Original Article

Frequency of Carpal Tunnel Syndrome in Patients Having Diabetes Mellitus with Neuropathy in a Tertiary Care Hospital of Bangladesh

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Abstract

Background: *Carpal tunnel syndrome (CTS) is one of the most frequent entrapment neuropathies of the upper limb. CTS and diabetic polyneuropathy (DPN) are common conditions in patients with diabetes and therefore frequently occur concomitantly. Diagnosis of CTS in patients with DPN is important, as therapeutic interventions directed toward relief of CTS may be effective irrespective of diffuse neuropathy.*

Methods: *This study was a hospital based descriptive cross sectional study done in a tertiary care hospital, Dhaka between July, 2015 and June, 2016. The initial clinical diagnosis of diabetic peripheral neuropathy was made from history and examination. It was confirmed by doing nerve conduction study. After having informed written consents, a standard preformed questionnaire was filled up for each case. Collected data were checked, verified for consistency and edited for final results. Data cleaning, validation and analysis were performed using Statistical Package for the Social Sciences (Version 20.0).*

Results: *A total of 354 cases were finally analyzed with 153 (43.2) patients being symptomatic for CTS and among those 54 (58.7%) had electrophysiology proven CTS. It was observed that 26.0% of patients established as having DPN also had CTS. The frequency of CTS among those with symptoms was significantly higher than in asymptomatic participants. The mean age was found to be 55.99 ± 9.25 years with a range from 28 to 80 years. Majority (38.4%) of patients belonged to the age group of 51-60 years. Among all cases of electrophysiology proven CTS (92 patients), females (53.3%) numbered greater in comparison to males (46.7%). One hundred and ninety two (54.2%) patients were housewives, 57 (16.1%) were garment workers, 45 (12.7%) patients were businessmen and 60 (16.9%) patients were service holders.*

Study subjects with CTS had significantly higher body mass index, higher fasting blood glucose and higher HemoglobinA1c in comparison to patients without CTS. Examination of upper limb sensory nerves showed that nerve conduction velocity was significantly decreased and distal latency was found to be significantly increased in patients with CTS on median nerve examination. The mean compound motor action potential was not significantly different between patients with and without CTS.

Conclusion: *Symptoms and signs of CTS are mostly masked by the symptoms of DPN and patients presenting with such symptoms in the upper limbs should be evaluated for CTS as a separate entity to DPN. The finding of a frequency of CTS of 26% in subjects with diabetes with varying degrees of DPN is remarkably high. Given the high prevalence of CTS in subjects with DPN, it is recommended that therapeutic decisions be made carefully after nerve conduction study and proper diagnosis.*

Keywords: *Diabetes mellitus, nerve conduction studies, diabetic neuropathy, carpal tunnel syndrome*

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Introduction

Carpal tunnel syndrome (CTS) is one of the most frequent entrapment neuropathies of the upper limb.[1] Due to entrapment of the median nerve between the flexor tendons of the hand in the carpal tunnel, symptoms like tingling and nocturnal burning pain occur.[1] The combination of these clinical symptoms together with positive signs by physical examination and nerve conduction studies (NCS) is the most valid way of diagnosing CTS.[1]

The prevalence of CTS in the general population is approximately 0.6-2.1% for men and 3.0-5.8% for women.[2]The prevalence of clinical CTS was found to be 14% in diabetic subjects without diabetic peripheral neuropathy (DPN) and 30% in those with DPN.[3] Obesity, hypothyroidism, pregnancy, rheumatoid arthritis, osteoarthritis and occupational factors like repetitive work are identified as the main risk factors for CTS.[1] In addition, diabetes mellitus (DM) is also considered as a risk factor.[4-7] Literature also suggests a relationship between hemoglobinA1c, duration of DM, microvascular complications and CTS.[8-10]

There are studies from the South-Asian region, which have stated that the prevalence of type 2 diabetes and its complications are predicted to rise extensively in the coming years.[11] The prevalence of DM ranged from 2.2 to 8.1% both in rural and urban communities in Bangladesh.[12] The aim of this study was to estimate the frequency of CTS among patients with diabetic neuropathy in a developing country like Bangladesh because functional outcome and symptoms can be improved in CTS if early diagnosis and intervention can be made in patients with coexisting neuropathy.

