Original Article

Role of High-Resolution Grey Scale and Power Doppler Ultrasonography in the Evaluation of Synovial Activity of Wrist and Hand Joints in Rheumatoid Arthritis

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ABSTRACT

Background: Ultrasound is well established for diagnosis of Rheumatoid Arthritis (RA); it enhances clinical examination by early detection and identifying true remission.

Aim of the Work: Evaluate the efficacy of ultrasound and power Doppler in diagnosing and evaluating the activity of RA compared to serology & DAS28 scoring system.

Patients and Methods: Cross-sectional study involved 53 patients diagnosed with RA. Joints were evaluated by Ultrasound for synovial thickening, effusion, bony erosions and increased Doppler activity. Patients underwent serological assessment for (RF), CRP, ESR, and anti-CCP levels. DAS28 scoring system was also applied for each patient.

Results: Ultrasound detected synovial thickening in 100%, synovial effusion in 60.4%, bony erosions in 26.4 % & increased Doppler activity in 84.9 % of patients. Positive RF test in 47.2 % of cases, Positive anti-CCP test in 81.1%, elevated ESR level in 84.9%, and elevated CRP level in 100% of cases. According to DAS 28 score, 50.9% of patients had low to moderate disease activity while 49.1% had severe disease activity. RF had significant correlation with synovial thickening in 2 joints and joint effusion in 2 joints. Anti-CCP had significant correlation with joint effusion and power Doppler activity in 1 joint. ESR had significant correlation with synovial thickening in 3 joints and with joint effusion in 2 joints. CRP had significant correlation with synovial thickening in 10 joints, with joint effusion in 11 joints, with power Doppler activity in 5 joints and with bony erosions in 1 joint. DAS 28-scoring system had significant correlation with synovial thickening in 5 joints and with power Doppler activity in 5 joints.

Conclusion: US has better diagnostic value compared to clinical and laboratory assessment of RA, it can assess both soft tissue and erosive joint changes that occur in RA and differentiate between inactive and active synovial hypertrophy by using power Doppler signal.

Key Words: DAS 28, laboratory, RA, US.

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INTRODUCTION

Rheumatoid arthritis is a systemic autoimmune inflammatory disease that predominantly impacts the joints. It is linked to progressive disability, premature mortality, and significant socioeconomic costs[1]. It primarily targets the small joints of the feet and hands, where ongoing inflammation can result in structural damage to joints and tendons, ultimately leading to bone erosions[2].

Ultrasound provides comprehensive visualization of the perfusional, structural, and morphological variations caused by rheumatoid synovitis at both the tendon and joint level[3].

When evaluating synovitis using US two components are assessed: hyperaemia through Doppler US and hypoechoic synovial hypertrophy via grayscale (GS).

Baseline US Doppler assessment of wrist synovitis is a better predictor for RA than the 2010 American College of Rheumatology/European League Against Rheumatism (ACR/EULAR) criteria[4] and can increase the accuracy of these criteria compared to clinical joint examination[5].

When it comes to examining joint effusions, the US is the most effective method and can identify fluid as little as 1 ml[6]. Articular cartilage becomes disrupted, and bone erosions may be visible at the osteochondral junction, as

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synovial proliferation advances, Early bone erosions can be detected by US[7].

The two autoantibody systems most frequently used as an assist for classifying and diagnosing RA are Anti–cyclic citrullinated peptide (anti-CCP) antibody and Rheumatoid Factor (RF)[8]. But since both anti-CCP and RF tend to stay positive even in remission, they are not used to track the activity of the disease[9].

C-reactive protein (CRP) and Erythrocyte sedimentation rate (ESR) are employed to track illness activity and response to therapy[10].

The Disease Activity Score in 28 Joints (DAS28) is now advised for guiding clinical decisions regarding the initiation and adjustment of treatment in rheumatoid arthritis (RA). In accordance with the British Society of Rheumatology, to track the course of the illness and the effectiveness of treatment, the majority of RA patients should undergo a DAS28 assessment at each clinic visit[11].

AIM OF THE WORK

The objective of this study is to assess the efficacy of ultrasound and power Doppler in identifying rheumatoid arthritis activity in the wrist and small hand joints, compared to serological data and the DAS28 scoring system.

PATIENTS AND METHODS

This is a cross-sectional study carried out on 53 patients diagnosed with rheumatoid arthritis referred to the Diagnostic and Interventional Radiology Department, Ain Shams University Hospitals, in Cairo, Egypt.

Inclusion criteria for the study include patients above 18 years old, diagnosed with RA according to the criteria of 2010 American College of Rheumatology/European League Against Rheumatism (ACR/EULAR) and presented with different symptoms like pain, swelling and stiffness in more than one joint. Exclusion criteria include advanced deformities of the wrist and hand joints detected clinically.

After explaining the procedure and taking consent from the patients, all patients were subjected to US examination by Toshiba aplio 400 (TUS A400) ultrasound machine using high-resolution linear US transducer (12 MHz). Power Doppler was conducted with a pulse repetition rate of 15.6–17.3 kHz, velocity scale range was 5 cm/s and 7 frames per second.

