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Correlation between clinical and electrophysiological findings of carpal tunnel syndrome

Abstract

Objective: correlate between clinical and electrophysiological findings of carpal tunnel syndrome

Methods: cross sectional study at outpatient setting.109 patients (83females, 26males) with clinical manifestations of carpal tunnel syndrome participated in the study.

All the patients had the following: Medical history and neurological examination including Tinel's sign and Phalen test and nerve conduction studies including median-ulnar, median -radial comparative studies and electromyography of both upper extremities.

Results: mean age 57.71±13.4. pain was mild in 9.2%, moderate in 25.7% and severe in 56% of patients. Numbness was present in 87.2%. Impaired sensory exam in 43.1% Impaired motor exam in 8.3%. Positive Tinel's sign unilateral (38.5%) and bilateral (47.7%). Positive Phalen test unilateral (30.3%) and bilateral (34.9%). Unilateral thenar Muscle wasting in 4.6% and bilateral in 1.8%. Pure sensory median neuropathy was found in 65 patients (59.6%), sensory motor median neuropathy in 44 patients (40.37%). Demyelinating neuropathy in 91.7% and demyelinating-axonal neuropathy in 8.3% of patients.

Abnormal distal motor latency was significantly correlated with severity of pain p=0.0025, impaired sensory exam p=0.0001, impaired motor exam p=0.0001, positive Tinel's sign of both hands p=0.0001, positive Phalen test of both hands p=0.0001. as well as with unilateral or bilateral muscle wasting p=0.001.

Prolonged peak median sensory latency was significantly correlated with numbness p=0.0001, severity of pain p=0.001, Impaired sensory exam p=0.005, positive Tinel's sign for either one or both hands p=0.0001, positive Phalen test of one or both hands p=0.0001

Conclusion: Highly significant correlation was found between subjective and objective sensory manifestation and peak median sensory latency. While distal motor latency were significantly correlated with severe pain, only bilateral positive Tinel's sign and Bilateral Phalen test and the objective sensory and motor deficit.

Keywords: carpal tunnel syndrome, phalen, tinel, nerve conduction tests

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Introduction

Carpal tunnel syndrome (CTS) is one of the most common upper limb entrapment neuropathies. It constitutes approximately 90% of all entrapment neuropathies.[1]It is the result of squeezing or compression of median nerve at the carpal tunnel. An estimated one million adults from the united states annually have CTS requiring medical treatment with high cost burden on health care system.[1,2]

The incidence and prevalence vary 0.125%-1% and 5-16% depending upon the criteria used for the diagnosis.[1–8] Carpal tunnel syndrome is more prevalent among middle aged female with peak incidence around 55-60 years.[1,2,5,9]

Carpal tunnel syndrome presents clinically with variable symptoms depend on the severity of the disease. These symptoms include numbness, tingling, burning and pain in the hand predominantly, in the thumb, index, middle and lateral half of ring finger. The pain or tingling may travel up the forearm toward the shoulder. In addition to weakness, clumsiness of the hands.[1]

Several clinical tests have been described to aid in the diagnosis of CTS. None of these tests are diagnostic on their own. Most of these tests complement the diagnosis of CTS. Tinel's sign is one the diagnostic tests for CTS. Tinel described this sign in 1915.[10] It is not a precise test. Several factors can influence the outcome of the test. It is reported to be associated with sensitivities 23-67% and specificities of 55 % to 100%.[11–14]Phalen's test is another test described in 1957.[15] The reported sensitivity ranges between 10%-91% and specificity between 33%-100%. [11,12,16–20]

Electro diagnostic testing can be helpful to confirm or exclude CTS when the clinical diagnosis is uncertain.[21] It is also useful to determine the severity of nerve compression and to assist in decision regarding surgical intervention.[21]

The combination of characteristic symptoms and signs and confirmatory testing appears to be most accurate for the diagnosis of CTS.[22,23]

The aim of the study was to correlate between clinical and electrophysiological findings of carpal tunnel syndrome

Patients and methods

This was cross sectional study at outpatient setting. A total of 104 patients who had symptoms of pain, paresthesia and /or weakness in their hands during the period of Augst, 2016 till July, 2017 were included to the study. Exclusion criteria were polyneuropathy signs and symptoms, cervical radiculopathy or any other neurological or neuromuscular disease. The following data were recorded from all the included patients after signing informed consent for participation in the study; Medical history, pain scale using visual analogue scales (VAS) from 0-10, where 0 means no pain, 10 means severe pain. presence or absence of numbness of the hands, detailed neurological examination including wasting of thenar muscles, the presence of impaired sensory examination, presence of impaired motor examination by manual muscle testing, Tinel's sign[10] and Phalen test[15]and electrophysiological testing.

