

Carpal Tunnel Syndrome: Clinical manifestations, Diagnosis and Risk factors among Yemeni Patients

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Submitted: 30 Mar 2022; Accepted: 06 April 2022; Published: 12 April 2022

Citation: Mohamed Salam, Ahmed Al-Gharati, Afif Al-Nabhi, Amin Abdulrab and Ali Ahmed Al-Zaazaai (2022). Carpal Tunnel Syndrome: Clinical manifestations, Diagnosis and Risk factors among Yemeni Patients. *Adv NeurNeur Sci*, 5(2):68-76.

Abstract

Background: Carpal tunnel syndrome (CTS) is one of the most common compressive canalicular neuropathies of the upper extremities. It results from compression or injury of the median nerve at the wrist within the confines of the carpal tunnel.

Objective: To determine the pattern of clinical manifestation, diagnosis, and risk factors of carpal tunnel syndrome among Yemeni patients presented to the neurological center, Sana'a city.

Method: This cross-sectional study was conducted in a neurological Centre in Sana'a city. The study included all patients with symptoms of carpal tunnel syndrome (CTS). History, physical examination, and laboratory were collected. Demographic data were recorded for every case. A nerve conduction study of both hands was performed according to the protocol.

Results: Out of 73 included subjects, 52 (71.2%) patients were females and 21 (28.8%) were males, with a mean age of (44.05 years). Most of the patients (80.8%) had bilateral CTS, and it affected both hands. The majority of CTS cases were of moderate to profound severity. All patients with (CTS) presented with pain numbness, and tingling on bilateral hands. More than two-thirds of the patients (64.4%) had weakness of both hands and (79.5%) of patients had night pain and wake at night. Distal latency > (4.2ms) was positive generally in (84.9%) and it was positive bilateral in (56.2%) of the patients. Significant association with CTS was found between gender, obesity, diabetes mellitus, and to a less extent with Rheumatoid arthritis,

Conclusion: High prevalence of bilateral CTS was found among most patients. Diabetes mellitus and obesity play a significant role in CTS. The severity of functional impairment was relatively moderate to severe.

Keywords: Carpal Tunnel Syndrome; Nerve Conduction Tests; Risk Factor; Yemen

Introduction

Carpal Tunnel Syndrome (CTS): is a clinical syndrome due to compression of the median nerve in the wrist at the carpal tunnel site [1]. Compression of the median nerve occurs, followed by ischemia and mechanical disruption of the nerve. It is the most common disorder affecting the median nerve and the most frequent nerve entrapment syndrome [1]. The estimated prevalence of CTS in the general population is 1 to 5 percent and it is a leading

cause of work disability [2].

The syndrome is essentially a sensory one; the loss or impairment of superficial sensation affects the palmar aspect of the thumb and the index and middle fingers (especially the index finger) and may or may not split the ring finger [3, 4].

The etiology of the condition is not exactly known, although it

sometimes occurs secondary to disorders such as thyroid disease, rheumatoid arthritis, or fracture forearm [5, 6]. Other risk factors such as obesity, repetitive wrist work, and pregnancy have been implicated in (CTS) [7, 8]. Moreover, (CTS) is associated with types of work like computer work with vibration tools and work that requires strong grip [7-9].

The clinical presentation involves tingling in the thumb, index finger, middle finger, and the thumb side of the ring finger. Associated with pain and numbness [7].

Symptoms typically start gradually and during the night. Pain may extend up the arm [8]. Weak grip strength may occur, and after a long period of time the muscles at the base of the thumb may waste away [8]. However, both hands were found to be affected in significant cases [6].

Several risk factors have been incriminated including obesity, monotonous wrist work, pregnancy, rheumatoid arthritis, hypothyroid, and genetic [9-12].

Nevertheless, there is no consensus reference standard for the diagnosis of carpal tunnel syndrome. A combination of described symptoms, clinical findings, and electrophysiological testing are used [11,12].

Several studies in developing and developed countries occurred, but such a study has not been taken in Yemen.

The objective of this study was to determine the pattern of clinical manifestation, diagnosis, and risk factors of carpal tunnel syndrome among Yemeni patients presented at the neurological center in Sana'a city.

