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# Frequency of Carpal Tunnel Syndrome in Patients of Diabetic Peripheral Neuropathy

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# FREQUENCY OF CARPAL TUNNEL SYNDROME IN PATIENTS OF DIABETIC PERIPHERAL NEUROPATHY

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## ABSTRACT

**Background:** A variety of focal neuropathies (Carpel Tunnel Syndrome; Radial or Common Peroneal Neuropathies) are seen in diabetics. Commonest focal neuropathy is 'Carpal Tunnel Syndrome (CTS)'. It may be difficult to diagnose CTS in patients with co-existent 'Diabetic Peripheral Neuropathy (DPN)'.

**Aim:** To study the frequency of 'CTS' in patients symptomatic of 'DPN'.

**Methodology:** On the basis of non-probability purposive sampling, a cross sectional study was conducted in which 113 patients symptomatic of DPN were subjected to electrophysiology. Analysis of data was done using Independent -Samples T-Test.

**Results:** Out of 113 diabetics, 48 (42.5%) were male and 65 (57.5%) were female. Mean age at presentation of CTS was earlier in female (51.3 yrs.) than in male gender (52.1 yrs.). On electrophysiology, a total of 15/113 cases (13.27%) of CTS were found. Frequency of CTS was statistically significant ( $p < 0.020$ ) in female gender (12/15 cases i.e. 80%) than in males (03/15 cases i.e. 20%). There was no marked difference ( $p < 0.796$ ) in the frequency of U/L (8/15 cases i.e. 53.33%) vs. B/L CTS (7/15 cases i.e. 46.67%). Right sided CTS (7/8 cases i.e. 87.5%) was frequent ( $p < 0.000$ ) than left sided (1/8 case i.e. 12.5%). CTS as part of diabetic polyneuropathy (11/15 cases i.e. 73.33%) was statistically significant ( $p < 0.000$ ) than CTS presenting as diabetic mononeuropathy (4/11 cases i.e. 26.67%). Sensory-motor mixed polyneuropathy (7/11 cases i.e. 46.66%) was the commonest electrophysiological pattern. Males developed symptomatic CTS earlier (1.48 mean yrs. earlier) than females.

**Conclusion:** The study revealed that CTS constituted 13.27% of all types of diabetic peripheral neuropathies. Not only mean age at presentation of CTS was earlier but female gender had a statistically significant (80% cases) predilection for CTS. U/L CTS was mainly right sided. In 26.67% diabetics, CTS presented as mononeuropathy without concomitant evidence of peripheral polyneuropathy. Sensory-motor mixed neuropathy was the commonest electrophysiological pattern seen in diabetics with CTS. Males developed neuropathy earlier than females.

**Key words:** Polyneuropathy, Mononeuropathy, Electrophysiology

## INTRODUCTION

Population-based studies of neuropathy in persons with diabetes indicate that neuropathy is a common complication of Insulin-dependent diabetes mellitus (IDDM) and noninsulin-dependent diabetes mellitus (NIDDM). Subclinical neuropathy is much more common than clinical neuropathy. Prevalence of neuropathy increases with age, duration of diabetes and worsening of glucose tolerance [1].

The frequency of carpal tunnel syndrome (CTS), a focal entrapment neuropathy, is increased in patients with diabetic peripheral neuropathy (DPN) than in the general population. Frequency of CTS in general public is 2% & it is 14% in diabetics [2]. Even in pre-diabetics (when exposure to hyperglycemia has been generally less prolonged and less severe), there has been an increased incidence of CTS [3; 4]. CTS has predilection for female gender [5].

The clinical diagnosis of CTS depends upon a combination of appropriate symptoms, with or without signs [6]. Symptoms of CTS include numbness, tingling or burning in the thumb, index, long & radial half of the ring finger. Signs of CTS include decrease in pain sensitivity (in the hand distribution of median nerve) and wasting of thumb. Provocation tests (Phalen's Test; Tinel's Sign; Pressure/Tourniquet Test) are helpful signs but with limited sensitivity and specificity to discriminate CTS from other causes of hand dysesthesia [7].