US examination of the wrist and hand joints was done while the patient was sitting upright and the hand fully pronated then supinated. Joint US was done to assess the presence of synovial thickening, evaluation of synovial vascularity using power Doppler, presence of joint effusion and bony erosions.

A semi-quantitative scoring method was used to grade synovial thickening, power Doppler signals, and joint effusion. Regarding synovial thickening, grade 0 refers to absent synovial thickening; grade 1 denotes minimal thickening; grade 2 indicates moderate thickening, with bulging over the joint line but without extension along the bone diaphysis; and grade 3 refers to extensive thickening, with bulging over the joint line and extension along the bone diaphysis. Joint effusion grading involves grade 3 for an extensive amount of effusion, grade 2 for moderate effusion, grade 1 for minimal effusion, and grade 0 for no effusion.

Semi-quantitative scoring for the synovial Doppler signal includes grade 3 for more than 50% of the synovial area showing doppler activity, grade 2 for less than 50% of the synovial area, grade 1 for a few vessels (one or two), and grade 0 for no power Doppler signal in the synovium. The joints were also examined for the existence or lack of bony erosions.

Serological assessment was performed for all the patients in the same day for the following, Rheumatoid Factor (RF), Anti–cyclic citrullinated peptide (anti-CCP), Erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP).

RF and Anti-CCP levels below 20 IU/ml were considered negative tests and above 20 IU/ml were considered positive tests, respectively.

ESR levels ranging from 20 to 40 mm/hr. were considered moderate elevation and levels over 40 mm/hr. were considered marked elevation. Regarding CRP, from 1 to 10 mg/dl was considered moderate elevation and levels over 10 mg/dl was considered marked elevation.

The DAS28 score was calculated for all the patients, it is a measure of disease activity in (RA). DAS stands for ‘disease activity score’, and the number 28 refers to the 28 joints that are examined in this assessment. It is an online tool collates a clinical assessment of 28 specified

joints, consisting of a 28 tender joint count (range, 0–28), a 28 swollen joint count (range, 0–28); value of ESR test, and facultatively, a patient global assessment on a visual analog scale (range, 0–100). Scores ranging from 2.6 to less than 3.2 were considered indicative of low disease activity, Scores ranging from 3.2 to 5.1 were considered indicative of moderate disease activity, while scores above 5.1 were considered indicative of marked disease activity.

Statistical analysis of data

Spearman correlation test was used to examine the potential relationship between two variables within each group. Data were gathered, checked, coded, and added to IBM SPSS, version 27 of the Statistical Package for Social Science. The quantitative data were reported as means with standard deviations and ranges for parametric data, and as medians with inter-quartile ranges (IQR) for non-parametric data. Quantitative variables were also displayed as percentages and numbers.

When the predicted count in any cell was less than 5, the Chi-square test and/or Fisher's exact test were used to compare the qualitative data between the groups.

The margin of error was set at 5%, and the confidence interval was set at 95%. The *p-value* was interpreted as follows: *P-value* < 0.01 was considered highly significant (HS), *P-value* < 0.05 was considered significant (S), and *P-value* > 0.05 was considered non-significant (NS).

Ethical considerations

The regional ethical committee of the Faculty of Medicine at Ain Shams University granted approval for our study (MS 252/2023). Throughout all phases of the study, participants' privacy and confidentiality were protected.

RESULTS

Table 1: Demographic data and characteristics of the studied patients.

		Total no. = 53
Gender	Female	51 (96.2%)
	Male	2 (3.8%)
Age	Mean ± SD	46.28 ± 9.69
	Range	23 – 75
Duration (years)	Median (IQR)	6 (3 – 12)
	Range	0.5 – 30

This cross-sectional study involved 53 patients identified with RA. It included 51 females and 2 males. The patients' ages varied from 23 and 75 years with a mean age of 46.28 ± 9.69 years. The time of illness ranged between 6 months and 30 years.

As shown in (Table 2), (Figure 3) and (Figure 4) the 53 patients included in our study (100%) revealed synovial thickening on US examination, where 2 patients (3.8%) showed grade 1, 36 patients (67.9%) showed grade 2 and 15 patients (28.3%) showed grade 3 synovial thickening, (Figure 1) a, b and c.

Regarding joint effusion, 21 patients (39.6%) showed no effusion while 4 patients (7.5%) showed grade 1, 23 patients (43.4%) showed grade 2 and 5 patients (9.4%) showed grade 3 joint effusions, (Figure 1) d, e and f.

Power Doppler signal was noted in 45 patients (84.9%), with 18 patients (34.0%) showing grade 1, 21 patients (39.6%) showing grade 2, and 6 patients (11.3%) showing grade 3 Power Doppler signal (Figure 2 a, b, and c). Bony erosions were detected in 14 patients (26.4%) in our study (Figure 2 d), while 39 patients (73.6%) showed no bony erosions.

Table 2: US findings of the examined patients (patients are graded according to the highest grade of the US findings in the same patient).

