

Carpal Tunnel Syndrome in type 2 diabetic patients

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ABSTRACT

Objective: To determine the frequency of carpal tunnel syndrome in type 2 diabetic patients, its clinical profile and its other predisposing factors.

Methods: One hundred and forty six consecutive patients (57 male, 89 female) with type 2 diabetes mellitus seen in the diabetic clinic were examined prospectively and submitted to comprehensive electrophysiological studies to detect carpal tunnel syndrome and sensorimotor neuropathy. Those with carpal tunnel syndrome were compared to the others to determine the additional predisposing factors for carpal tunnel syndrome in diabetic patients.

Results: The mean duration of diabetes was 11.5 years. Carpal tunnel syndrome was diagnosed in 39% of the patients (28% of the males and 46% of females). Numbness of the hands, Tinel's sign and Phalen's sign had

poor sensitivity (61%, 54% and 37% respectively) but high specificity (75%, 85% and 91%). The main risk factor for carpal tunnel syndrome in diabetics was the duration of diabetes ($p<0.001$) and to a lesser degree female gender and obesity ($p<0.05$).

Conclusion: Carpal tunnel syndrome is quite frequent in type 2 diabetic patients. Its clinical diagnosis may be difficult because of the poor sensitivity of its classical symptoms and signs. It should be suspected mainly in obese women with long-standing diabetes mellitus. Electrodiagnostic studies should be done in these patients because the earlier the diagnosis, the sooner consideration can be given to the need for surgical decompression.

Keywords: Diabetes mellitus, neuropathy, median nerve, carpal tunnel.

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Diabetes mellitus (DM) is one of the main predisposing factors for carpal tunnel syndrome (CTS). Median mononeuropathy has been reported to occur in 22%-32% of diabetic patients in cross-sectional studies^{1,2} while its lifetime prevalence in the general population does not exceed 10%.^{3,4} In a previous study⁴, we found that DM was present in 30% of CTS cases diagnosed in our clinical neurophysiology laboratory and that DM was the strongest risk factor for CTS, after female gender. These findings lead us to design the present study in order to: 1) estimate the frequency of CTS in type 2 diabetic patients; 2) determine the clinical profile of CTS in diabetics compared to non-diabetics and 3) establish what are the other possible predisposing

factors of CTS in patients with DM.

Methods. From January to December 1997, patients presenting to the Diabetic Clinic in our hospital were assessed to obtain baseline data about their disease. Those with type 2 DM were then referred to the clinical neurophysiology laboratory. They were examined by a neurologist for clinical symptoms and signs of diabetic neuropathy, according to the recommendations of the San Antonio Conference.⁵ All patients were also interviewed for the usual symptoms of CTS and examined for Tinel's (wrist percussion) and Phalen's (wrist flexion) signs. They were then subjected to

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Table 1 - Age and sex distribution.

Age Group	Male	Female	Total
<20	1	1	2
20-24	5	8	13
25-29	12	27	39
30-34	22	33	55
35-39	12	18	40
>40	5	2	7
Total	57	89	146

comprehensive conduction studies of both median and right ulnar nerves (motor and sensory), right peroneal (motor) and sural (sensory) nerves. All studies were done at room temperature according to well established protocol.

Median motor distal latency was recorded using a distance of 7 cm from stimulation to recording electrode. Antidromic sensory peak latency was measured using a stimulation to recording electrode distance of 14 cm. The diagnosis of CTS was based upon two absolute and one relative criteria: 1) distal motor latency > 4.4 msec or 2) sensory peak latency > 3.8 msec and 3) median to ulnar motor latencies difference of more than 1.5 msec or sensory latencies difference of more than 0.5 msec. The last (relative) criterion is thought to be less sensitive to factors such as age, temperature, anthropometric characteristics and associated sensorimotor neuropathy because individual median and ulnar nerves share the same general environment, different only in their location relative to the carpal tunnel.² The following values were considered abnormal for peroneal and sural nerves studies and suggestive of the presence of a more widespread neuropathy: peroneal conduction velocity < 40 m/sec, distal latency > 6.4 msec and amplitude < 1.6 mV, sural amplitude < 6V, conduction velocity < 40 m/sec and distal latency > 4.3 msec.⁶

Patients with CTS were compared to those without CTS for different factors thought to be associated with increased risk for the development of CTS, including demographic data, body mass index [weight in Kgs / (height in m)²], duration of the DM and conduction studies suggestive of generalised neuropathy. Odds ratios, Chi square test and, when indicated, the Student's two-tail test were used for statistical analysis.