Investigations may be required to confirm the diagnosis of CTS. Certain studies regard electrodiagnostic studies to be 85% sensitive and 95% specific and depend on it for diagnosing carpal tunnel syndrome [8; 9]. However, the most accurate Electrodiagnostic discriminator (s) of the two conditions i.e. DPN & CTS has not been established [10]. Thus the diagnosis of CTS in those with DPN is complex [11]. In secondary CTS, biochemical studies to assess diabetes mellitus and other causes may be helpful [12].

The current study was undertaken to estimate the frequency of CTS in a population of subjects with DPN. Diagnosis of CTS in patients with early symptoms of DPN may contribute to effective treatment and prevention of further neurological damage.

## STUDY

**Objective** of the study was to study the 'Frequency of Carpal Tunnel Syndrome (CTS) in patients symptomatic of Diabetic Peripheral Neuropathy (DPN)'.

**Study design** was cross sectional

**Venue & duration of study:** Study was conducted at the Department of Neurology, Mayo Hospital, Lahore, over a period of six months (from May, 2011 to November, 2011).

## METHODOLOGY

**Study Sample:** On the basis of non-probability purposive sampling, hundred and twenty patients of DPN were selected from amongst those visiting the hospital OPD. There was drop out of seven cases. So, one hundred and thirteen patients (n=113) went through the study.

**Inclusion criteria** consisted of: (1) Diagnosed patients of diabetes mellitus (Type 1 or 2) with symptoms of peripheral neuropathy. (2) Both males & females. Exclusion criteria were based on History, examination or record showing: (1) Hereditary neuropathies. (2)

Chronic Inflammatory Demyelinating Polyradiculopathy. (3) Renal or Thyroid disease. (4) Alcoholics or toxic drug intake; Nutritional deficiencies. (5) Malignancy or an autoimmune disorder.

**Data collection:** Data, collected on a Performa, included: (a) History (b) Physical examination (c) Electrodiagnostic test. After taking consent, patients were subjected to electrophysiology. Standardized techniques for nerve conduction study (NCS) with temperature control and fixed distances were applied. Measurements of latencies, distances, and amplitudes were done in a standard fashion.

Electrodiagnostic parameters of CTS: Absolute increase in median motor and sensory distal latencies (Absolute Criteria) combined with significant difference between median and ulnar sensory distal latencies (Relative Criteria) were used to identify

median neuropathy before making a diagnosis of CTS. All sensory nerve conduction studies were Antidromic [18]

To quantify the above criteria, distal median motor latency (DMML) was taken prolonged when exceeded (>) 4.4 milliseconds (msec.). Distal median sensory latency (DMSL) value >3.8 msec. was taken as prolonged. Normal distal ulnar sensory latency (DUSL) was taken equal to or less than 3.1 msec. i.e. <3.1msec. A median-ulnar sensory latency difference [DMSL & DUSL difference (DUSL being higher)] greater than (>) 0.8 msec. was also used to label demyelinating median mononeuropathy [8; 9].

Normal distal median & ulnar sensory conduction velocities (DMSCV & DUSCV) were taken as equal to or greater than (>) 49 meters/sec. Decrease in DMSCV more than 10 m/s when compared to DUSCV was taken as a marker of demyelinating median neuropathy.

Normal distal median motor amplitude (DMMA) being > 4 millivolts and normal distal median sensory amplitude (DMSA) was taken as > 20 microvolts. In axonal variety of neuropathy, amplitude is less than normal. Sural nerve latency (SL), sural amplitude (SA) and sural conduction velocity (SCV) studies were used to pick diabetic polyneuropathy [18].

