultrasound

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Abstract:

Background: Rheumatoid arthritis (RA) is a chronic, immune-mediated inflammatory disease affecting the synovial joints, including the elbows, leading to significant joint damage and decreased quality of life. Objectives: This study evaluates the frequency of elbow joint involvement in RA patients by musculoskeletal ultrasound (MSUS) and its impact on disease activity and quality of life. **Methods:** This cross-sectional study included 35 RA patients, and 35 healthy controls recruited from Benha University Hospitals. Patients were classified as having RA according to the ACR/EULAR 2010 criteria. All patients underwent clinical evaluation, ultrasound examination, and assessment of disease activity (DAS28) and quality of life (SF-36). **Results:** Right elbow involvement was observed in 63% of patients while 37% patients had a left one, with tenderness (97%) and flexion deformity (46%) being the most common clinical signs. Ultrasound revealed synovitis in 63%, effusion in 80%, and Doppler signal in 66% of patients. All SF-36 domain scores, including physical functioning (p < 0.001) and mental health (p < 0.001), were lower in RA patients with elbow affection. **Conclusions:** Ultrasound is a valuable tool for assessment of elbow involvement in RA. Elbow joints are frequently affected in RA patients with associated high disease activity and reduced quality of life.
Keywords: Rheumatoid arthritis, synovitis, chronic inflammatory disorder, elbow, and an ultrasound.

Introduction

Rheumatoid Arthritis (RA) is an immune-mediated multi-system inflammatory disease that predominantly affects the synovial joints. The disease can lead to inflammation, joint destruction, deformity and disability, and may also present with extra-articular manifestations. Small joints, especially those of the hands, are the most frequently involved, but also large joints are commonly affected. Erosive changes of the elbow joint are seen in about 32 % of patients. Early and accurate diagnosis and subsequent treatment are necessary in order to avoid structural damage and deformity, which will result if the disease is left untreated [1].

Musculoskeletal ultrasound (MSUS) shows many advantages over other imaging modalities, probably the most important being its capability to perform a dynamic assessment of musculoskeletal elements with patient's partnership and observation during examination. Ultrasonography (US) is cost effective, easy, available and highly accepted by patients. In addition, the US has excellent and multiplanar capability to visualize soft tissue structures [2].

Ultrasonography (US) of the elbow is a very helpful and reliable diagnostic procedure for a broad spectrum of rheumatic and orthopedic conditions. US of the elbow provides detailed information about pathologic conditions affecting the joints, including the synovial membrane inflammation, joint effusion, bony surface erosions, enthesitis. Compared with clinical examination, it is a more sensitive method for detecting synovitis and tenosynovitis [3].

So far, mostly small joints of the hand and wrists have been studied in RA, being the most affected joints. In contrast, large joints have not been extensively studied, and elbow involvement has only been incorporated in two ultrasound scoring systems [4].

This study is designed to determine the frequency of elbow joint involvement by US in patients with RA to elucidate its relation to their quality of life.

Patients and methods

Design and population

This is a cross-section study that was conducted on 35 patients with RA diagnosed according to the ACR/EULAR 2010 classification criteria [5]. Patients were recruited from Rheumatology, Rehabilitation and Physical Medicine Department of Benha University Hospitals from November 2022 to April 2023. An informed written consent was obtained from the patients. Every patient received an explanation of the purpose of the study and had a secret code number.

Patient Selection

The study included subjects of both sexes aged more than 18 years with rheumatoid arthritis. Patients with surgical intervention of any side of the elbow joint or were known to have hyperuricemia were excluded from the study. Subjects who refused to enrol into the study were also excluded.

This study involved two groups; Group (A) which included thirty-five patients diagnosed as RA according to the ACR/EULAR 2010 classification criteria [5] and group (B) (control group) which included thirty-five apparently healthy subjects with matched age and sex.

Methods

Clinical evaluation and disease activity assessment

In this study, all selected patients underwent a comprehensive evaluation, including detailed history taking, clinical examination, and laboratory investigations. Clinical examination of the elbow was performed for every patient. The elbow was assessed for swelling, tenderness and range of motion. [6] The patient-rated visual analog scale for disease activity (VAS range 0–100) was reported [7]. The Disease Activity Score in 28 joints (DAS28) using ESR was used to assess overall disease activity [8].

