Assessment of Carpal Tunnel Syndrome (Cts) In Patients with Rheumatoid Arthritis in Basrah, South of Iraq

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Abstract

Background: Rheumatoid arthritis (RA) is an inflammatory, long-term systemic autoimmune disease with extra-articular manifestations(EAMs). One of the most common EAMs associated with rheumatoid arthritis is median nerve entrapment at wrist (Carpal Tunnel Syndrome), occurring in about 30% of rheumatoid arthritis patients.

Aims: This study aimed to determine the prevalence of Carpal Tunnel Syndrome among rheumatoid arthritis patients in Basrah, south of Iraq, and to assess its clinical and electrophysiological changes.

Methods: A cross-sectional study was carried out in Basrah governorate, south of Iraq on patients with confirmed diagnosis of rheumatoid arthritis. Their clinical, and electrophysiological characteristics using nerve conduction studies were documented.

Results: Out of 110 individuals with rheumatoid arthritis, 44 (40%) were diagnosed with carpal tunnel syndrome. The CTS and non-CTS groups exhibited no significant differences in age, sex, BMI, RA duration, disease activity, treatment, or laboratory parameters (all $P>0.05$), however, smoking was much more common among CTS patients ($P=0.003$). Bilateral involvement was predominant (72.7%). Nerve conduction examinations revealed markedly prolonged median motor and sensory latencies, diminished conduction velocities, and decreased sensory amplitudes in patients with CTS (all $P<0.01$), but median motor amplitudes remained unchanged. Ulnar nerve parameters exhibited considerable variation (all $P\leq0.006$). Needle electromyography of the abductor pollicis brevis demonstrated neurogenic alterations in about one-third of patients bilaterally, accompanied by rare spontaneous activity.

Conclusions: Carpal tunnel syndrome impacts 40% of rheumatoid arthritis patients, with a significant 72.7% exhibiting bilateral involvement, and is mostly a localized entrapment neuropathy not associated with systemic inflammation or disease activity. Cigarette consumption shown a notable correlation with CTS ($P=0.003$). Electrophysiological assessment revealed bilateral median nerve demyelination accompanied by varying degrees of axonal involvement and neurogenic EMG alterations in one-third patients. we recommend routine CTS screening in all RA patients, early electrophysiological evaluation, cessation of smoking, local wrist assessment, and future studies on synovitis control and CTS prevention.

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Keywords: Rheumatoid arthritis, carpal tunnel syndrome, electrophysiological studies

1. Introduction

Rheumatoid arthritis (RA) is an inflammatory, long-term systemic autoimmune disease. It is characterized by symmetrical synovial joint inflammation which can progress to joint destruction with cartilage loss and bone erosions [1]. Its prevalence varies depending on geographical location but in general it ranges from 0.25% to 1%, females are 2 to 3 times more affected than

males, people who are older than 40 years old have increased incidence of RA, but it could be presented at any age group [2].

One of the most common extra-articular complications of rheumatoid arthritis is entrapment neuropathy, which occurs when peripheral nerves are compressed or irritated as they pass through constricted anatomical spaces [3, 4].

Carpal tunnel syndrome (CTS) is considered the most prevalent compressive neuropathy in clinical practice [5]. Occurs in about 30% of rheumatoid arthritis patients, The predominant observation of (CTS) in rheumatoid arthritis patients is inflammation of the synovial tissue, such as tenosynovitis of the flexor tendons of the fingers and synovitis of the radiocarpal joint, rather than swelling of the median nerve (MN) that occurs in idiopathic CTS [6].

The sensory part of median nerve is first affected in CTS, and the patient presented with numbness specially at night, which gradually develop into pain and burning sensation in the median-innervated fingers (thumb, index, middle and half of the ring finger), later on motor involvement occur resulting in wasting of the radial side of the thenar muscles and weakness of thumb opposition which is sometimes difficult to assess in rheumatoid arthritis because of hand deformity [7]. The symptoms usually worsen after long or repetitive hand use as in typing, holding a book or driving, and improve when the hands are shaken out or placed under running water.

Although the diagnosis of CTS is mainly clinical based on history and examination, electrodiagnostic study can help in confirming the diagnosis, assessing the severity and exclude other disorders [8]. NCS are considered the gold standard test for diagnosing CTS with 94% specificity and approximately 56-85 % sensitivity rates [9].