On NCS, a disproportionate prolongation of DMML plus DMSL and reduction of DMMA, DMSA, and DMSCV when compared with other upper-limb latencies was used to diagnose CTS. Moreover, difference in side-to side median nerve conduction studies with more

abnormality on the affected side pointed at unilateral CTS. Other NCS parameters were normal [9; 18].

**Data analysis:** Statistical analysis of data was done using Independent-Samples T Test (SPSS-16). CTS in diabetics has been studied with respect to:-

1. Frequency of CTS in diabetic population.
2. Frequency of CTS vs. Gender.
3. Mean age at presentation of CTS.
4. Unilateral or bilateral CTS
5. EMG-NCS patterns in CTS
6. CTS relative to symptom duration.

## RESULTS

On statistical analysis, frequency of CTS in the diabetic population came to a total of 15/113 (13.27%) cases. Amongst these 15 cases of CTS, only 03/15 (20%) were male and 12/15 (80%) were female. Thus, on the basis of gender, frequency of CTS was significantly higher ( $p < 0.020$ ) in female gender (Table-I).

Mean age of the entire sample (113 cases) came to 51.73 yrs. (Std. dev. +9.05). Mean age of male gender (48 cases i.e. 42.5%) was 52.1 yrs. and that of female (65 cases i.e. 57.5%) was 51.3 yrs. Thus, mean age at presentation of CTS was earlier in female gender (Diagram-I).

There were 8/15 (53.33%) cases of unilateral (U/L) and 7/15 (46.67%) cases of bilateral (B/L) CTS. Thus, as a whole and irrespective of gender, there was no significant difference ( $p < 0.796$ ) in the frequency of U/L versus B/L CTS. On the basis of gender, out of 08 cases of U/L CTS, there were seven females (7/8 i.e. 87.5%) and only one male (1/8 i.e. 12.5%). Five females (5/7 i.e. 71.43%) and only two males (2/7 i.e. 28.57%) exhibited B/L CTS. Thus, CTS, U/L or B/L, was more common in female gender. Among unilateral cases (8/15), right sided CTS (7/8 cases i.e. 87.5%) was significantly ( $p < 0.000$ ) more frequent than left sided CTS (1/8 case i.e. 12.5%). (Diagram-II).

Study of EMG-NCS patterns on the basis of electrophysiology revealed that in the entire sample, CTS as a part of polyneuropathy (11/15 cases i.e. 73.33%) was significantly ( $p < 0.000$ ) more frequent than CTS presenting as mononeuropathy (4/11 cases i.e. 26.67%). Whether CTS presented as a part of polyneuropathy or was present as mononeuropathy, sensory-motor mixed polyneuropathy (7/15 cases i.e. 46.66%) was the commonest while sensory axonal polyneuropathy (5/15 cases i.e. 33.33%) was the

second most frequent electrophysiological pattern seen. Further, in polyneuropathy group two cases (2/15 i.e. 13.33%) of CTS were part of diabetic polyradiculopathy & only one case (1/15 i.e. 06.66%) of sensory-motor demyelinating mononeuropathy was observed. Interestingly, CTS didn't present as mononeuropathy in male gender (Table-II).

Mean duration of diabetes mellitus (DM) in females (9.08 yrs.) was relatively more than in males (5.66 yrs.). At the same time, mean period of symptoms of CTS in female (1.52 yrs.) was less than in male gender (3.00 yrs.). Considering 'Duration of DM' verses 'Duration of CTS symptoms', females, though having a longer duration of diabetes, took more time (1.48 mean yrs.) than males to become symptomatic for CTS. In other words, males developed neuropathy earlier than females (Table-III).

## DISCUSSION

Carpal tunnel syndrome (CTS) is a disorder characterized by paraesthesia over the median nerve cutaneous distribution of the thumb, index, middle, and lateral half of the ring fingers, which is often worse at night. The symptoms may be caused by compression of the median nerve within the carpal tunnel, diabetic neuropathy or a combination of both.