Quality of life measurement

Quality of life was measured using the Short-Form 36 (SF-36) Questionnaire. The SF-36 is a 36-item patient-reported questionnaire that covers eight health domains: physical functioning (10 items), bodily pain (2 items), role limitations due to physical health problems (4 items), role limitations due to personal or emotional problems (4 items), emotional well-being (5 items), social functioning (2 items), energy/fatigue (4 items), and general health perceptions (5 items). Scores for each domain range from 0 to 100, with a higher score defining a more favorable health state. [9]

Musculoskeletal ultrasound assessment

MSUS evaluation was performed using a linear high frequency 6-15 MHz probe on LOGIQ P9 (Korea) - ultrasound machine. The MSUS examination was done by an expert physician at Rheumatology, Rehabilitation and physical medicine department of Benha University Hospitals. A standard protocol with optimization of scanning parameters was performed. The patient is sitting in front of the sonographer. The anterior scans are performed in neutral position of the elbow with supination of the hand and the posterior scans are scanned in neutral position and with up to 90° flexion of the elbow. In flexed position of the elbow US is more sensitive for detecting small fluid collections in the olecranon fossa. The dynamic examination is done by extension and flexion of the elbow. The elbow joint was scanned in longitudinal and transverse standard planes from radial to ulnar sides on both ventral and dorsal aspects. They were examined by B-mode for synovitis, joint effusion and enthesitis at the medial or lateral epicondyle plus power doppler assessment. The sonographic findings were classified three times to establish the consistency of the findings. [10]

As published by the OMERACT ultrasound group, synovitis was identified as hypo-echoic, poorly compressible, not displaceable, perhaps exhibiting color signals. Effusion was defined as anechoic or hypo-echoic, compressible and displaceable, not exhibiting color signals. Enthesitis is defined as hypoechoic and thickened insertion of the tendon close to the bone (within 2 mm from the bony cortex) which exhibits doppler signal if active, and which may show erosions and enthesophytes/calcifications as a sign of structural damage [11].

Statistical methods

Data analysis was performed by SPSS software, version 25 (SPSS Inc., PASW statistics for windows version 25. Chicago: SPSS Inc.). Qualitative data were described using number and percentage. Quantitative data were described using median (minimum and maximum) for non-normally distributed data and mean± Standard deviation for normally distributed data after testing normality using Kolmogrov-Smirnov test. Significance of the obtained results was judged at the (≤0.05) level. Chi-Square, Fisher exact test, Monte Carlo tests were used to compare qualitative data between groups as appropriate

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Results

There was no significant difference in age and sex between the groups, but BMI was significantly higher in group A (**Table 1).** All SF-36 domain scores, including physical and mental health measures, were significantly lower (P<0.001) in RA patients compared to controls (**Fig. 1).**

In our study, twenty-two (63%) patients had right elbow involvement while thirteen (37%) patients had left one. On clinical examination, swelling was present in thirteen (37%) patients, tenderness in thirty-four (97%) patients, and flexion deformity in sixteen (46%) patients. Methotrexate was used by 54.3% (n=19) of patients, leflunomide by 20% (n=7), and all patients used steroids.

Elbow MSUS revealed synovitis in 63%, effusion in 80%, doppler signal in 66%, and enthesitis in 43% of patients. (**Fig. 2)**

Regarding demographics, there was no significant association in age, sex and BMI between patients with positive or negative elbow MSUS findings. Patients with positive enthesitis had significantly higher DAS28 (P=0.011) compared to patients with negative enthesitis. Similarly, DAS28 was significantly higher (P<0.001) in patients with positive effusion and positive doppler signal compared to patients with negative findings.

Table 2 summarizes the association between presence of elbow joint effusion and quality of life parameters in RA patients. All domains except for physical role limitation were significantly lower in patients with positive effusion compared to patients with negative effusion. **(Table 2)**

Table 1: Demographic data among studied groups.

		Group A (n =35)	Group B (n =35)	P value
Demographic data				
Age (year)	Mean ± SD	47.6 ± 8.83	43.17 ± 9.91	0.053
	Range	30 - 75	25 - 60	
Sex	Male	7 (20%)	9 (26%)	0.777
	Female	28 (80%)	26 (74%)	
BMI (kg/m²)	Mean ± SD	28.28 ± 3.43	25.51 ± 3.27	**<0.001****
	Range	22.1 - 35.2	21 - 35	

BMI: Body Mass Index, DAS28: Disease Activity Score-28, **: highly Significant when p value <0.001

Table 2: Association between elbow joint effusion by MSUS and quality of life domains by SF-36 in RA patients.