2. Patients and Methods

A cross-sectional study was carried out in Basrah governorate, south of Iraq, on rheumatoid arthritis patients attending the biological center and the Rheumatology outpatients' clinic in Basrah teaching hospital and referred for electrophysiological testing at the neurophysiology outpatients' clinic in both Basrah teaching hospital and Basrah specialized children's hospital. The study was conducted over a 12-month period, from 1st October 2024 to 1st October 2025. The study was conducted on 110 subjects of both sexes (male and female) of diverse age groups ranging from 20-70 years. The patients were diagnosed with rheumatoid arthritis according to 2010 ACR/EULAR diagnostic criteria and were on different medications including biological agents, methotrexate, steroids or combination therapy. Patients less than 20 years or more than 75 years of age were excluded from the study.

Data collection of the study started with active surveying and identification of rheumatoid arthritis cases. Then, the patients were interviewed directly for the information required on thorough demographics, recent neurological illness clinical manifestations, medical history, drug history, clinical examination and to get their agreement to participate in the study. Electrophysiological testing was performed using surface and needle electrodes on a Nihon Kohden Neuropack S3, and the diagnosis of carpal tunnel syndrome (CTS) was confirmed.

The reference values of the NCS parameters of the studied nerves (Preston, Kimura) were used to define the test results as normal or abnormal. Data were analyzed using SPSS (Statistical Package for the Social Sciences) version 26 statistical computer program. The numerical data were reported as mean ± standard deviation. A two-sample t-test was used for comparing two groups. Categorical data were presented in tabular form as percentages (%) and evaluated using Chi-square or Fisher exact tests. Statistical significance was defined as a P value of ≤ 0.05.

3. Results

Table 1 presents an overview of the general characteristics of patients with rheumatoid arthritis. Out of the 110 participants, 44 were diagnosed with CTS while 66 were not. The CTS and non-CTS groups exhibited no notable disparities in age, sex, weight, height, BMI, or duration of rheumatoid arthritis (all $P > 0.05$). Nonetheless, the smoking status exhibited a substantial disparity between the groups ($P = 0.003$), with both active and passive smoking being more prevalent among patients with CTS, but the majority of individuals in both cohorts were non-smokers.

Table 1: General characteristics of the RA patients

Parameter		CTS (n=44)	No CTS (n=66)	P value
Age (years)		46.73±10.6	48.5±8.4	0.356
sex	Male	7 (6.4%)	9 (8.2%)	0.787
	Female	37 (33.6%)	57 (51.8%)	
Weight (kg)		76.7±13.8	81.1±16.5	0.139
Height (cm)		163.3±8.6	163.8±10.5	0.738
BMI (kg/m²)		29±5.6	30.4±6.5	0.211
Duration of RA (months)		118.4±91.9	94.5±71.2	0.149
Smoking	Non-smoker	36(32.7%)	61(55.5%)	0.003
	Active smoker	6(5.5%)	1(1.5%)	
	Passive smoker	2(1.8%)	0 (0%)	
	Ex-smoker	0 (0%)	4 (3.6%)	
Chi-square test, ANOVA BMI: Body mass index				

Table 2 presents the distribution of RA patients according to disease activity, type of treatment, and symptom status. No statistically significant differences were detected between patients with and without CTS concerning RA disease activity, treatment modalities, or symptoms (all P > 0.05). Moderate disease activity was the predominant category in both cohorts, and the combination of biological therapy with methotrexate was the most often administered intervention. Symptomatic illness was observed more frequently in patients with CTS (72.7%) compared to those without CTS (56.1%), however the disparity was not statistically significant (P = 0.107).

Table 2: Distribution of RA patients according to disease activity, type of treatment, symptoms, and past medical history (n=110)

Parameter	Disease activity	CTS (n=44)	No CTS (n=66)	P value
RA activity	Low activity	7(15.9%)	6 (9.1%)	0.511
	Moderate activity	23 (52.3)	34 (51.5%)	
	High activity	14 (31.8%)	26 (39.4%)	
Type of treatment	Biological	8(18.2%)	8 (12.1)	0.853
	MTX	2(4.5%)	3(4.5%)	
	Biological and MTX	27(61.4%)	42(63.6%)	
	Biological and prednisolone	5(11.4%)	7 (10.6%)	
	Biological, MTX and prednisolone	2(4.5%)	6(9.1%)	
Symptoms	Symptomatic	32(72.7%)	37(56.1%)	0.107
	Asymptomatic	12(27.3%)	29(43.9%)	
Chi-square Test RA: Rheumatoid arthritis; MTX: Methotrexate Disease activity was determined according to simplified disease activity index (SDAI) composite measure.				