An epidemiologic study of CTS, largest to date, has shown CTS to be common in the general population. Study data revealed that 1 in 5 symptomatic subjects would be expected to have CTS based on clinical examination and electrophysiological testing. In general population, the prevalence of clinically certain CTS was 3.8%. The prevalence of clinically and electrophysiologically confirmed CTS in general population came to 2.7% [13]. In a study conducted by Krom and associates, female-male ratio of CTS in general population came to 1.4:1 [14].

In 2007, Makepeace & associates found that frequency of CTS is more than four times in diabetic population than in general population [15]. A study from Phalen & another one from Comi & associates also studied the prevalence of CTS in diabetic population. They found that not only CTS is more common in diabetic population but also suggested associations between carpal tunnel syndrome, age and the duration of diabetes

[16;17]. The above two studies along with study of Perkins & colleagues put the frequency of CTS in DPN around 14% [18]. In our study frequency of CTS in DPN stands at 13.27%.

Considering the gender based prevalence of CTS in diabetic population, it is commonly agreed that CTS is more common in diabetic women than in men [5;16]. In a Dutch study, CTS has been found to be more than twice as common in females as it is in males. The incidence of CTS for women increases with age and reaches a peak between 50 and 59 years where after it declines. In this study, the female: male ratio was estimated to be about 3:1 [19;20]. The female-male ratio of CTS in our study closely follows the above figure i.e. the ratio is 4:1.

In 2001, a study by Gale and Gillespie revealed that regarding prevalence of diabetes mellitus, male excess is a consistent finding in populations of European origin. However, populations mostly of non-European origin, characteristically show a female bias. There was also a significant difference in mean age at presentation of DPN (54.49+5.60 mean yrs. in females; 57.19+5.63 mean yrs. in males) [21;22]. In our study, as well, diabetes was more prevalent in females. Not only the mean age at presentation of CTS (51.73+9.05) was earlier in females but frequency of CTS was also significantly higher in female (80%) than in male gender (20%). Thus, females contract diabetes earlier than male gender.

Albers & associates found that patients with median mononeuropathy (MM) had a longer duration of diabetes than remaining patients and this was independent of age. Patients with MM and type II diabetes were more likely to be female with a higher body mass index [23].

Regarding frequency of B/L CTS versus U/L CTS, Bagatur & Zorer stated that CTS is mainly a bilateral disorder and that it becomes more evident as time passes. They reported the incidence of bilateral symptoms in CTS to be between 60% and 87%. Out of 229 cases, bilateral symptoms of CTS were present in 59% patients when first seen [24]. Nevertheless, in our study, there has been no significant difference in the frequency of U/L (53.33%) versus B/L CTS (46.67%). However, among U/L cases of CTS, significant numbers of cases are right sided (87.5%).

Diabetic Peripheral Neuropathy (DPN) also called 'Distal symmetric polyneuropathy' or 'Sensorimotor neuropathy' is the most commonly recognized electrophysiological form of diabetic neuropathy [25]. International data states that normal electrophysiological findings do not rule out CTS. In our study, as well, sensory-motor mixed (demyelination plus axonal) neuropathy was the commonest EMG-NCS pattern (46.66%) in diabetics with CTS. Distal symmetrical sensory polyneuropathy

was the second most frequent pattern (33.33%) in our study.

A study by Melanie & colleagues demonstrated that a difference in progression of DPN between male and female genders may exist. The males in the study population developed neuropathic complications earlier than did the females [26]. Our study supports this finding. In our study, while comparing 'duration of DM' with 'duration of CTS symptoms', females, in spite of having a longer duration of diabetes, took more time (1.48 mean yrs.) than males to become symptomatic for CTS. Is there any gender specific factor which effects the progression of neuropathy?

Normal electrophysiological findings do not rule out CTS [10]. In our study, 16 cases (14%) of symptomatic DPN had normal NCS.