Methods

This cross-sectional study was carried out in Department of Neurology, BIRDEM General Hospital from July, 2015 to June, 2016. Three hundred and fifty four Adult patients aged e" 18 years of either sex, with duration of diabetes mellitus of more than 5 years and symptoms of peripheral neuropathy, admitted or referred from outpatient departments who underwent nerve conduction study were consecutively and purposively selected for the study.

A detailed questionnaire was filled out for each case, with a view to detecting symptoms and signs of peripheral nerve disease, excluding confounding factors that may affect NCS results, and recording complications of DM. Patients having diseases with symptoms that may mimic neuropathic symptoms including spine disease, alcoholism, toxin exposure, other endocrine metabolic or nutritional disorders, inflammatory diseases, pregnancy and those with diabetic emergencies were excluded.

Their detailed family history, treatment and medical history was taken along with physical and clinical examination. Clinical assessments were carried out by the investigator, focusing specifically on sensory complaints and objective abnormalities in the upper and lower extremities. Glycosylated haemoglobin (HbA1c) and fasting and postprandial blood glucose levels were measured in venous blood from all patients.

NCS was performed by the investigator with standard surface stimulation and recording techniques on a Neuropack S1 four channel electromyograph with standard filter settings and a surface stimulator using a 0.1 ms square-wave pulse.

Measures in were employed to evaluate peroneal and tibial motor, median and ulnar motor and sensory, and sural sensory responses. Standard recording sites and stimulation to recording electrode distances were used: stimulation at the wrist and elbow for median and ulnar motor NCS recording from the abductor pollicis brevis and abductor digiti minimi respectively; stimulation at the wrist for median and ulnar antidromic sensory studies recording from the second and fifth digits respectively; stimulation at the ankle and fibular neck for peroneal motor NCS recording from the extensor digitorum brevis and stimulation in the calf recording from the foot for sural studies.

For motor NCS, gain was kept at 2 mV/division, time sweep at 2 ms/division and low and high frequency filters at 10 and 32 kHz respectively, while for sensory studies gain was at 20 ìV/division and time sweep at 1 ms/division, with the same filter settings. Since the studies were performed in a tropical country where the ambient temperature at the time of performing NCS was around 25 °C, limb temperature was not monitored. Compound muscle action potential amplitudes were measured from the baseline to negative peak and onset latencies were measured for distal and proximal stimulation sites. Sensory nerve action potential (SNAP) amplitude was measured from the baseline to the negative peak. The results were calculated on the basis of average of ten or more responses.

Conduction velocities were calculated from the onset latency and distance measurements. Motor conduction velocities were determined for the median nerve, ulnar nerve and peroneal nerves and calculated by dividing the distance between proximal and distal stimulating cathodes by the latency. Sensory conduction velocity was calculated by dividing the distance between stimulating and recording electrodes by response latency.

Statistical methods

All data were entered into a database and this was exported to statistical software (SPSS Inc, version 20) for analysis. Descriptive statistics such as mean, standard deviation, frequency, median, range and percentage were used to express data. Categorical variables were analysed using chi square test, while one-way analysis of variance and univariate analysis of variance were used for continuous variables. Logistic regression was employed to describe risk. A p value of d” 0.05 was considered statistically significant.

Results

It was observed that 26.0% of patients having DPN also had CTS. Among all cases of electrophysiology proven CTS (92 patients), females (53.3%) numbered greater in comparison to males (46.7%). One hundred and ninety two (54.2%) patients were housewives, 57 (16.1%) were garment workers, 45 (12.7%) patients were businessmen and 60 (16.9%) patients were service holders. A total of 153 (43.2) patients were symptomatic for CTS and among those 54 (58.7%) had electrophysiology proven CTS. The frequency of CTS among those with symptoms was significantly higher than in asymptomatic participants (P<0.001).

Study subjects with CTS had significantly higher body mass index, higher fasting blood glucose and higher HbA1c in comparison to patients without CTS. The values of the other parameters (diabetes duration, fasting blood glucose) were also greater in those with CTS but not significantly. Nerve conduction velocity was significantly decreased and distal latency was significantly increased in patients with CTS on median nerve examination. The mean compound motor action potential was not significantly different between patients with and without CTS.