Materials and Methods

This study was conducted between 2016 and 2020 at the neurological Centre in Sana'a City. The center is a referral center in the northern part of Yemen. All patients presented at the neurological center complaining of numbness and pain along with the distribution of median nerve and suggested carpal tunnel syndrome were included in this study. All patients were subjected to clinical examination, past and present history, investigations including thyroid function test, blood sugar, obesity, rheumatoid factor, CBC, ESR., and X-ray for elbow and hands. The special questioner was designed to collect demographic data including age, sex, occupation, and education, as well as clinical findings and existing history of smoking, alcohol intake, and QAT chewing.

Median Motor Nerve Conduction Studies

Nerve conduction studies were performed to show the presence of conduction slowing in the median across the wrist and to differentiate between (CTS) and a proximal lesion of the median nerve. A nerve conduction study (NCS) was performed on the right and left hands for every participant. The procedure included examination of both nerves (the median and the ulnar nerve). Nerve conduction velocity (NCV) studies were performed using (NIHON KOHDEN

Machine; Japan 2007).- Skin temperature of the hands was maintained at a minimum of 31. C0, and it was measured before and after each test. Compound muscle action potential (CMAP) was recorded by means of surface electrodes. Both hands of each participant were examined.

We used two tests;

1. Median nerve distal motor latency (DML), which was obtained by recording the abductor pollicis brevis (APB) muscle at a distance of 8 cm from the stimulation at the wrist (13)

Distal latency of greater than 4.2 milliseconds (ms) may indicate CTS.

It was compared with the ulnar nerve to rule out a generalized motor neuropathy (14,15)

2. Lumbrical&Interossei muscles recording. Another relatively simple motor comparison technique to record a median CMAP latency from the second lumbrical and an ulnar CMAP latency from the interossei was used (16-18).

Procedures

Electrode Position: Active electrode (+): 2 cm proximal to the interdigit index finger and middle finger, reference electrode(-): PIP joint of index finger.

Stimulation Point: In the median and ulnar nerve, an equal distance to the active electrode, A difference of >0.4 (ms) between the median and ulnar latencies is considered significant (19, 20).

Provocation Tests

Provocation maneuvers such as Tinel's and Phalen's testes may elicit symptoms of CTS (21) were done for each participant

1 -Tinel's sign: paresthesia radiating in a median nerve distribution on tapping on the wrist or over the median nerve.

2 -Phalen's sign: paresthesia radiating in a median nerve distribution within 60 seconds of sustained flexion of the wrist.

Ethical Consideration

Verbal consent was obtained from every patient who participated in this study. Approval and agreement of this research were obtained from the research committee at Sana'a University.

Statistical Analysis

All data were entered into PC and statistically analyzed using SPSS package, numerical data was presented as %, and categorical data were analyzed using mean and SD. P. Value < than 0.05 was considered significant

Results

A total of 73 patients who fulfilled the criteria of carpal tunnel syndrome were included in this study, of which 52 (71.2%) were females and 21(28.8%) were males. Their age varies between 21-74 years, with a mean of 44.05 years. Most patients (76.5%) with carpal tunnel syndrome were between 30-59 years old. Only 8 patients (11.0%) were less than 29 years old, and 9 patients, 12.3% were 60 years or above.

More than half of the patients (56.2%) were from Sana'a and (16.4%) from Taiz, the other cases came from other cities in Ye-

men [Table 1].

Regarding marital status, almost (94.5%) of the patients were currently married or married before (divorced 4 patients and widow 9 patients) and only 4 patients, 5.5% were single.

The majority of cases were females, and they were housewives and represented in 65.8% of all cases. Regarding male occupation, 10 (3.75%) patients were hand workers, farmers represented in (5.5%). Other occupations were builders, teachers, policemen, and tailor represented in (5.5%, 4.1%, 2.7%, 1.4%), respectively,

Table1: Demographic characteristics of patients presented with Carpal tunnel syndrome

variable .	No	%	Chi- Square	P-value	
Sex					
Female	52	71.2%			
Male	21	28.8%	13.164	0.282	
Total	73	100.0%			
Age					
20 - 29	8	11.0%	16.247.	0.132	
30 - 39	23	31.5%			
40 - 49	10	13.7%			
50 - 59	23	31.5%			
60+	9	12.3%			
Place of birth	Sana'a	41	56.2%	61.726	0.001
	Taiz	12	16.4%		
	Dhamar	6	8.2%		
	Ibb	5	6.8%		
	Others	9	12.3%		
Total	73	100.0%			
Marital status	Yes	69	94.5%	57.877	0.001
	No	4	5.5%		
Total	73	100.0%			
Occupation	House wife	48	65.8%	66.233	0.001
	Worker	10	13.7%		
	Farmer	4	5.5%		
	Others	11	15.1%		
Total	73	100.0%			