To sum up, given the high prevalence of CTS in patients with DPN, it is recommended that therapeutic decisions for CTS be made independently of electrodiagnostic findings.

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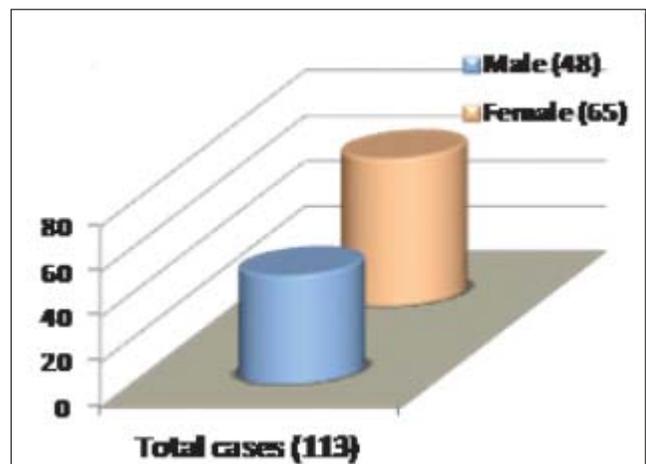
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## Tables & Diagrams

**Table-I: CTS Frequency vs. Sample & Gender**

Gender	Number	Percentage (%)
Male	03	20 %
Female	12	80 %
<b>Total</b>	<b>15 (13.27%)</b>	<b>100 %</b>

**Diagram-I: Gender vs. Age of sample**



[Mean Age of sample = 51.73 (+ 9.05) yrs.]

(U/L Diagram-II: CTS---Unilateral) or  
Bilateral (B/L)

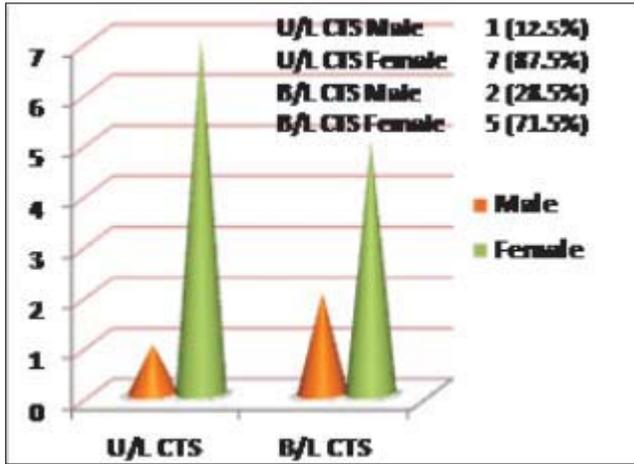


Table-III : Duration of symptomatic DM  
VS. Duration of CTS symptoms (mean yrs.)

Gender	Mean Age of Symptomatic DM (yrs.)	Mean Duration of DM (yrs.)	Mean Duration of CTS symptoms (yrs.)
Males	52.1	5.66	3
Females	51.3	9.08	1.52

Gender	U/L CTS	B/L CTS	Total
Total Cases (%)	08	07	15
	(53.33%)	(46.67%)	(100%)

Table-II: EMG-NCS Patterns in CTS

Main groups	EMG-NCS Pattern in CTS	No of cases	Gender	
			Male	Female
Poly-neuropathy (11/15 cases i.e. 73.33%)	SM Mixed PN	05/11 (45.46%)	01	04
	Sensory Axonal	04/11 (36.36%)	01	03
	Diabetic Radiculo pathy	02/11 (18.18%)	01	01
Mono-Neuropathy (4/15 cases i.e. 26.67%)	SM Mixed PN	02/4 (50%)	00	02
	Sensory Axonal	1/4 (25%)	00	01
	SM Demyelination	1/4 (25%)	00	01
<b>Total cases</b>		<b>15</b>	<b>03</b>	<b>12</b>