	Negative	Positive		
		Grade 1	Grade 2	Grade 3
Synovial thickening	0 (0.0%)	2 (3.8%)	36 (67.9%)	15(28.3%)
Effusion	21(39.6%)	4 (7.5%)	23 (43.4%)	5 (9.4%)
Power Doppler signal	8 (15.1%)	18 (34.0%)	21 (39.6%)	6 (11.3%)
Erosions	39(73.6%)		14 (26.4%)	

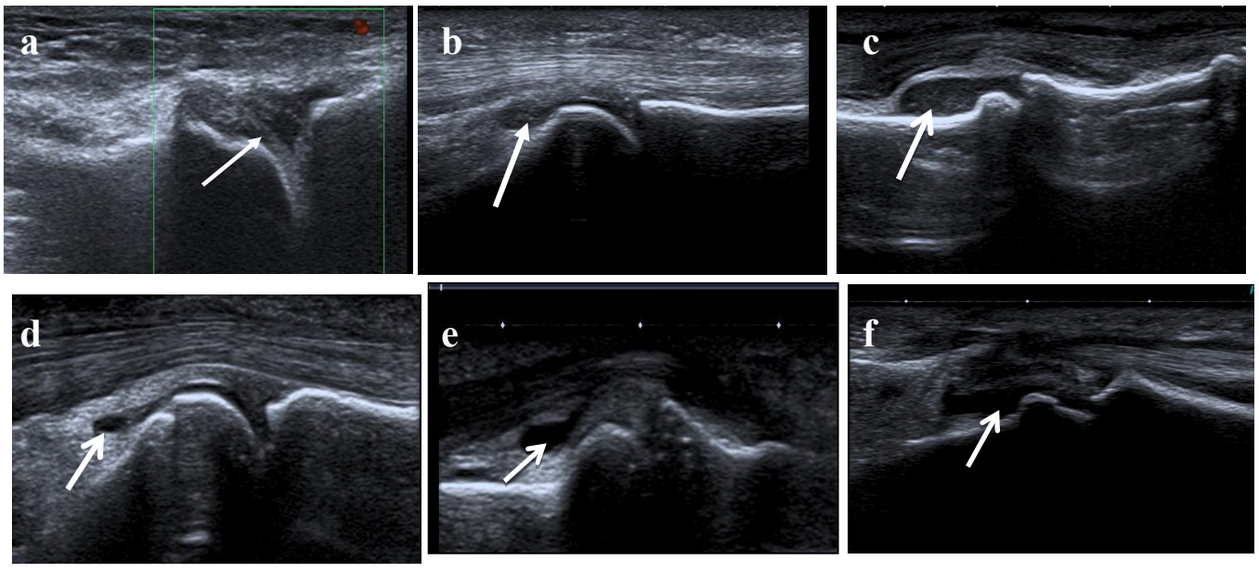

Fig. 1: (a) Grade 1 minimal synovial thickening, (b) grade 2: moderate synovial thickening bulging over the joint line but without extension along the bone diaphysis, (c) grade 3: extensive synovial thickening bulging over the joint line with extension along the bone diaphysis, (d) grade 1: minimal amount of joint effusion, (e) grade 2: moderate amount of joint effusion, (f) grade 3: extensive amount of joint effusion.