Clinical Manifestations

Pain, numbness, and tingling were found in all patients. Sixty-eight of the patients (93.2%) with the sites of pain were in both hands. Only 5 patients (6.8%) had pain in the right hand. Pain awake patients at night were found in 58 (79.5%) patients, while 15 patients(20.5%), reported no manifestations like that. About two- thirds ((65.8%) of the patients presented with pain radiating to the shoulder [Table2]. Most of the (CTS) patients 47 (64.4%) were suffering from weakness of the hands and restricted the hand from doing the task [Table2].

The duration of (CTS) among our cases is shown in [Table 3], about half of the patients (46.6%) suffered from (CTS) within 1-5 years duration. A duration of less than one year was found in (38.4%) of the patients. While the patient suffered from disease with long duration 6-10 years and more than 10 years represented in (6% &5%), respectively.

Table 2: clinical manifestations of patients presenting with carpal tunnel syndrome

Variable	No.	%	Chi Square	P value
Pain ,numbness & tingling				
Yes	73	100		
No	0	0.0		
Total	73	100		
Site of pain				
One hand	5	6.8	54.370	0.000
Bilateral hands	68	93.2		
Total	73	100		
Pain Awake patient at night				
Yes	58	79.5	25.329	0.008
No	15	20.5		
Total	73	100		
Pain radiated to shoulder				
Yes	48	56.8	7.247	0.778
No	25	43.2		
Total	73	100		
Weakness of hands				
Yes	47	64.4	6.041	0.870
No	26	35.6		
Total	73	100		

Table 3: Duration of carpal tunnel syndrome among study population

Duration of disease In years	No.	%	Chi Square	P value
< 1	28	38.4		
1-5	34	46.6		
6-10	06	8.2	36.644	0.000
10	05	6.8		
Total	73	100		

Provocation Tests**Tinel's Sign (Percussion test).**

Tinel's sign was positive bilaterally in 60 (82.2%) (patients with (CTS), while 6 (8.2%) patients was positive in the right upper limb. A negative test was elicited among 7(9.7%) patients.

Phalen's Maneuver (the wrist-flexion test).

The Phalen's Maneuver test was positive bilaterally in 52 ((71.2%) patients, while in 2 patients (2.7%) the test was positive in the right upper limb. The test was negative in 19 (26%) patients with (CTS) table (4).

Table 4: results of provocation tests performed among patients with carpal tunnel syndrome.

Variable	No	%	Chi square	P Value
Tinel's Sign(Percussion Test)				
•Positive, bilateral	60	82.25%	78.438	0.00
•Positive right	6	8.2%		
•Negative	7	9.7%		
Total	73	100%		
Phalen's (Flexion Test)				
•Positive bilateral	52	71.2%	53.123	0.00
•Positive right	2	2.7%		
•negative	19	26%		
Total	73	100%		

Medianmotornerveconductionstudy

-Lumbrical & Interossei muscle record was positive (higher than 0.4 ms) bilaterally in 59 (80.8%) patients. The test was positive on the right and left upper limbs in (9.6% & 8.2%), respectively. The test was negative in only one of the patients (1.4%). The test was demonstrated highly significant variation (with P value of 0.00) [Table 5]:

As it is shown in table (5), the median motor nerve conduction study showed prolonged median nerve motor distal latency (>4.2ms) in 62 (84.9%), of the total patients and negative in 11(15.1%) patients. However, the positivity in 41(56.2%) patients were bilateral, 14(19.2%) patients' positivity was in the right. upper limb, and 7 (9.65) in the left upper limb. This difference was statistically significant.

Table 5: median motor nerve conduction study among patients with carpal tunnel syndrome

Variable	No	%	Chi square	P Value
Lumbrical & Interossei muscle recorded (>0.4 ms)	59	80.8%	22.452	0.000
Positive bilateral	7	9.6%,		
Positive right	6	8.2%		
Positive left		1.4%		
Negative	1			
Total	73	100%		
Prolonged DML (>4.2ms)				
Positive bilateral	41	56.2%	39.164	0.00
Positive left	7	9.6%		
Positive right	14	19.2%		
Negative	11	15.1%		
Total	73	100%		

Risk Factors

Several risk factors associated with (CTS) were studied, the results show that the frequency of risk factors presented among patients with (CTS) was Arthritis, diabetes mellitus, and obesity which accounted for (32.9%, 23.3% & 19.2%) respectively [Table6]. Myx-

edema was detected in (4.1%) and pregnancy accounted for 4.1% of women and one case of (CTS) had gout. Risk factors such as obesity, Diabetes mellitus, and Myxedema were significantly associated with (CTS).