		Positive effusion (n =28)	Negative effusion (n =7)	P value
Physical functioning	Median (IQR)	32.5 (20 – 45)	50 (45 – 72.5)	**0.004***
	Range	5 – 75	40 – 85	
Role limitations (physical)	Median (IQR)	0 (0 – 25)	75 (0 – 75)	0.095
	Range	0 – 25	0 – 75	
Bodily pain	Median (IQR)	27.5 (12.5 – 45)	55 (40 – 61.3)	**0.01***
	Range	10 - 67.5	22.5 - 77.5	
General health perceptions	Median (IQR)	35 (25 – 40)	65 (60 – 65)	**<0.001****
	Range	20 – 60	45 – 70	
Energy / vitality	Median (IQR)	25 (12.5 – 35)	55 (45 – 57.5)	**0.013***
	Range	0 – 65	0 – 60	
Social functioning	Median (IQR)	25 (18.8 – 37.5)	62.5 (50 – 87.5)	**<0.001****
	Range	0 – 50	50 - 87.5	
Role limitations (emotional)	Median (IQR)	0 (0 – 33.3)	66.7 (35.7 – 66.7)	**<0.001****
	Range	0 - 66.67	33.3 - 66.67	
Mental health	Median (IQR)	36 (24 – 54)	76 (68 – 80)	**<0.001****
	Range	12 – 76	60 – 84	

MSUS: Musculoskeletal ultrasound, SF-36: short form 36, RA: Rheumatoid arthritis, IQR: Interquartile range. p: Probability value, *: Significant when p value <0.05, **: highly Significant when p value <0.001

Table 3 shows the association between enthesitis around the elbow and quality of life domains in RA patients. (**Table 3**) Regarding the doppler signal findings, all quality-of-life domains were significantly lower in patients with positive doppler signals compared to patients with negative doppler signal except for physical role limitations domain. **(Table 4)**

DAS28 showed significant negative correlations (p<0.05) with general health perceptions (r= -0.337, P=0.048) and energy / vitality (r=-0.498, P=0.002). There were highly significant negative correlations (p<0.001) between DAS28

and social functioning, role limitations (emotional), and mental health (r=-0.544, r=-0.662, r=-0.559 respectively). However, DAS28 had no significant correlations with Physical functioning, Role limitations and Bodily pain (r=-0.247, r=-0.096, r=-0.199 respectively).

Table 3: Association between enthesitis by MSUS and quality of life domains by SF-36 in RA patients.

		Positive enthesitis (n =15)	Negative enthesitis (n =20)	P value
Physical functioning	Median (IQR)	30 (15 – 35)	45 (37 – 65)	**<0.001****
	Range	5 - 50	20 - 85	
Role limitations (physical)	Median (IQR)	0 (0 – 12.5)	12.5 (0 – 25)	0.158
	Range	0 - 25	0 - 75	
Bodily pain	Median (IQR)	32.5 (16.3 – 32.5)	45 (17.5 – 55)	0.158
	Range	10 - 67.5	10 - 77.5	
General health perceptions	Median (IQR)	25 (22.5 – 37.5)	45 (40 – 60)	**<0.001****
	Range	20 - 45	30 - 70	
Energy / vitality	Median (IQR)	15 (5 – 25)	37.5 (30 – 55)	**<0.001****
	Range	0 - 30	0 - 65	
Social functioning	Median (IQR)	25 (12.5 – 31.3)	37.5 (25 – 50)	**0.009***
	Range	0 - 50	12.5 - 87.5	
Role limitations (emotional)	Median (IQR)	0 (0 – 33.3)	33.3 (0 – 51.2)	**0.004***
	Range	0 - 33.3	0 - 66.7	
Mental health	Median (IQR)	24 (18 – 36)	58 (36 – 74)	**0.001***
	Range	12 - 70	24 - 84	

MSUS: Musculoskeletal ultrasound, SF-36: short form 36, RA: Rheumatoid arthritis, IQR: Interquartile range.
p: Probability value, *: Significant when p value <0.05, **: highly Significant when p value <0.001

Table 4: Association between doppler signal by MSUS and quality of life domains by SF-36 in RA patients.