Table I Prevalence of CTS among the established DPN cases (N=354)

CTS	Frequency (n)	Percentage (%)
Present	92	26.0
Absent	262	74.0
Total	354	100.0

Table II Distribution of adult type 2 diabetes patients with diabetic polyneuropathy (DPN) according to gender (n=354)

Gender	Category wise Number of Patients (%)	CTS		P value
		Present	Absent	
Male	153(43.2)	43(46.7)	110(42.0)	0.428
Female	201(56.8)	49(53.3)	152(58.0)	
Total	354(100.0)	92(100.0)	262(100.0)	

Chi-square test was done to measure the level of significance

Table III shows the age distribution of the study patients. It was observed that the majority (38.4%) of patients belonged to the age group of 51-60 years. The mean age was found to be 55.99 ± 9.25 years with a range from 28 to 80 years. There was no significant difference between the mean age of patients with and without CTS.

Table III Distribution of adult type 2 diabetes patients with diabetic polyneuropathy (DPN) according to age (n=354)

Age (years)	Category wise number of patients (%)	CTS		P value
		Present	Absent	
≤ 40	17(4.8)	2 (2.2)	15 (5.7)	
41-50	90(25.4)	24 (26.1)	66 (25.2)	
51-60	136 (38.4)	37(40.2)	99 (37.8)	
61-70	99 (28.0)	26 (28.3)	73(27.9)	
> 70	12 (3.4)	3 (3.2)	9 (3.4)	
Total	354(100.0)	92(100.0)	262(100.0)	
Mean±SD	55.99±9.25	56.53±8.40	55.70±9.69	0.421
(min-max)	(28.00-80.00)	(32.00-80.00)	(28.00-80.00)	

Unpaired t-test was done to measure the level of significance

Table IV shows distribution of patients according to their symptoms. 201 (56.8%) patients were asymptomatic and among these 38 (41.3%) had CTS. On the other hand a total of 153 (43.2) patients were symptomatic and among those 54 (58.7%) had electrophysiology proven CTS. The frequency of CTS among those with symptoms was significantly higher than in asymptomatic participants. Similarly, among the group of patients with CTS proven by electrophysiology a significantly greater number of patients were symptomatic than in the other group of subjects who were negative for CTS on electrophysiology.

Table IV Distribution of adult type 2 diabetes patients with diabetic polyneuropathy (DPN) according to status of symptoms of CTS (n=354)

Status of CTS symptoms	Category wise number of patients (%)	Electrophysiology proven CTS Present	Absent	P value
Symptomatic	153 (43.2)	54 (58.7)	99 (37.8)	< 0.001
Asymptomatic	201 (56.8)	38 (41.3)	163 (62.2)	
Total	354 (100.0)	92 (100.0)	262 (100.0)	

Chi-square test was done to measure the level of significance

Table V shows distribution of patients according to their occupation. 192 (54.2%) patients were housewives, 57 (16.1%) were garment workers, 45 (12.7%) patients were businessmen and 60 (16.9%) patients were service holders. The frequency of CTS was not found to be significantly different from within any one of these occupations to any other.

Table V Distribution of adult type 2 diabetes patients with diabetic polyneuropathy (DPN) according to occupation (n=354)

Occupation	Category wise Total No. of Patients (%)	CTS Present	Absent	P value
Housewife	192 (54.2)	49 (53.3)	143 (54.6)	0.744
Garment worker	57 (16.1)	17 (18.5)	40 (15.3)	
Businessman	45 (12.7)	13 (14.1)	32 (12.2)	
Service holder	60 (16.9)	13 (14.1)	47 (17.9)	
Total	354 (100.0)	92 (100.0)	262 (100.0)	

Chi-square test was done to measure the level of significance

Table VI Comparison of clinical and laboratory findings in study subjects with diabetic polyneuropathy (DPN) with and without CTS (n=354)