Table 3 presents the comparison of laboratory parameters between RA patients with and without CTS. No statistically significant differences were detected between the two groups regarding red blood cell count, white blood cell count, platelet count, hemoglobin concentration, erythrocyte sedimentation rate (ESR), or C-reactive protein (CRP) levels (all P > 0.05).

Table 3: Hematological parameters of RA patients, n=110. mean±SD

Parameter	CTS (n=44)	No CTS (n=66)	P value
RBC ($\times 10^6/mm^3$)	4.5±5.3	4.8±0.88	0.81
WBC ($\times 10^3/mm^3$)	7.07±2.25	6.91±1.98	0.697
Platelets ($\times 10^3/mm^3$)	286.98±71.26	298.9±85.58	0.447
Hb (gm%)	11.91±1.93	11.82±1.78	0.794
ESR (mm/hr)	34.29±22.08	31.9±21.3	0.571
CRP (mg/L)	7.01±7.19	7.07±7.87	0.966
ANOVA. RBC: Red blood cell; WBC: White blood cell; Hb: Hemoglobin; ESR: Erythrocyte sedimentation rate; CRP: C. reactive protein			

Table 4 illustrates the distribution of the affected hand in RA patients with carpal tunnel syndrome. The most prevalent manifestation was bilateral hand involvement in 32 individuals (72.7%), right-hand involvement in 7 patients (15.9%) and left-hand involvement in 5 patients (11.4%). This finding indicates that the majority of cases of CTS in RA patients were bilateral.

Table 4: affected hand in RA patients with carpal tunnel syndrome, n=44.

Affected hand	Frequency	Percentage (%)
Right	7	15.9
Left	5	11.4
Bilateral	32	72.7
Total	44	100

The parameters of nerve conduction studies in RA patients with and without CTS are compared in Table 5. Patients with CTS had significantly longer motor and sensory latencies and significantly slower conduction velocities of the median nerve bilaterally than control subjects (all P < 0.01). Median sensory nerve amplitudes were considerably lower in the CTS group (all P < 0.001). Median motor amplitudes were not statistically different between the groups. In addition, ulnar nerve conduction investigations showed significant differences in latency and conduction velocity, and lower sensory amplitudes in individuals with CTS (all P<0.01), but ulnar motor amplitudes were similar in both groups.

Table 5: results of NCS in RA patients, n=110. mean±SD

Nerve	parameter	CTS (n=44)	No CTS (n=66)	P value
Median motor R	Latency	3.947±0.83	3.141±0.36	<0.001
	Amplitude	8.921±3.75	9.367±2.36	0.448
	CV	56.563±5.44	59.544±4.52	0.002
Median motor L	Latency	3.791±0.69	3.056±0.37	<0.001
	Amplitude	7.840±3.49	8.676±2.36	0.139
	CV	56.998±5.88	61.033±5.37	<0.001
Ulnar motor R	Latency	2.248±0.27	2.536±0.42	<0.001
	Amplitude	8.543±1.97	8.494±1.91	0.896
	CV	60.339±7.30	64.188±6.79	0.006
Ulnar motor L	Latency	2.575±0.43	2.215±0.26	<0.001
	Amplitude	10.09±8.6	8.461±1.87	0.138
	CV	59.364±8.36	64.624±7.71	0.001
Median sensory R	Latency	2.914±0.41	2.255±0.20	<0.001
	Amplitude	30.698±12.16	41.826±15.5	<0.001
	CV	44.198±6.96	54.839±5.88	<0.001
Median sensory L	Latency	2.836±0.39	2.238±0.17	<0.001
	Amplitude	36.962±19.23	49.933±17.13	<0.001
	CV	45.521±8.04	55.741±5.39	<0.001
Ulnar sensory R	Latency	2.177±0.29	1.967±0.23	<0.001
	Amplitude	29.764±14.03	38.798±15.26	0.002
	CV	50.509±6.39	54.191±6.40	0.004
Ulnar sensory L	Latency	2.161±0.30	1.914±0.17	<0.001
	Amplitude	35.000±18.50	47.220±16.86	0.001
	CV	51.123±6.84	55.970±6.11	<0.001
ANOVA				

The EMG findings of the abductor pollicis brevis (APB) muscle are shown in Table 6. The majority of patients had normal EMG findings. About one third of patients had neurogenic motor unit potentials, polyphasic potentials, increased insertional activity, and reduced recruitment. Spontaneous activity was seen only infrequently, in one patient on each side.