Table 6: risk factors among patients with carpal tunnel syndrome

Risk factors	No	%	Chi square	P. Value
Arthritis				
Yes	24	32.9%	8.562	0.665
No	49	67.1%		
Total	73	100%		
DM				
Yes	17	23.3	27.740	0.004
no	56	76.7		
Total	73	100%		
Obesity				
Yes	14	19.2	27.740	0.004
No	59	80.8		
Total	73	100%		
Myxedema				
Yes	3	4.1	61.493	
No	70	95.9		
Total	73	100%		

Discussion

Carpal tunnel syndrome (CTS) results from entrapment of the median nerve as it passes through the tunnel defined by the carpal bone and the transverse ligament [22].

Compression of the median nerve in the carpal tunnel is common. Usually, it is an idiopathic phenomenon spontaneously occurring generally in middle-aged women. It is often bilateral, although more symptomatic in the dominant hand [23,24].

In this study, a total of 73 patients with carpal tunnel syndrome were diagnosed, of which 21(28.8%) were males and 52(71.2%) females, a male to female ratio of (1:4). A similar result was reported in a study done in King Abdulaziz University Hospital, Jeddah, where 79 (86%) of CTS Occurred in females and 12 (13.2%) were males [25].

Moreover, de Kromet et al. (26) reported that CTS is nearly ten times more common in women than in men. Females had a significantly greater risk of having (CTS) symptoms than males because women have smaller wrist and smaller carpal tunnel passageways than males, and the prevalence of CTS are frequent among them. The other reason may be related to hormonal changes in females [27]. The peak incidence occurs around 55 to 60 years [28].

Dawson et al., 1999, report that often (CTS) symptoms develop with repetitive hand movements, which usually causes involve a reduction in the size of the carpal tunnel [29]. In our study, we found the majority of Yemeni female patients were housewives and used hands for cleaning and washing, which may cause injury to the median nerve at the wrist.

While carpal tunnel syndrome can occur at any age, it most often affects people between the ages of 40 and 60 years. The mean age

of CTS among our patients was (44.05 years) with ages ranging between 21-74 years. This is consistent with another study, which reported that the average age of (CTS) was (47 years) and ranged between (17-77 years) [30].

According to the National Center for Biotechnology Information, the majority of people who experience carpal tunnel syndrome are between the ages of 30 to 60. The prevalence of (CTS) increases with age in such a way that it reaches 22.2% in ages over 55 years, as opposed to 6% among participants between ages between 25 and 34 [31]. Since the typical CTS onset is after age 45, tendinosis may progressively cause CTS in the old population. This phenomenon was observed among old people in our case.

CTS is well known to result in a group of symptoms frequently reported by patients. Those include pain, numbness, tingling, thenar muscle wasting, weakness, nocturnal exacerbations, and difficulty grasping items. Patients frequently awaken at night or early morning and shake their hands to relieve these symptoms [31].

In our study, we recorded the most clinical symptoms the patients presented with, which were tingling, pain, and numbness, nocturnal pain, bilateral hand pain, pain that referred to the shoulder, and weakness of hands.

Comparing these results with reports from other countries, they reported similar symptoms with lower rates of instant tingling and numbness (30%-70%), versus (100%), nocturnal pain in (10%-66.7%) versus (79%), Hand weakness (20%, 73.7%) versus (64%) (32,33) Electromyography (EMG) and nerve conduction studies (NCS), are the first-line investigations in the suggested carpal tunnel syndrome (CTS) [34]. Defects on electrophysiologic testing, in link with specific symptoms and signs, are considered the criterion standard for CTS diagnosis. Nerve conduction studies usually con-

firm the diagnosis reliably and other neurologic diagnoses can be excluded with these test results.

Motor Nerve Conduction in Our Study

A prolonged distal motor latency on stimulating the nerve at the wrist and recording the muscle action potential from the abductor pollicis brevis is diagnostic in moderate and severe carpal tunnel syndrome. In more severe cases, sensory nerve action potentials (SNAP) may not be recordable. In this case, motor nerve conduction studies are the only electrophysiological means to confirm the clinically defined diagnosis of CTS [35].