		Positive doppler signal (n =23)	Negative doppler signal (n =12)	P value
Physical functioning	Median (IQR)	30 (20 – 40)	50 (45 – 72)	**<0.001****
	Range	5 – 60	30 - 85	
Role limitations (physical)	Median (IQR)	0 (0 – 25)	0 (0 – 75)	0.461
	Range	0 - 25	0 - 75	
Bodily pain	Median (IQR)	22.5 (12.5 – 32.5)	47.5 (27.5 – 55)	**0.013***
	Range	10 - 67.5	12.5 - 77.5	
General health perceptions	Median (IQR)	35 (25 – 40)	60 (42.5 – 65)	**<0.001***
	Range	20 - 45	35 - 70	
Energy / vitality	Median (IQR)	25 (10 – 30)	55 (37.5 – 57.5)	**<0.001***
	Range	0 - 40	0 - 65	
Social functioning	Median (IQR)	25 (12.5 – 37.5)	50 (31.3 – 75)	**0.001***
	Range	0 - 50	25 - 87.5	
Role limitations (emotional)	Median (IQR)	0 (0 – 33.3)	35.7 (34.5 – 66.7)	**<0.001***
	Range	0 - 33.3	33.3 - 66.67	
Mental health	Median (IQR)	36 (24 – 46)	68 (56 – 78)	**<0.001***
	Range	12 - 70	24 - 84	

MSUS: Musculoskeletal ultrasound, SF-36: short form 36, RA: Rheumatoid arthritis, IQR: Interquartile range.
p: Probability value, *: Significant when p value <0.05, **: highly Significant when p value <0.001
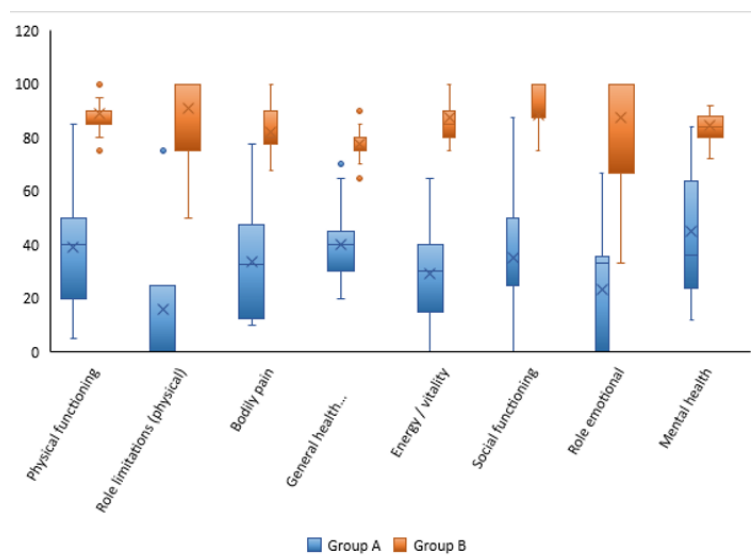
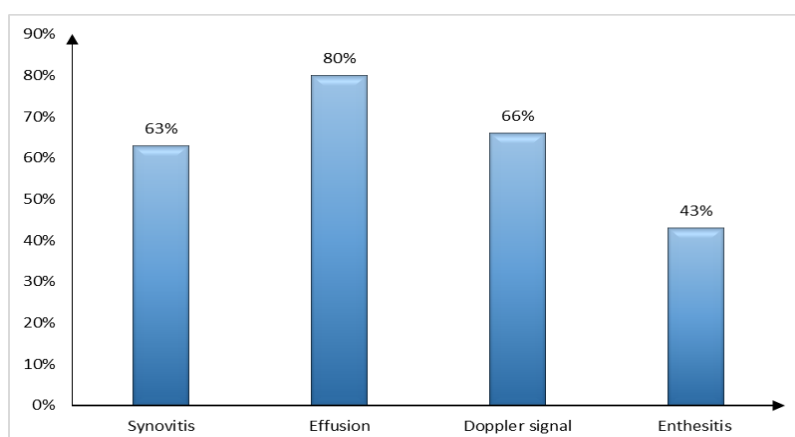**Figure 1:** SF-36 domains score in the studied groups.

Figure 2: Musculoskeletal ultrasound findings in RA patients.