Table 6: Electromyographic (EMG) findings of the abductor pollicis brevis (APB) muscle among RA patients with carpal tunnel syndrome. (n = 44).

muscle	EMG parameters	findings		Total
Right abductor pollicis brevis (APB)	Motor unit potential	Normal 28	Neurogenic 11	39
	Polyphasic potentials	Normal 28	Polyphasic 11	39
	Insertional activity	Normal 28	Increase 11	39
	Spontaneous activity	Absent 38	Present 1	39
	Recruitment pattern	Normal 28	Reduce recruitment 11	39
Left abductor pollicis brevis (APB)	Motor unit potential	Normal 25	Neurogenic 12	37
	Polyphasic potentials	Normal 25	Polyphasic 12	37
	Insertional activity	Normal 25	Increase 12	37
	Spontaneous activity	Absent 36	Present 1	37
	Recruitment pattern	Normal 25	Reduce recruitment 12	37

4. Discussion

The current study revealed that carpal tunnel syndrome (CTS) is a prevalent neurological complication in individuals with rheumatoid arthritis (RA), but its occurrence showed no significant variation based on age, sex, body weight, height, body mass index (BMI), or duration of RA, indicating that general demographic and anthropometric factors may play a minimal role in influencing CTS risk after RA has developed. Conversely, smoking status demonstrated a distinct and statistically significant correlation with CTS, suggesting that both active and passive tobacco smoke exposure may serve as a crucial modifiable factors influencing median nerve compression in RA, potentially via vascular and inflammatory pathways that intensify local tissue injury around the wrist. From a biological perspective, smoking can exacerbate both systemic and localized inflammation, impede microvascular circulation around the wrist, and thereby contribute to compression and ischemic damage of the median nerve within an already inflamed RA joint. These results align with extensive evidence indicating that rheumatoid arthritis (RA) heightens vulnerability to carpal tunnel syndrome (CTS) as an extra-articular manifestation, while smoking is a well-established environmental risk factor that exacerbates RA activity and fosters systemic inflammation, potentially leading to peripheral neuropathies [5, 9, 12, 13].

In this cohort, carpal tunnel syndrome (CTS) was observed across all levels of RA activity, with no significant differences between low, moderate and high SDAI categories (Table 2), suggesting that the risk of CTS is not directly driven by global disease activity scores [14, 15]. Similarly, the incidence of CTS was not substantially different between individuals treated with biologic drugs, methotrexate or their combinations, suggesting that the existing treatment

strategies for RA may be effective in decreasing the overall inflammation but may not be adequate to prevent completely the entrapment of the median nerve at the wrist [6]. The identification of both symptomatic and asymptomatic cases of CTS underlines that CTS can be both silent and have clinical effects, hence underlining the importance of screening RA patients regularly for median nerve compression regardless of disease activity or treatment modality [6, 15].

As was shown by Table 3, there was no statistically significant difference in hematological indices and systemic inflammatory markers including RBC count, WBC count, platelet count, hemoglobin, ESR and CRP between RA patients with and without carpal tunnel syndrome (CTS), suggesting that the occurrence of CTS in RA is not closely related to routine blood parameters or general inflammatory burden as measured by these tests. This trend supports the idea that CTS in RA is mainly a localized entrapment neuropathy due to structural and synovial changes in the wrist, instead of differences in systemic hematological or inflammatory status. It also underscores the need to consider clinical and local imaging assessment of the wrist in detecting CTS rather than blood markers alone. The comparable ESR and CRP levels in RA patients with and without CTS in our present study are consistent with earlier evidence that these markers are only weakly associated with RA disease activity and can be within normal limits in the setting of clinically significant joint involvement [6, 15, 16, 17]. This supports the notion that CTS in RA is mainly related to local wrist pathology and not to systemic inflammatory burden and that normal inflammatory indicators do not exclude clinically relevant median nerve compression.

In our cohort of RA patients with carpal tunnel syndrome (CTS), bilateral involvement was predominant (72.7%), while isolated right- and left-sided CTS accounted for 15.9% and 11.4%, respectively (Table 4). This pattern is consistent with prior reports showing that CTS in RA is frequently bilateral, reflecting the systemic and symmetric nature of wrist synovitis and flexor tenosynovitis in rheumatoid arthritis. For example, Mahmoud *et al*. reported CTS in 95.9% of assessed wrists among RA patients, implying very high bilateral involvement in those with electrophysiologic or ultrasound-confirmed disease. Similarly, contemporary reviews note that RA-associated CTS typically presents with multi-nerve or bilateral involvement, unlike idiopathic CTS, which more often begins unilaterally [9, 19]. Although exact patient-level proportions of right/left/bilateral CTS vary with diagnostic method (clinical, ultrasound, or nerve conduction studies), the overarching finding across studies is a marked predominance of bilateral disease in RA, aligning closely with our observed 72.7% bilateral rate.