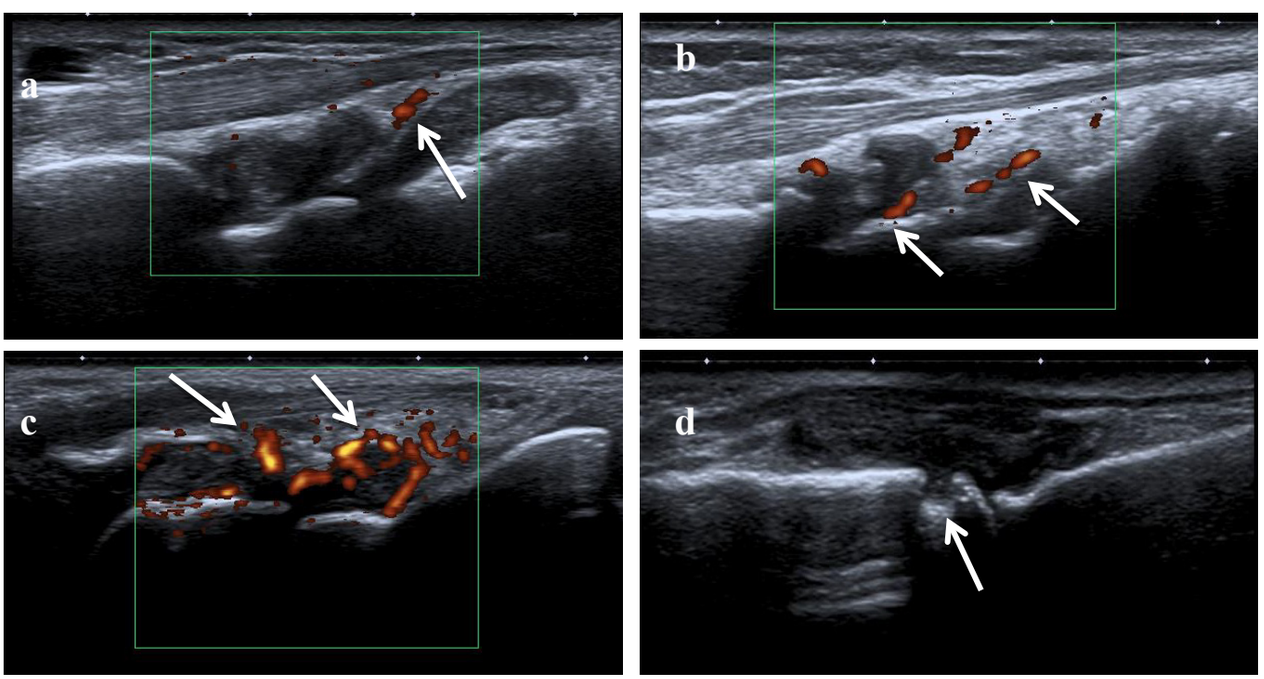

Fig. 2: (a) Grade 1 Power Doppler signal with few vessels (one or two) in the joint, (b) grade 2: Power Doppler signal less than 50% of the synovial area, (c) grade 3: Power Doppler signal more than 50% of the synovial area, and (d) bony erosions.

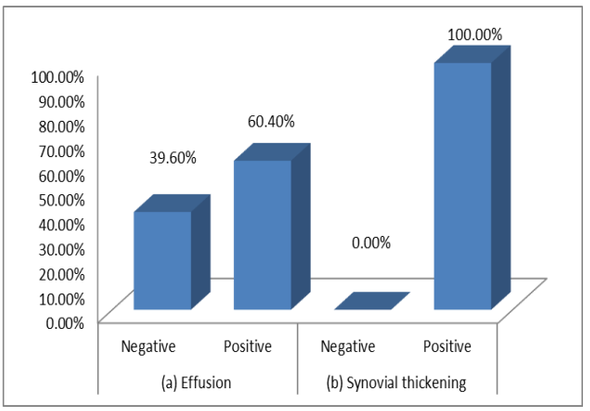

Fig. 3: Presence of joint effusion and synovial thickening among the studied patients.

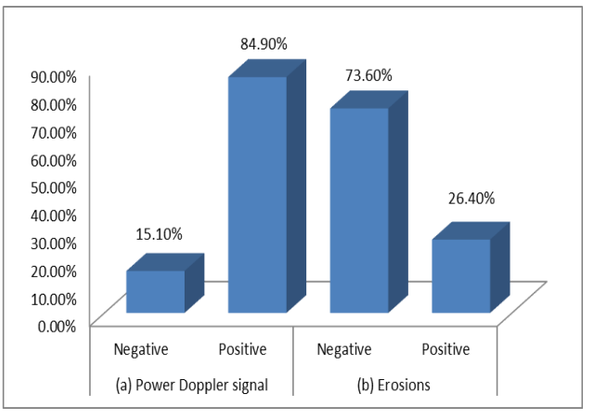

Fig. 4: Presence of power Doppler signal and bony erosions among the studied patients.

As shown in (Table 3), the different findings detected by ultrasound showed that the most impacted joint was the wrist joint, followed by the MCP joint then the PIP joint.

Table 3: Distribution of the ultrasound findings in the wrist & small hand joints among the studied cases, expressed as number and percentage of patients affected.

		Effusion	Synovial thickening	Power Doppler signal	Erosions
Wrist	Right	27 (50.9%)	53(100%)	34 (64.2%)	10 (18.9%)
	Left	12 (22.6%)	53(100%)	30 (56.6%)	5 (9.4%)
1st MCP	Right	8 (15.1%)	35 (66%)	9 (17%)	3 (5.7%)
	Left	4 (7.5%)	28 (52.8%)	5 (9.4%)	1 (1.9%)
2nd MCP	Right	8 (15.1%)	43 (81.1%)	6 (11.3%)	3 (5.7%)
	Left	7 (13.2%)	39 (73.6%)	5 (9.4%)	2 (3.8%)
3rd MCP	Right	12 (22.6%)	38 (71.7%)	3 (5.7%)	1 (1.9%)
	Left	9 (17%)	32 (60.4%)	1 (1.9%)	0 (0.0%)
4th MCP	Right	17 (32.1%)	30 (56.6%)	4 (7.5%)	0 (0.0%)
	Left	10 (18.9%)	22 (41.5%)	0 (0%)	0 (0.0%)
5th MCP	Right	15 (28.3%)	29(54.7%)	2 (3.8%)	0 (0.0%)
	Left	8 (15%)	19 (35.8%)	1 (1.9%)	0 (0.0%)
Thumb IP	Right	5 (9.4%)	12 (22.6%)	4 (7.5%)	0 (0.0%)
	Left	2 (3.8%)	7 (13.2%)	1 (1.9%)	0 (0.0%)
2nd PIP	Right	4 (7.5%)	13 (24.5%)	1 (1.9%)	0 (0.0%)
	Left	11 (20.8%)	15 (28.3%)	3 (5.7%)	0 (0.0%)
3rd PIP	Right	11 (20.8%)	19 (35.8%)	3 (5.7%)	1 (1.9%)
	Left	8 (15.1%)	21 (39.6%)	0 (0%)	0 (0.0%)
4th PIP	Right	8 (15.1%)	13 (24.5%)	4 (7.5%)	0 (0.0%)
	Left	7 (13.2%)	9 (17%)	1 (1.9%)	0 (0.0%)
5th PIP	Right	6 (11.3%)	14 (26.4%)	3 (5.7%)	0 (0.0%)
	Left	7 (13.2%)	6 (11.3%)	1 (1.9%)	1 (1.9%)

MCP: metacarpophalangeal; PIP: proximal inter-phalangeal; Thumb IP: Thumb inter-phalangeal.