Discussion

RA is a complex inflammatory that without proper recognition and management, the pain, functional loss, and decreased quality of life associated with active disease can severely impact both physical and mental well-being. The elbow joint plays a vital role in upper limb function by providing both motion and stability. We conducted a cross-sectional study that involved two groups, Group A (35 patients diagnosed with RA) and group B (35 control healthy subjects of matched age and sex). Our study aimed to determine the frequency of elbow joint involvement in patients with rheumatoid arthritis to elucidate its relation to their quality of life.

Our study found that BMI was significantly higher in group A compared to group B. In agreement with our finding, a study led by Feng et al aimed to explain the relationship between BMI and RA by conducting a dose-response meta-analysis. The overall and dose-response meta-analysis showed that increased BMI was

associated with an increased risk for rheumatoid arthritis [12].

Our study revealed that elbow involvement was almost 100% in all the patients involved in the study. On the contrary, a study led by Schafer et al that assessed the prevalence of elbow joint arthritis in rheumatoid arthritis by US. The study included 102 patients with rheumatoid arthritis and 50 patients without rheumatoid diseases. They found that the prevalence of elbow arthritis in RA seems to be high, with 35.29% [13].

The difference in findings between our study and Schäfer et al. [13] study could be attributed to several factors. First, the methodology and diagnostic tools used in our study are different, our study have utilized more sensitive and detailed diagnostic criteria, potentially leading to the higher detection of elbow involvement. Additionally, our study has focused on a specific subset of rheumatoid arthritis patients with more advanced or widespread disease, resulting in higher rates of elbow joint involvement. In contrast, in the study led by Schäfer et al. [13] included a broader cohort, potentially with earlier-stage RA, which could explain the lower prevalence of elbow arthritis [13].

Our study detected US findings in the RA patients involved synovitis, effusion, doppler signal and enthesitis. Similarly, a study conducted by Karimzadeh et al. that aimed to recognize the findings of US in remitted RA patients for detection of subclinical arthritis. The study included 70 individuals with RA in remission. Although these patients showed no signs of arthritis during clinical examinations, all underwent ultrasound scans. The ultrasound scans revealed positive findings in about 44.3% of the participants, which equates to 31 patients. Specifically, synovitis was detected in 20% of cases, hyperaemia in 21.4%, and joint effusion was observed in 18.6% of patients, corresponding to 13 individuals [14].

Our study found that the DAS 28 scores correlate with quality-of-life domains by SF-36. These results were in line with the study conducted by Nasir et al. whose aim was to determine the correlation between DAS28 and the modified Health Assessment Questionnaire (mHAQ) [15]. In addition, another study explored the Relationship between function and disease activity as measured by the HAQ and DAS28 and found them to be correlated significantly at all time points [16].

Our study revealed that all SF-36 domains scores were significantly lower in RA patients compared to controls. This is consistent with another study led by Rahman et al. whose aim was to assess the quality of life of rheumatoid arthritis patients by the SF-36 questionnaire. This cross-sectional observational research involved 62 patients with RA. The study concluded that individuals with RA experienced a comparatively low quality of life, with negative impacts on both their physical and mental well-being. However, the physical aspects of health were found to be more significantly impaired than the mental aspects. Also, this study found a significant negative correlation was present between SF-36 scores and the DAS-28 scores [17].

In a study by Micu et al., the impact of MSUS on clinical diagnosis and variable treatment strategies was explored. The authors reported that US of the elbow joint led in 80% to a change of final diagnosis and therapy regime and proved to be very helpful, while in all other anatomic areas studied, the percentage was lower [18].

Our study was limited by the small sample size and reliance solely on US for inflammation assessment, limiting generalizability and comprehensiveness. A multi-centre study in a larger cohort of patients with RA with longer period of follow up is necessary to fully assess role of US in diagnosis and management of elbow involvement. However, our study showed the strength of US in detection of variable elbow joint pathologies in a significant number of patients, especially when a rapid and efficient medical service

is advantageous for advancing health resources in an outpatient setting.

Conclusions

In conclusion, our study demonstrated that RA frequently affects the elbow joints, with associated high disease activity and reduced quality of life. MSUS is a valuable tool for detecting elbow involvement in RA.

Conflict of interest

None of the contributors declared any conflict of interest

Acknowledgments: There was none to declare.

Declaration of interest statement: None to be declared.

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