All the patients had the following electrophysiologic tests:[24]

Nerve conduction studies(NCS) for both upper extremities including;

i. Median motor conduction study recording from abductor pollicis brevis while stimulating at the wrist and elbow.

ii. Ulnar motor conduction study recording from abductor digiti minimi while stimulating at wrist and at the elbow above and below the ulnar groove.

iii. Median and ulnar F wave responses.

iv. Median sensory response recording from digit two while stimulating the wrist.

v. Ulnar sensory response recording from digit five while stimulating the wrist.

vi. Radial sensory response recording snuffbox, stimulating over lateral radius.

vii. Additional comparative studies; median-ulnar digit four sensory latencies, median -radial digit one sensory latencies were conducted in case of normal routine NCS.

viii. Needle electromyography (EMG) of both upper extremities; muscles tested: Abdactor pollicis brevis, first dorsal interosseous, pronator teres, biceps, triceps, deltoid, extensor digitorm communis, and cervical paraspinal muscles.

Electrophysiological severity of CTS was classified as mild, moderate and severe according to the following criteria. Mild CTS was determined as prolongation of distal latency and decrease in the amplitude of median sensory nerve. Moderate CTS was determined as in addition to mild CTS criteria prolongation of distal latency of median motor nerve. Severe CTS was determined as no record of sensory potential, prolongation of distal latency and decrease in amplitude of median motor nerve.[25]

Statistical analysis

The Data was collected and entered into the personal computer. Statistical analysis was done using Statistical Package for Social Sciences (SPSS/version 21) software. Descriptive statistics were done for quantitative data as minimum& maximum of the range as well as mean±SD (standard deviation) for quantitative parametric data, while it was done for qualitative data as number and percentage.

Inferential analyses for independent variables were done using Chi square test for differences between proportions and Fisher's exact test for variables with small expected numbers.

Results

mean age 57.71±13.4.14 patients had unilateral CTS (12.84%) and 95 patients had bilateral CTS (87.16%). Table 1 shows demographic and clinical data. Pain was severe in 56% of patients. Numbness was present in 87.2%. Impaired sensory exam in 43.1%, Impaired motor exam in 8.3%. Positive Tinel's sign unilateral (38.5%) and bilateral (47.7%). Positive Phalen test unilateral (30.3%) and bilateral (34.9%). Unilateral thenar Muscle wasting in 4.6% and bilateral in 1.8%. Table 2 demonstrates NCS findings, while Table 3 & Table 4 shows the relationship between motor distal latency and peak sensory latency and clinical findings respectively. Table 5 & Table 6 demonstrate the relation between pain scale and distal motor latency and peak sensory latency respectively.

Table 1 Demographic and clinical data of the studied patients group

	Number	Percent
Age		
< 50	29	26.6
50-	37	33.9
60-	26	23.9
70+	17	15.6
Range	28-90	
Mean±S.D.	57.7±13.4	
Sex		
Male	26	23.9
Feamle	83	76.1
Pain scale		
No	10	9.2
Mild	10	9.2
Moderate	28	25.7
Severe	61	56.0
Numbness (positive)	95	87.2
Sensory exam		
Intact	62	56.9
Impaired	47	43.1
Motor exam		
Intact	100	91.7
Impaired	9	8.3
Tinnel's sign		
No	15	13.8
One hand	42	38.5
Both hands	52	47.7
Phalen's test		
No	38	34.9
One hand	33	30.3
Both hands	38	34.9
Muscle wasting		
No	102	93.6
One hand	5	4.6
Both hands	2	1.8

Abnormal distal motor latency was significantly correlated with severity of pain p=0.0025, impaired sensory exam p=0.0001, impaired motor exam p=0.0001, positive Tinel's sign of both hands p=0.0001,

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positive Phalen test of both hands p=0.0001. As well as with unilateral or bilateral muscle wasting p=0.001.