In our study, Lumbrical & interosseous muscle record (>0.4 ms), was found positive in 59 (80.8%) patients with bilateral carpal tunnel syndrome, while 6 patients 8.2% was positive in patients who have left carpal tunnel syndrome, and 7 patients 9.6% have wright carpal tunnel syndrome. The majority of CTS patients were moderate to profound.

A study in the United Kingdom reported that Bilateral CTS is common at first presentation, affecting up to 65 percent of patients [36]. In Saudi Arabia, they found that the majority of CTS patients had bilateral conductive latency and about one-third of the study subjects had unilateral CTS. The majority of cases were of very mild or mild severity (27.5% and 26.7%, respectively [37], which agrees with our study.

The high positivity in the median motor conductive test in this study is much higher than that detected among patients in India (19.8%), and in Turkey [38,39]. This variation may be attributed to the chosen criteria for including patients or advanced disease. In our study, more cases were females with advanced disease.

Tinel's sign is a classic test to detect median nerve irritation. It has 38–100% sensitivity and 55–100% specificity for the diagnosis of CTS.

In our study, Tinel's sign was positive bilaterally in 60 (82.2%) CTS patients and negative in (9.80%). Similarly, Phalen's Maneuver (wrist flexion test) in our study showed that it was positive bilaterally in 52 CTS patients (71.2%), while 2 (2.7%) CTS patients were positive in wright. Upper limb. However, 19 CTS patients were negative, these results agreed with other studies.

Risk Factors for CTS Include the Following

Several risk factors were found associated with CTS in this study, which included; arthritis, diabetes mellitus, obesity, myxedema, pregnancy and Gout which presented in (32.9%, 23.3%, 19.2%, 4.1%, 4.1%, and 1.4%), respectively.

However, significant risk factors associated with CTS in this study were diabetes mellitus and obesity.

The association between diabetes and CTS in this study is higher than that detected among diabetics in Thanjavur (19.8%), and in

Turkey (16%) [31,32]. This variation may be related to the high prevalence of uncontrolled diabetes mellitus in our case [38, 39]. Paranthakan and Govindarajan found that uncontrolled diabetes is a risk factor for carpal tunnel syndrome and is more common among uncontrolled diabetics [38].

Pasnoor et al., reported that focal and multifocal neuropathies in diabetic patients were mainly attributed to vascular derangements, such as hypoxia or ischemia, caused by chronic hyperglycemia, whereas symmetrical polyneuropathies were mainly caused by metabolic disorders in those patients [39]. Several studies reported the prevalence of soft tissue hand lesions including CTS is higher in the diabetic population [9,11,40–41].

Myxedema is a well-known risk factor of CTS. Oktayoglu et al. reported a higher incidence (32.5%) of CTS in hypothyroid patients compared to our study where myxedema was found in only 4.1% [42]. The association between myxedema and (CTS) was found in several studies [8,11,12], with symptoms persisting in the majority of patients after the hypothyroid state has been corrected [12]. It is most likely that there is a mild compression within the carpal tunnel of a physiologically altered peripheral nerve resulting in the symptoms of CTS. Yüксеlet al., demonstrated that the median motor and sensory nerves were more affected compared to other nerves in hypothyroid patients according to the electrophysiological study findings [43].

Obesity is a recognized risk factor for CTS, in this study we found a significant association between obesity and (CTS). This result coincided with Ferry et al., who found an increased risk of CTS obesity [11].

Rheumatoid arthritis is a risk factor for (CTS) was detected in 24(32.9%) of our patients and a similar figure was reported by other studies [40].

Conclusion

A high prevalence of bilateral CTS was found among most patients. Diabetes mellitus and obesity play a significant role in CTS. The severity of functional impairment was relatively moderate to severe.

Recommendation

Health care professionals should be aware of this high bilateral CTS prevalence among female patients. Screening for risk factors by using a median motor nerve conduction study should be done in diabetic and obese patients in whom CTS are suspected.

Authors' Contribution

Dr. Dr. Mohamed Salam, Dr. Ahmed Al-Gharati, Dr. Afif Al-Nabhi, Prof. Amin Abdulrab, study concept and design, data acquisition, interpretation; manuscript drafting, study supervision, idea of the manuscript, collection, analysis, writing and literature review.

Conflict of Interests

The authors declared that there were no conflicts of interests arising in the process of this study.

Funding

No

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