Turkish Journal of Endocrinology and Metabolism, (2004) 1 : 43-47 **ORIGINAL ARTICLE**

Relationship Between Carpal Tunnel Syndrome and Polyneuropathy in Diabetics: Is the Polyneuropathy A Risk Factor or Not?

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The prevalence of carpal tunnel syndrome (CTS) is thought to be higher in patients with diabetic polyneuropathy (DPN) than in the general population. DPN and CTS frequently occur concomitantly in diabetes. In this cross-sectional study we aimed to study the prevalence of CTS and to evaluate the relationship between CTS and DPN in a group of diabetic patients.

A total of 100 patients with type 2 diabetes melllitus (DM) without known neuropathy status and 50 healthy controls were included in this study. All subjects underwent nerve conduction study.

Among all cases, we found 54 patients with DPN. CTS ratio of these patients was 27.8% ($p < 0.05$). However, CTS was present in 16% of all diabetic patients and of these 93% were found to have DPN ($p < 0.001$). There was no relationship between CTS and BMI or duration of diabetes and age, gender, diabetic nephropathy and retinopathy.

In conclusion, we revealed the high prevalence of CTS in diabetics with DPN. It is well known that the treatment of CTS with traditional methods in diabetics with DNP is less successful than those without DNP. Our study suggests that therapeutic decisions for CTS be made dependently presence of DNP.

Key words: **Diabetic polyneuropathy, carpal tunnel syndrome, diabetes mellitus, electromyography**

Introduction

One of the most common complications of diabetes is peripheral neuropathy and it increases the morbidity in diabetic patients. The prevalence of diabetic polyneuropathy (DPN) has been reported as 5%-60% in several studies (1).

Carpal tunnel syndrome is the second most important cause of diabetic neuropathy after distal symmetric sensory motor polyneuropathy (2). The prevalence of CTS in diabetes was found to be between 15-25% in some previous studies (3,4).

CTS results from the compression of the median nerve at the wrist (5). The most typical symptoms are pain and paresthesia, occurring especially at night. It is also very common for patients to wake up with hypoesthesia in their hands and relief of their symptoms by shaking hands (6-8). These symptoms might be confused with symptoms of DPN in diabetics. The most reliable method to obtain objective diagnosis of CTS is the electro-diagnostic study (9,10).

Carpal tunnel syndrome (CTS) and diabetic poly-neuropathy (DPN) are common conditions in patients

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with diabetes and therefore frequently occur concomitantly (2,11).

The prevalence of CTS is thought to be higher in patients with DPN (3,4,13,14) than in the general population, and treatment of these patients is less effective than others (2,14-17).

The clinical significance of these coexistence is not clear (18,19). For future treatment planning, it is important to determine whether CTS is an entrapment of the median nerve under the transverse carpal ligament, or it results from diabetic polyneuropathy. There seems to be the risk of developing CTS with additional DPN in diabetics (20).

This cross-sectional study was performed to determine the prevalence of CTS and the relationship between CTS and DPN, age, gender, duration of diabetes, and other microangiopathic complications in diabetics.

Material and Methods

Subjects

We included one hundred diabetic patients who were randomly selected without any knowledge about their neuropathy status. The study was performed at diabetic clinic. Fifty age and gender matched healthy volunteers without a history of neuropathy comprised the control group.

Of the 100 diabetic patients, 58 were female whereas 42 were male and the mean age of the group was 39.8 ± 8 years. Duration of diabetes was 8.8 ± 3 years and BMI was 25.8 ± 5.6 kg/m^2.

The diagnosis of CTS was done by the presence of nocturnal and activity related pain or dysesthesia limited to the hand, positive Phalen's or Tinel's signs in physical examination and the nerve conduction study (NCS) which is accepted as the gold standard tecnic in diagnosis of CTS and DPN is performed (21). Diabetic patients were investigated for serum glucose regulation by the glycosylated hemoglobin (HbA1c) measurement which was measured by HPLC (BoiRad Diamand: Germany). Urinary albumin concentration was analysed by nephelometry (Behring Diagnostics, Germany). Urinary albumin/creatinine ratio was calculated and we applied the following definitions: normoalbuminuria. <30 mg/24 hours: and microalbuminuria 30-300 mg/24 hours: and macroalbuminuria >300mg/24 hours. Diabetic retinopathy was detected by fundoscopic examination. If there was any suspicion about the presence of diabetic retinopathy, the patient was further evaluated by flourescein angiography for diagnosis microvascular disease. All patients gave informed consent to participate in the study.