	Category wise number of patients (%)	CTS Present	Absent	P value
BMI	25.84 ± 1.70	26.11 ± 1.99	25.70 ± 1.50	0.035
(kg/m^2)	(21.99 - 31.23)	(22.10 - 31.23)	(21.99 - 31.10)	
Fasting Glucose	8.88 ± 1.67	9.15 ± 1.66	8.74 ± 1.66	0.026
(mmol/L)	(6.20 - 15.20)	(6.20 - 15.20)	(6.20 - 15.20)	
Glucose 2h ABF	10.70 ± 2.54	11.04 ± 2.36	10.52 ± 2.62	0.064
(mmol/L)	(7.00 - 21.20)	(7.30 - 18.90)	(7.00 - 21.20)	
HbA1c	8.59 ± 1.83	8.89 ± 1.69	8.42 ± 1.88	0.023
(%)	(1.30 - 15.20)	(1.30 - 15.20)	(1.30 - 15.20)	

Unpaired t-test was done to measure the level of significance

Table VII Risk factor analysis for CTS (multiple logistic regression models)

	B	S.E.	Wald	P value	OR	95% CI for OR Lower	Upper
BMI	-0.148	0.068	4.810	**0.028**	0.862	0.755	0.984
FBS	-0.082	0.074	1.226	0.268	0.921	0.797	1.065
HbA1c	-0.127	0.068	3.481	0.062	0.881	0.771	1.006

Discussion

It was observed that 26.0% of patients with DPN had CTS in our study. Perkins et al found that the prevalence of CTS was 30% in those with DPN in their study.[10] A study done by Öge et al concluded that 27.8% of their DPN patients had CTS.[13]Akulwar,after doing electrophysiological study in diabetic patients, concluded in their study that 24.53% cases had CTS.[15] The prevalence of CTS in diabetics was found to be between 15-25% in a few other studies described by Chammaset al.[15] Gamstedt found that CTS was present in about 20% of their patients with diabetes.[16]Pandey et al stated that CTS was seen in up to 20% of diabetic patients in their study.[17] The specific relationship of CTS to diabetes is thought to be due to median nerve entrapment caused by diabetes induced connective tissue changes.

Statistically significant ($p<0.05$) female predominance was also observed in gender-wise distribution of clinical CTS proven electrophysiologically in a study done by Akulwar et al.[15]Paranthakan et al found that56% were female and 44% were male in their study population.[18]

Among patients with proven features of CTS by electrophysiological studies, 58.7% had symptoms of CTS. However 41.3% CTS patients had no symptoms of the disease,which is probably due to the disease being in the early stages. A study done by Dyck et al included type 2 diabetes as study subjects and found that 29% of non insulin dependent diabetes mellitus patients had electrophysiologic abnormalities characteristic of the CTS without any symptoms.[19] 4% of non insulin dependent diabetes mellitus patients had symptoms, with or without electrophysiologic abnormalities, which were suggestive of CTS.

It was found that BMI was significantly ($p < 0.05$) higher in patients with CTS. M P Vessey, L Villard-Mackintosh and D Yeates showed that an increase in BMI of 1.99 to 2.6 caused doubling of CTS cases.[20]

Regarding glycemic status, it was found that patients with CTS had higher HbA1c (8.89 ± 1.69) in comparison to patients without CTS and this was found to be statistically significant. Perkins et al found that the mean glycosylated hemoglobin value was $8.1\% \pm 1.7$ in patients with CTS and diabetic polyneuropathy in their study, which is almost similar to that in our study.[10]

In this study, CTS frequency was significantly higher in patients with higher BMI in comparison to those with lower BMI as seen after multiple logistic regression analysis. However, we found no significant difference in the frequency of CTS between patients with higher HbA1c level and lower HbA1c levels, this being consistent with the study done by Han et al.[21]

Kim et al reported that 6.8% of patients with diabetes had asymptomatic electrophysiological CTS and investigated whether the cause of asymptomatic CTS in patients with diabetes was a manifestation of early DPN or an entrapment neuropathy itself.[22] Their results suggest that asymptomatic CTS in patients with diabetes is related to an increased vulnerability to the entrapment of the median nerve rather than to early DPN.

Conclusion

One fourth of DPN patient's had concomitant CTS. Symptoms and signs of CTS are mostly masked by the symptoms of DPN and patients presenting with such symptoms in the upper limbs should be evaluated for CTS as a separate entity to DPN. Given the high prevalence of CTS in subjects with DPN, it is recommended that therapeutic decisions be made carefully after nerve conduction study and proper diagnosis.

Conflict of interest: Nothing to declare.

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