As shown in (Table 4), serological assessment of the studied patients showed 25 patients (47.2%) with positive RF test while 28 patients (52.8%) with negative results. 43 patients (81.1%) showed positive anti-CCP test while 10 patients (18.9%) showed negative results. 8 patients (15.1%) showed normal ESR level, 19 patients (35.8%) showed moderate ESR elevation and 26 patients (49.1%) showed marked ESR elevation. 36 patients (67.9%) showed moderate CRP elevation and 17 patients (32.1%) showed marked CRP elevation. According to DAS 28 score, 27 patients (50.9%) had low to moderate disease activity, while 26 patients (49.1%) had severe disease activity.

Table 4: Laboratory investigation of the studied patients.

		Total no. = 53
ESR	Median (IQR)	40(30 – 65)
	Range	7 – 120
	Normal	8 (15.1%)
	Moderate	19 (35.8%)
	Marked	26 (49.1%)
CRP	Median (IQR)	6(4 – 12)
	Range	3 – 48
	Moderate	36 (67.9%)
	Marked	17 (32.1%)
RF	Median (IQR)	16(8 – 64)
	Range	2 – 321
	Negative	28 (52.8%)
	Positive	25 (47.2%)
Anti CCP	Median (IQR)	88(25 – 200)
	Range	4 – 607
	Negative	10 (18.9%)
	Positive	43 (81.1%)
DAS 28	Mean ± SD	5.35 ± 1.40
	Range	2.53 – 7.93
	Low to moderate	27 (50.9%)
	Severe	26 (49.1%)

Distribution of Rheumatoid Arthritis cases based on their Laboratory Investigations and clinical data.

Table 5: The significant relations between RF and ultrasound findings.

	RF						
	Negative No. = 28		Positive No. = 25		Test value	*P-value*	Sig.
Synovial thickening in dorsal(Right)							
2nd MCP	15	53.6%	21	84.0%	5.613	0.018	S
Thumb IP	0	0.0%	4	16.0%	4.846	0.028	S
Effusion in dorsal (Right)							
5th MCP	5	17.9%	0	0.0%	4.929	0.026	S
1st MCP	4	14.3%	0	0.0%	3.863	0.049	S

Statistical analysis showed significant correlation between RF and synovial thickening detected by Ultrasound in dorsal right 2nd MCP and thumb IP with *p-value* 0.018 and 0.028 respectively, a significant correlation was also found between RF and joint effusion in dorsal right 5th MCP and 1st MCP with *p-value* 0.026 and 0.049 respectively. Conversely, there was no statistically significant relationship between RF and both power Doppler activity and bony erosions.

Table 6: The significant relations between Anti CCP and ultrasound findings.

	Anti CCP						
	Negative No. = 10		Positive No. = 43		Test value	*P-value*	Sig.
Effusion in Dorsal (Right)							
Wrist	1	10.0%	26	60.5%	8.268	0.004	HS
Power Doppler signal in dorsal (Right)							
Wrist	3	30.0%	31	72.1%	6.251	0.012	S

A significant association was detected between anti-CCP levels and effusion detected by ultrasound in the dorsal right wrist joint, with a *p-value* of 0.004, a significant association was also observed between anti-CCP levels and power Doppler signal detected by ultrasound in the dorsal right wrist joint, with a *p-value* of 0.012. Conversely, there was no statistically significant correlation between anti-CCP and both synovial thickening and bony erosions.

Table 7: The significant relations between ESR and ultrasound findings.

	ESR											
	Normal No. = 8		Moderate No. = 19		Marked No. = 26		Test value	*P-value*	Sig.			
Synovial thickening in dorsal(Left)												
5th MCP	0 (	0.0%	2 (	10.5%	9 (	34.6%	6.341	0.042	S			
2nd MCP	6 (	75.0%	9 (	47.4%	22 (	84.6%	7.347	0.025	S			
2nd PIP	3 (	37.5%	0 (	0.0%	6 (	23.1%	6.961	0.031	S			
Effusion in Volar(Right)												
5th PIP	3 (37.5%)		2 (10.5%)		1 (3.8%)		6.920*	0.031	S			
Effusion in Volar (left)												
4th MCP	2 (25.0%)		6 (31.6%)		1 (3.8%)		6.419*	0.040	S			

A significant correlation was found between ESR and synovial thickening detected by Ultrasound in dorsal left 5th MCP, 2nd MCP and 2nd PIP with *p-value* 0.042, 0.025 and 0.031 respectively, a significant correlation was also found between ESR and effusion detected by Ultrasound in volar right 5th PIP and volar left 4th MCP with *p-value* 0.031 and 0.040 respectively. Conversely, no statistically significant association was found between ESR, power Doppler signal, and bony erosions.