In our RA sample, nerve conduction studies (NCSs) demonstrated a distinct electrophysiological profile of CTS, characterized by predominant median nerve abnormalities over ulnar alterations, effectively differentiating CTS from non-CTS wrists (Table 5). As anticipated, median motor and sensory latencies were significantly prolonged in bilateral CTS patients (all $p<0.001$), indicating distal demyelination within the carpal tunnel, whereas median sensory amplitudes and conduction velocities were substantially diminished in CTS (all $p<0.001$), suggesting simultaneous axonal impairment and conduction delay. The median motor conduction velocity was markedly reduced in CTS (right $p=0.002$; left $p<0.001$), indicative of more widespread median nerve impairment, but median motor amplitudes showed no significant variation, implying that motor axonal degeneration is less pronounced at this stage. Ulnar motor and sensory parameters, although generally within normal clinical ranges, showed modest but significant abnormalities in CTS (e.g., ulnar motor latency, amplitude, and conduction velocity; ulnar sensory latency, amplitude, and conduction velocity; all $p\leq0.006$), potentially indicating subclinical concurrent ulnar neuropathy or widespread peripheral nerve hyperexcitability in RA rather than solely median nerve compression. In summary, these results confirm that RA-related CTS is marked by bilateral median nerve demyelination accompanied by varying degrees of axonal degeneration, and that even "non-CTS" RA wrists display minor NCS alterations, highlighting the influence of the systemic inflammatory environment on peripheral nerve performance [9, 19, 20].

As demonstrated by Table 6, needle electromyography of the abductor pollicis brevis exhibited a primarily neurogenic pattern indicative of median nerve impairment at the wrist, with similar results observed bilaterally. Approximately one-quarter to one-third of tested APB muscles showed neurogenic motor unit potentials, polyphasic potentials, increased insertional activity, and reduced recruitment (right 11/39 [28.2%]; left 12/37 [32.4%]), while spontaneous activity was uncommon (present in only 1/39 right and 1/37 left), indicating that active denervation was limited in this sample. This profile corresponds with recognized electrodiagnostic tenets in CTS, wherein abnormalities in APB needle EMG (neurogenic MUAP morphology, polyphasia, diminished recruitment) are associated with greater median motor axonal degeneration and reduced CMAP amplitudes, while fibrillation potentials and other spontaneous activities typically manifest in advanced or chronic cases. The limited occurrence of spontaneous activity, coupled with evident neurogenic MUAP alterations, indicates subacute-to-chronic axonal involvement rather than acute denervation, a phenomenon previously documented in RA-related CTS where inflammatory compression leads to progressive axonal loss with compensatory reinnervation. Clinically, these EMG results indicate that APB needle assessment enhances the evaluation of severity and tracking of progression or postoperative recovery in CTS, especially when NCS reveals considerable motor impairment [21].

5. Conclusions and Recommendations

This research establishes that carpal tunnel syndrome (CTS) is a common neurological complication in rheumatoid arthritis (RA), impacting 40% of individuals, with a notable bilateral occurrence rate of 72.7%, and is chiefly influenced by localized wrist conditions—especially synovitis and flexor tenosynovitis—rather than systemic inflammation, as indicated by the absence of correlation with age, sex, BMI, RA duration, disease activity, treatment approach, ESR, or

CRP. The notable association between both active and passive smoking and carpal tunnel syndrome underscores tobacco exposure as a vital modifiable risk factor that could intensify localized inflammation and microvascular impairment surrounding the median nerve. Electrophysiological assessment of RA-related CTS demonstrates bilateral median nerve demyelination accompanied by varying degrees of axonal damage and minor ulnar nerve abnormalities, indicating potential subclinical neuropathy; needle EMG of the abductor pollicis brevis shows neurogenic alterations in about one-third of patients, with rare spontaneous activity, suggesting subacute to chronic axonal involvement. Based on these data, we suggest screening for CTS in RA patients regardless of disease activity or symptoms, offering specific advice on smoking cessation, encouraging early electrophysiological testing for early diagnosis and treatment, emphasizing the local wrist assessment and ultrasound instead of systemic inflammatory markers, promoting multidisciplinary collaboration for better medical and surgical management, and conducting longitudinal studies in the future to understand the time course of smoking and synovitis control in the prevention of CTS in RA.

Conflicts of interest

The authors declare no conflict of interest in this study.

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