Nerve Conduction Study

Nerve conduction studies were performed with conventional techniques of supramaximal percutaneous nerve stimulations and surface recordings in 3 extremities including median, ulnar nerve sensory (UNSCV) and motor conduction velocity (UMCV), and peroneal nerve motor (PNMCV) and sural sensory nerve conduction velocity (SSNCV). Results were interpreted as abnormal for CTS when the median – ulnar nerve conduction velocity was slower by more than 2 standard deviations of the normal means. If the two or more recordings revealed prolonged nerve conduction velocity, the diagnosis of diabetic polyneuropathy was made.

Statistical analysis

For the comparison of mean values of NCS parameters and ratios in different groups, the statistical analysis was performed by the ANOVA test. The multiple linear regression method was applied to compare the parameters. The p values lower than 0.05 was accepted as statistically significant. Data were presented as mean ± standard deviation.

Results

There was significant slowing of NCV in diabetic DNP in the median, peroneal, and sural nerves. There was significant slowing in diabetic CTS in the median and ulnar nerves. As a results of nerve studies, of the 100 diabetic patients, 16 had CTS and of the 16 CTS cases 15 were found to have DPN ($p < 0.001$); diagnosed by performing electrophysiologic studies and also we detected that 54 patients had DPN and 27.8% of these patients had also CTS ($p < 0.05$) (Table 1). The results of nerve conduction studies of diabetic electrophysiologic DPN and the normal controls are shown in Table 2 and that of diabetic electrophysiologic CTS and the normal controls are shown in Table 3.

Table 1. Characteristics of t he patients with CTS and without CTS and control subjects.

	CTS (-)	CTS (+)	Controls
Number of patients	84	16	50
Age (years)	41.8 ± 15.05	46.3 ± 15.02 *	38.3±10.3
Gender (female/male)	47/37	11/5*	25/25
BMI (kg/m^2)	25.4 ± 5.06	26.3 ± 6.3	23.2±4.5
Duration of DM(years)	7.7 ± 5.7	6.9 ± 5.5	-
HbA1c (%)	7.4 ± 0.2	7.1 ± 1.5	-
Retinopathy (+/-)	32/52	7/9	-
Microalbuminuria (mg/24 hours)	26.2 ± 4.8	17.9 ± 7.2	-
DPN (+)	54/30	16/15*	-

* $p < 0.05$

Table 2. Results of Nerve Conduction Velocity Studies in diabetics and controls.

Nerve	Diabetic group (n = 100)	Control (n =50)	p-value
Median motor			
TL (msec)	3.7 ± 0.07	3.65 ± 0.54	0.04
NCV (m/sec)	50.0 ± 9.95	60.75 ± 7.40	0.03
F	29.3 ± 3.76	25.60 ± 1.90	0.01
A (mV)	7.48 ± 3.42	15.45 ± 2.10	0.001
Peroneal motor			
TL (msec)	5 ± 1.23	4.35 ± 0.55	0.05
NCV (m/sec)	42 ± 9.29	57.05 ± 4.05	0.03
F	54 ± 6.68	43.45 ± 2.80	0.04
A (mV)	5 ± 4.38	20.05 ± 6.60	0.001
Median sensory			
NCV (m/sec)	51 ± 8.24	57.65 ± 5.25	0.02
A (uV)	9.8 ± 8.26	12.20 ± 2.20	0.01
TL(msec)	3.56 ± 0.74	10.06 ± 3.1	0.001
Sural sensory			
NCV (m/sec)	46.60 ± 6.26	48.25 ± 4.25	0.05
A (uV)	8.16 ± 7.83	11.25 ± 2.25	0.03
TL (msec)	2.92 ± 0.60	10.05 ± 3.30	0.005

Out of 16 patients with CTS 11 were female. Female gender was associated with an increased risk of CTS in our study (p=0.003). Mean age of the group was 46.37 ± 15.02 and 41.80 ± 15.05 years with and without CTS respectively. Age group distribution showed that 12 of the 16 CTS cases were 40 and older (as shown in Figure 1, p=0.03).

The average duration of the DM was 7.72 ± 5.73 years in the CTS positive group and 6.93 ± 5.51 years in the CTS negative group. There was no statistically significant correlation between duration of diabetes and CTS.

Table 3. Comparision of Median and Ulnar Nerve Conduction Studies in Diabetics with CTS(+) and Controls.