Table 8: The significant relations between CRP and ultrasound findings.

	CRP						
	Moderate No. = 36		Marked No. = 17		Test value	*P-value*	Sig.
Synovial thickening in dorsal(Right)							
3rd PIP	3	8.3%	5	29.4%	4.003*	0.045	S
2nd PIP	3	8.3%	5	29.4%	4.003*	0.045	S
Synovial thickening in dorsal (left)							
5th MCP	4	11.1%	7	41.2%	6.346*	0.012	S
3rd MCP	19	52.8%	4	23.5%	4.021*	0.045	S
Synovial thickening in volar (Right)							
Wrist	22	61.1%	16	94.1%	6.199*	0.013	S
5th PIP	2	5.6%	5	29.4%	5.733*	0.017	S
Synovial thickening in volar (left)							
5th PIP	0	0.0%	6	35.3%	14.328*	0.000	HS
4th PIP	1	2.8%	5	29.4%	8.159*	0.004	HS
3rd PIP	8	22.2%	9	52.9%	5.001*	0.025	S
1st MCP	3	8.3%	5	29.4%	4.003*	0.045	S
Effusion in Dorsal (Right)							
3rd MCP	0	0.0%	2	11.8%	4.401*	0.036	S
Effusion in Dorsal (left)							
Wrist	3	8.3%	5	29.4%	4.003*	0.045	S
Effusion in Volar(Right)							
Wrist	1	2.8%	4	23.5%	5.820*	0.016	S
1st MCP	0	0.0%	5	29.4%	11.691*	0.001	HS
Effusion in Volar (left)							
Wrist	1	2.8%	5	29.4%	8.159*	0.004	HS
5th PIP	2	5.6%	5	29.4%	5.733*	0.017	S
3rd MCP	3	8.3%	5	29.4%	4.003*	0.045	S
3rd PIP	2	5.6%	6	35.3%	7.968*	0.005	HS
2nd MCP	2	5.6%	5	29.4%	5.733*	0.017	S
2nd PIP	3	8.3%	8	47.1%	10.529*	0.001	HS
1st MCP	0	0.0%	2	11.8%	4.401*	0.036	S
Power Doppler signal in dorsal (Right)							
3rd PIP	0	0.0%	2	11.8%	4.401*	0.036	S
Power Doppler signal in volar (Right)							
Wrist	0	0.0%)	2 (	11.8%)	4.401*	0.036	S
3rd PIP	0	0.0%)	2 (	11.8%)	4.401*	0.036	S
Power Doppler signal in volar (left)							
Wrist	0	0.0%)	2 (	11.8%)	4.401*	0.036	S
2nd MCP	0	0.0%)	3 (	17.6%)	6.734*	0.009	HS
Erosions in dorsal (Right)							
2nd MCP	0	0.0%	2	11.8%	4.401*	0.036	S

There was statistically significant relationship between CRP and synovial thickening in dorsal right 3rd PIP, dorsal right 2nd PIP, dorsal left 5th MCP, dorsal left 3rd MCP, volar right wrist, volar right 5th PIP, volar left 3rd PIP and volar left 1st MCP with *p-value* 0.045, 0.045, 0.012, 0.045, 0.0013, 0.017, 0.025 and 0.045 respectively. A highly significant correlation was found between CRP and synovial thickening in volar left 5th PIP and volar left 4th PIP with *p-value* 0.000 and 0.004 respectively.

There was statistically significant relationship between CRP and effusion detected by Ultrasound in dorsal right 3rd MCP and dorsal left wrist joint with *p-value* 0.036 and 0.045 respectively, volar right wrist joint with *p-value* 0.016, volar left 5th PIP, 3rd MCP, 2nd MCP and 1st MCP with *p-value* 0.017, 0.045, 0.017 and 0.036 respectively. A highly significant correlation was noted between CRP and effusion in volar right 1st MCP with *p-value* 0.001, volar left wrist, 3rd PIP and 2nd PIP with *p-value* 0.004, 0.005 and 0.001 respectively.

There was statistically significant relation between CRP and power Doppler signal detected by Ultrasound in dorsal right 3rd PIP with *p-value* 0.036, volar right wrist, 3rd PIP and volar left wrist with *p-value* 0.036, 0.036 and 0.036 respectively. A highly significant correlation was found between CRP and power Doppler signal in the volar left 2nd MCP, with a *p-value* of 0.009.

There was statistically significant correlation between CRP and erosions detected by Ultrasound in dorsal right 2nd MCP with *p-value* 0.036.

Table 9: The significant relations between DAS 28 and ultrasound findings.