Table 2 Nerve conduction studies (NCS) and EMG findings in the studied group

	Number	Percent
NCS showing pure sensory neuropathy		
One hand	14	12.84
Both hands	51	46.8
NCS showing sensorimotor neuropathy		
One hand	7	6.4
Both hands	37	33.9
NCS and EMG showing demyelinating neuropathy		
One hand	17	15.6
Both hands	83	76.1
NCs and EMG showing demyelinating - axonal neuropathy		
One hand	4	3.7
Both hands	5	4.6

Table 3 Relation between motor distal latency and clinical signs and symptoms

			Motor distal latency		P
			Normal "n=65	Abnormal "n=44"	
Numbness	Present	No.	60	35	.003
		%	81.1%	100.0%	
	Absent	No.	14	0	
		%	18.9%	0.0%	
Sensory exam	Intact	No.	61	1	0.0001*
		%	82.4%	2.9%	
	Impaired	No.	13	34	
		%	17.6%	97.1%	
Motor exam	Intact	No.	74	26	0.0001*
		%	100.0%	74.3%	
	Impaired	No.	0	9	
		%	0.0%	25.7%	
Tinnel's sign	No	No.	15	0	0.0001*
		%	20.3%	0.0%	
	One hand	No.	42	0	
		%	56.8%	0.0%	
	Both hands	No.	17	35	
		%	23.0%	100.0%	
Phalen's test	No	No.	38	0	0.0001*
		%	51.4%	0.0%	
	One hand	No.	33	0	
		%	44.6%	0.0%	
	Both hands	No.	3	35	
		%	4.1%	100.0%	
Muscle wasting	No	No.	74	28	0.001*
		%	100.0%	80.0%	
	One hand	No.	0	5	
		%	0.0%	14.3%	
	Both hands	No.	0	2	
		%	0.0%	5.7%	

Table 4 Relation between peak median sensory and clinical signs and symptoms.

			Peak median sensory		P
			Normal "n=13"	Abnormal n=96	
Numbness	Present	No.	5	90	0.0001*
		%	38.5%	93.8%	
	Absent	No.	8	6	
		%	61.5%	6.2%	
Sensory exam	Intact	No.	12	50	0.005*
		%	92.3%	52.1%	
	Impaired	No.	1	46	
		%	7.7%	47.9%	
Motor exam	Intact	No.	13	87	0.304
		%	100.0%	90.6%	
	Impaired	No.	0	9	
		%	0.0%	9.4%	
Tinnel's sign	No	No.	9	6	0.0001*
		%	69.2%	6.2%	
	One hand	No.	2	40	
		%	15.4%	41.7%	
	Both hands	No.	2	50	
		%	15.4%	52.1%	
Phalen's test	No	No.	11	27	0.0001*
		%	84.6%	28.1%	
	One hand	No.	2	31	
		%	15.4%	32.3%	
	Both hands	No.	0	38	
		%	0.0%	39.6%	
Muscle wasting	No	No.	13	89	0.389
		%	100.0%	92.7%	
	One hand	No.	0	5	
		%	0.0%	5.2%	
	Both hands	No.	0	2	
		%	0.0%	2.1%	

Table 5 Relation between pain scale and motor distal latency

Pain scale	Motor distal latency			
	Normal		Abnormal	
	No.	%	No.	%
No	9	12.2	1	2.9
Mild	6	8.1	4	11.4
Moderate	24	32.4	4	11.4
Severe	35	47.3	26	74.3
Total	74	100	35	100
P	0.0025*			

Table 6 Relation between pain scale and peak median sensory

Pain scale	Peak median sensory			
	Normal		Abnormal	
	No.	%	No.	%
No	8	61.5	2	2.1
Mild	3	23.1	7	7.3
Moderate	2	15.4	26	27.1
Severe	0	0.0	61	63.5
Total	13	100.0	96	100.0
P	0.001*			

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Prolonged peak median sensory latency was significantly correlated with numbness p=0.0001, severity of pain p=0.001, Impaired sensory exam p=0.005, positive Tinel's sign for either one or both hands p=0.0001, positive Phalen test of one or both hands p=0.0001

Discussion

Carpal tunnel syndrome commonly affects middle age group, predominantly women.[25,26] Similar to the literature, the mean age of patients in this study was 57.7 and women represented the majority of the patients 83%.