	Diabetics with CTS(+) (n=16)	Control (n=50)	P value
Median			
Sens ory NCV (m/sec)	48.4 ± 3.2	57.65 ± 5.25	0.01
Sensory A (uV)	9.6 ± 4.2	12.20 ± 2.20	0.02
TL (msec)	3.4 ± 0.6	10.06 ± 3.1	0.005
Motor NCV(m/sec)	51 ± 7.9	60.75 ± 7.40	0.03
F	28.3± 3.4	25.60 ± 1.90	0.04
Motor A (mV)	8.4 ± 4.4	15.45 ± 2.10	0.002
Ulnar			
TL (msec)	2.43 ± 0.25	2.17 ± 0.31	0.007
Motor NCV (m/sec)	56.4 ± 4.3	60.4 ± 4.5	0.004
F	29.4 ± 4.5	24.7 ± 5.7	0.005
Motor A (mV)	14.2 ± 2.15	14.0 ± 2.34	0.179
Sensory NCV (m/sec)	42.8 ± 3.27	46.1 ± 3.87	0.03

NCV: Nerve Conduction velocity, TL: Terminal latency, A:Action potential, F: F wave

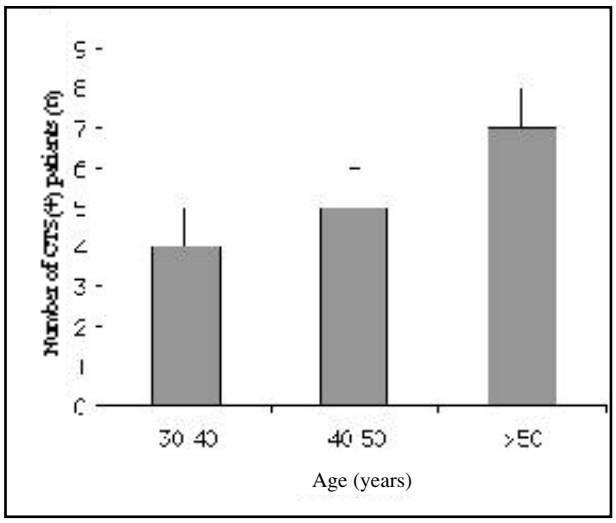

Figure 1. The relation between CTS and the age groups is seen in Figure 1. The prevalence of CTS is increased with the increasing age of the patient (p=0.003*).

The mean BMI was greater in the diabetic patients with CTS (26.34 ± 6.37) than in CTS negative group (25.44 ± 5.06) but there was no significance ($p > 0.05$). There was not found any relation between CTS and the microangiopathic complications of DM such as retinopathy and nephropathy.

Discussion

The prevalence of CTS in patients with diabetic was 16% in this study. This result clearly demonstrates similar prevalence of CTS in Turkish diabetic patients when compared to other studies (7,22,23). In our study, we also found that out of 16 patients with CTS 15 had also DPN. The prevalence of CTS in patients with DPN was 27.8%.

The risk of developing CTS increases in patients with additional PNP, especially in diabetics(24). Several studies showed that CTS and DPN are commonly seen together in diabetic patients(2;11). In other studies, DPN is found to be a major risk factor for developing CTS (3,4,12,13) and the treatment of these patients are not successful enough (2,14-17). According to these results, entrapment of median nerve in diabetics seems to be related with neuropathy. Several pathogenetic mechanisms are suggested for the development of CTS in diabetics. An increased glycosylation of proteins induces structural changes of the tissues (25). It is hypothesized that the median nerve is made more susceptible to the pressure effects existing in the carpal tunnel when underlying DPN, a length-dependent axonopathy, is present. The anatomy of the carpal tunnel may produce local vascular compromise, which is superimposed on the metabolically disordered nerve or a nerve with established endoneurial ischemia, leading to frequent dysfunction in this short segment. This combination of insults may result in impaired axonal transport (26), producing local pathology and retrograde nerve dysfunction.

Female gender was found an independent risk factor for CTS. This results are in accordance with several previous studies showing a marked predominance of females (22,28). This was probably due to the fact that number of our CTS positive patients was to small and most of them was female.

Among all CTS patients, 12 were in the age group of 40 and older. The prevalence of CTS was significantly related to the age as found in the other studies (22,29).

In this study, the average duration of DM was very close in the CTS(+) and (-) groups so there was not any statistical significance between duration of diabetes and CTS.

Concerning other evaluated factors, there was nc relationship between CTS and diabetic retinopathy, nephropathy and HbA1c outcomes. However, in a previous study obesity was found to be an independent risk factor for CTS (25,30) and also Werner et al. suggested BMI as a strong risk factor for CTS among males(29), The cause of that we could not find any relation between BMI and CTS, may be the close BMI values of our patients were close to each other.

In conclusion we suggest that it will be useful to perform electrodiagnostic study in diabetic patients in whom CTS is suspected, not only at the wrist but in all four limbs to evaluate DPN. CTS and DPN frequently occur together in diabetics. Because DPN decreases the effectiveness of surgery made for the treatment of CTS and DPN is a risk factor for CTS, priority should also be given to the treatment of DPN.

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