	DAS 28						
	Low to moderate No. = 27		Severe No. = 26		Test value	*P-value*	Sig.
Synovial thickening in dorsal(Right)							
5th PIP	1	3.7%	6	23.1%	4.337	0.037	S
2nd PIP	1	3.7%	7	26.9%	5.572	0.018	S
Synovial thickening in dorsal (left)							
5th MCP	1	3.7%	10	38.5%	9.729	0.002	HS
Synovial thickening in volar (left)							
4th PIP	0	0.0%	6	23.1%	7.026	0.008	HS
2nd PIP	1	3.7%	9	34.6%	8.268	0.004	HS
Power Doppler signal in dorsal (Right)							
1st MCP	0	0.0%	5	19.2%	5.733	0.017	S
Power Doppler signal in dorsal (left)							
Wrist	9	33.3%	21	80.8%	12.133	0.000	HS
Power Doppler signal in volar (Right)							
2nd MCP	0	0.0%	4	15.4%	4.493	0.034	S
1st MCP	0	0.0%	6	23.1%	7.026	0.008	HS
Power Doppler signal in volar (left)							
1st MCP	0	0.0%	4	15.4%	4.493	0.034	S

There was statistically significant correlation between DAS 28 and synovial thickening in dorsal right 5th PIP and 2nd PIP with *p-value* 0.037 and 0.018 and respectively. A highly significant correlation was noted between DAS 28 and synovial thickening in dorsal left 5th MCP, volar left 4th PIP and 2nd PIP with *p-value* 0.002, 0.008 and 0.004 respectively.

There was statistically significant correlation between DAS 28 and power Doppler signal in dorsal right 1st MCP, volar right 2nd MCP and volar left 1st MCP with *p-value* 0.017, 0.034 and 0.034 respectively. A highly significant correlation was noted between DAS 28 and power Doppler signal in dorsal left wrist and volar right 1st MCP with *p-value* 0.000 and 0.008 respectively. There was no statistically significant correlation between DAS 28 and joint effusion or between DAS 28 and erosions in right- and left-hand joints.

DISCUSSION

Our study involved 53 patients with chronic RA, comprising 51 females (96.2%) and 2 males (3.8%). Ages

ranged from 23 to 75 years, with a mean age of 46.28 ± 9.69 years. The duration of the illness ranged from 0.5 to 30 years, with a median (IQR) of 6 (3–12) years. This suggests that the study participants had advanced RA with considerable disease progression and synovial proliferation, underscoring the importance of evaluating the extent of lesion activity. The mean DAS28 was [5.35 ± 1.40], Median (IQR) ESR [40(30 – 65)], CRP [6(4 – 12)], (47.2%) of the patients were RF positive and (81.1%) of the patients were anti CCP positive.

In the present study, synovial thickening was detected in 53 patients (100%) which is close to the study results of ***Scire et al.***[12], where synovial thickening was detected in 95% of the examined patients.

In this study, wrist and MCP were the most affected by synovial thickening. The second metacarpophalangeal (2nd MCP) joint was the most affected by synovial thickening, with percentages of 81% on the right side and 73.6% on the left side. This coincides with the study conducted by ***Diamanti et al.***[13] which concluded that US examination of both wrists and 2nd MCP of the dominant hand showed a sensitivity of 90% for detecting subclinical synovitis.

Regarding power Doppler activity, 45 patients (84.9%) in the present study showed increased vascularity on power Doppler assessment, of those wrist joints were the most affected accounting for 64 wrist joints (60.4%) with 34 wrist joint (64.2%) on the right side and 30 wrist joint (56.6%) on the left side. This correlates with the results of ***Abdel Sattar et al.***[14] that showed positive signal by power Doppler in 30 wrist joints (60%).

Our findings do not match with the work of ***Filer et al***.[15], who found power Doppler signal in 28.7% of the examined small joints of the hand. This could be attributed by the fact that most of the patients enrolled in our study have chronic rheumatoid arthritis, while ***Filer et al*** study was conducted on patients with very early synovitis. This could be explained by the fact that synovial thickening and Doppler activity increase with the progression of the disease.

In the present study, joint effusion was detected in 32 patients (60.4%) particularly in MCP joints, which is close to the results of ***Saad et al.***[16] that reported effusion in (66.7%) of the studied cases.

Bony erosion could be identified by US in 14 patients (26.4%) in the current study, which correlates with ***Yang et al.***[17], who revealed bony erosions in 15 patients (28.30%). Also, the study performed by ***Saran et al.***[18] concluded that US is a reliable method for assessing bony erosive changes in the small hand joints with comparable results to MRI. Additionally, this aligns with the research conducted by ***Peran et al.***[19] that revealed a great role of ultrasound for detection of erosion progression in rheumatoid arthritis.

Our study showed that ultrasound has better diagnostic value compared with laboratory investigation as synovitis, in the form of synovial thickening, which is the hallmark of rheumatoid arthritis could be detected in 53 patients (100%) in our study, while RF test was positive in only 25 patients (47.2%) and anti-CCP was positive in only 43 patients (81.1%).

This correlates with the study done by ***Zhang et al.***[20], who stated that ultrasound was more efficient at identifying early synovitis than laboratory and clinical investigations (p=0.00015; q=4.548), as well as the study by Ten ***Cate et al.***[21], which stated that ultrasound identified a higher number of inflamed joints per patient than clinical examination in the diagnosis of RA.

This was also consistent with the study conducted by ***Kelsey and Patrick***[22], which found that ultrasound was definitive in diagnosing RA when radiographic findings were uncertain and laboratory analysis was negative.