All the included patients with signs and symptoms suggestive of CTS have shown positive electrophysiological studies, even with comparative techniques.

This is in contrast to Gunnarsson LG et al.[27] who reported high specificity of electrophysiological studies but less sensitivities as they had false negative diagnostic tests in 13% of their patients.

This may be because they were not using the comparative techniques for those patients with normal routine NCS to detect very mild CTS.

Tinel signs and Phalen test are commonly used to complement the clinical diagnosis of CTS. Their sensitivity and specificity are variable. Tinel 's sign is associated with sensitivity 23%-67% and specificity 55%-100%[11,13–17] While Phalen test reported sensitivity range from 10%-91% and specificity between 33% and 100%.[11,12,16,17–20]

Revising literature, a study investigating the prevalence of CTS in women in Iran, Tinel's sign was present in 58.9% and Phalen test in 50.9%.[28] In another study Tinel and Phalen were positive in 71.1% and 82.2% respectively.[28,29] In this study, Tinel's sign was positive in 86.2% of patients and Phalen was positive in 65.2% .

Pekel NB et al.[25] reported that Tinel sign and Phalen test were positively correlated with CTS in both right and left hand. They used the distal median motor latency and sensory median amplitude.[25]

In this study abnormal distal median motor latency was significantly correlated with bilateral Tinel's sign and bilateral Phalen, whereas Peak median sensory latency was significantly correlated with both Tinel's sign and Phalen test whether for one or both hands.

Pain is reported by 74% of patients with CTS while paresthesia reported by 50%.[30] In this study, pain was reported using VAS in 90.8% of patients out of them 56% were having severe pain. Numbness was reported by 87.2% of the studied patients.

In this study, the severity of pain was significantly correlated with prolonged peak median sensory latency as well as abnormal distal motor latency. While numbness was only correlated with prolonged peak median sensory latency.

Similarly, Pekel NB et al.[25] found positive correlation between the severity of pain and the severity of CTS as detected by electrophysiological tests.[25]

In the previous studies sensory loss was positively correlated with CTS.[25] Pavesi G et al.[31] found highly significant correlation between sensory deficit (hypoesthesia to tough and/or pain) and the amplitude of sensory action potential.[31]

In this study impaired sensory exam was significantly correlated with both prolonged peak median sensory latency and abnormal distal motor latency.

Also, in this study, the presence of motor deficit was only significantly correlated with abnormal distal motor latency. Pavesi G et al.[31] found similar result.[31]

In this study, unilateral and bilateral thenar muscle atrophy was significantly correlated with abnormal distal motor latency.

Similar results were found by Ertekinc et al.[26] and Pekel NB et al.[25] In contrast, Ozdolap et al.[32] reported no relation between thenar atrophy and electrophysiological findings and they reported that the reason of that is the low number of their patients.

In this study, the electrophysiological testing revealed pure sensory median neuropathy in 59.64% while sensory motor median neuropathy in 40.3% of patients. The majority of the studied patients had demyelinating pathology 91.7% and only 8.3% having secondary axonal changes. This demonstrates the importance of thorough NCS including the comparative studies to detect the very mild cases of CTS who having the clinical symptoms and signs of CTS and have normal routine NCS, since the sensory pathology constituting most of patients.

In contrast Vahdatpour et al.[33] reported that the most specific test is distal motor latency (93%) while the most sensitive was median nerve terminal latency index 82%.

Conclusion

Electrophysiological tests including comparative median nerve studies confirm the clinical diagnosis of CTS. Highly significant correlation was found between subjective and objective sensory manifestation and peak median sensory latency. While distal motor latency was significantly correlated with severe pain, only bilateral positive Tinel's sign and Bilateral Phalen test and the objective sensory and motor deficit

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None.

Conflict of interest

The Authors declare no conflict of interests.

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