There was a statistically significant association between CRP, ESR, and DAS28 with ultrasound findings of RA. Yet, a more significant association was noted between CRP and DAS28 with effusion, synovial thickening, and power Doppler signal. Conversely, ESR showed a less significant correlation with ultrasound findings, exhibiting only a positive correlation with effusion in two joints (volar right 5th PIP and volar left 4th MCP) and synovial thickening in three joints (dorsal left 5th MCP, 2nd MCP, and 2nd PIP), with no significant association between ESR and the power Doppler signal.

This finding might be attributed to CRP's greater sensitivity compared to ESR in detecting low-grade and/or recent-onset inflammation. This finding is consistent with the study by ***Dejaco et al.***[23], which showed that both ESR and CRP were adjunctive to sonographic measures of disease activity at baseline. However, once clinical remission was achieved (characterized by decreased disease activity and low-grade inflammation) only CRP remained correlated with ultrasound findings of disease activity. This is consistent with the study by ***Wang et al.***[24], which demonstrated that grey scale and power Doppler ultrasound assessment of joints were positively correlated with DAS28, CRP, and ESR.

There was no statistically significant relationship between erosions and laboratory investigations. This finding does not align with the study made by ***Tharwat et al.***[25], which demonstrated a significant correlation between bone erosions and DAS28 (*p-value* = 0.003) as well as between bone erosions and ESR (*p-value* = 0.005).

CONCLUSION

Ultrasound has a better value compared to using only laboratory investigation and clinical data in assessment of RA, as it can assess both soft tissue and erosive joint changes that occur in RA and differentiate between inactive and active synovial hypertrophy by using power Doppler signal.Consequently, enhancing the effectiveness of standard clinical evaluation in rheumatoid synovial inflammation.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest associated with the publication of this work.

ABBREVIATION LIST

RA: Rheumatoid Arthritis

US: Ultrasound

GS: Grey Scale

PD: Power Doppler

ACR: American College of Rheumatology

EULAR: European League Against Rheumatism

RF: Rheumatoid Factor

Anti-CCP: Anti–cyclic citrullinated peptide

ESR: Erythrocyte sedimentation rate

CRP: C-reactive protein

DAS28: Disease Activity Score in 28 Joints

MCP: metacarpophalangeal

PIP: proximal inter-phalangeal

Thumb IP: Thumb inter-phalangeal.

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دور الموجات فوق الصوتية والدوبلر في تقييم النشاط الزلالى لمفاصل الرسغ واليد في التهاب المفاصل الروماتويدي

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الخلفية: التهاب المفاصل الروماتويدي هو مرض التهابي مزمن يترافق مع قصور وظيفي كبير وإعاقة. يسمح التشخيص بالموجات فوق الصوتية والدوبلر بأخذ تصور شامل للتغيرات المورفولوجية والهيكلية والتغذية الدموية التي يسببها التهاب الغشاء المفصلي الروماتويدي على مستوى المفاصل والأوتار.

تعمل هذه الدراسة على اثبات فاعلية التشخيص بالموجات فوق الصوتية والدوبلر في تقييم حالات التهاب المفاصل الروماتويدى في مفصل الرسغ والمفاصل الصغيرة لليد.

شملت هذه الدراسة ٥٣ مريضاً مصاباً بالتهاب المفاصل الروماتويدي، ٥١ أنثى (٩٦,٢٪) و٢ من الذكور (٣,٨٪). تراوحت أعمارهم بين ٢٣-٧٥ سنة مع متوسط العمر [٤٦,٢٨ ± ٩,٦٩]، وكان متوسط DAS٢٨ [٥,٣٥ ± ١,٤٠]، وكان متوسط (IQR) ESR [٤٠(٣٠ – ٦٥)]، CRP [٦(٤ – ١٢))]، RF [١٦(٨ – ٦٤)]، مضاد CCP [٨٨(٢٥ – ٢٠٠)] لم يظهر ٢١ مريضًا (٣٩,٦٪) أي ارتشاح في المفاصل، بينما أظهر ٣٢ مريضًا (٦٠,٤٪) ارتشاحا في المفاصل، و٥٣ مريضًا (١٠٠,٠٪)) أظهر سماكة المفصل الزلالى، ولم يظهر ٨ مرضى (١٥,١٪) أي إشارة دوبلر قوية، بينما أظهر ٤٥ مريضًا (٨٤,٩٪) إشارة دوبلر قوية و ٣٩ مريضًا (٧٣,٦٪) لم يعانيوا من تآكلات عظمية، بينما كان لدى ١٤ مريضًا (٢٦,٤٪) تآكلات عظمية. تم العثور على ارتباطات إيجابية بين نشاط المرض السريري والتحاليل المعملية ومدة المرض ونتائج فحص جهاز الموجات الصوتية.

تعد الموجات فوق الصوتية ذات النطاق الرمادي تقنية موثوقة لتقييم كل من الأنسجة وتغيرات المفاصل التآكلية التي تحدث في التهاب المفاصل الروماتويدي، كما أن اشارة دوبلر قادرة على التمييز بين تضخم الزليلي غير النشط والنشط. حيث يمكنه اكتشاف تدفق الدم البطيء والمنخفض الحجم، وبالتالي تحسين نتائج التقييم السريري القياسي في الالتهاب الزليلي الروماتويدي.