Results. A hundred and forty six patients were included in the study (57 male, 89 female). Their mean age \pm SD was 52 ± 7.6 years. Age and sex distribution is shown in Table 1. All patients were suffering from type 2 DM and 39.7% of them were on insulin. The mean duration of the disease was

Table 2 - Body mass index (BMI) distribution in CTS patients compared to those without CTS. Results are expressed in percentages. CTS patients are over-represented in higher BMI groups (>30).

BMI(Kg/m ²)	No CTS	CTS
<20	2	4
20-24	13	9
25-29	46	37
30-34	28	33
35-39	9	14
40	1	4
Total	100%	100%

11.5 ± 5 years. Carpal tunnel syndrome was diagnosed on electrophysiological bases in 57 cases (39%), 16 men (28 %) and 41 women (46%). It was unilateral in 17 cases (4 men, 13 women) and bilateral in 40 (12 men, 28 women). In the unilateral cases, all CTS were noted on the right side. Thirty-six of 57 patients with CTS complained of numb hands as compared to 22/89 of those without CTS (sensitivity 63%, specificity 75%). Tinel's sign was present in 52/97 affected hands and in 19/131 non-affected ones (sensitivity 54%, specificity 85%). The numbers were respectively 36/97 and 12/131 for Phalen's sign (sensitivity 37%, specificity 91%).

Table 2 shows the distribution of the patients according to their body mass index (BMI) and the presence or absence of CTS. Patients with CTS were more represented in the higher BMI groups. Comparison of patients with CTS and those without in relation to BMI and other parameters is shown on Table 3. The factors which were the most significantly associated with CTS in diabetics were female gender ($p < 0.05$), higher BMI ($p < 0.05$), the duration of diabetes ($p < 0.001$), insulin treatment ($p < 0.01$) and the presence of sensory and/or motor neuropathy ($p < 0.01$). The mean BMI was significantly higher in patients with CTS but there was no significant difference when each gender was analysed separately, probably because of the small number of patients. However, in the Student's two-tail test, overweight status appeared more frequently associated with CTS in women ($p = 0.16$) than in men ($p = 0.32$).

As diabetes duration appeared to be the statistically strongest risk factor for CTS in this study, the 61 patients with an illness duration > 10 years were compared to those 33 with an illness duration of 5 years or less. In the first group, 32 patients (52%) had electrophysiologically proven CTS, 33 (54%) had peripheral neuropathy and 32 (52%) were on insulin therapy. In the second group, only 8 (24%) had CTS, 7 (21%) had peripheral neuropathy and 6 (18%) were on insulin treatment. All the differences between the 2 groups were significant at a $p < 0.001$. The presence of sensorimotor neuropathy and insulin therapy did

Table 3 - Comparison of the 57 diabetic patients with CTS and the 89 without CTS.

	With CTS	Without CTS	Odds (95% CI)	p-value
Number	57	88		
Age (mean \pm SD)	52.4 \pm 6.5	50.8 \pm 8.1		0.064
Female gender	41 (72%)	48 (55%)	2.13 (1.04-4.36)	0.035
BMI (mean \pm SD)	30.7 \pm 4.4	29.1 \pm 3.7		0.034
Duration DM (mean \pm SD)	13 \pm 5 years	9 \pm 4 years		0.000018
Insulin	31/57 (54%)	27/88 (31%)	2.69 (1.35-5.37)	0.004
Abnormal sural sensory conduction	27/57 (47%)	20/88 (23%)	3.06 (1.48-6.28)	0.002
Abnormal peroneal motor conduction	25/57 (44%)	20/88 (23%)	2.65 (1.28-5.47)	0.007
The two-tail student t-test was used for statistical analysis of the age, the duration and the body mass index (BMI).				

not appear to confer an increased association with CTS after multivariate analysis and correction for diabetes duration.

The frequency of CTS in the particularly prone individuals i.e. women with a BMI > 29 and duration of DM > 10 years was 65%.

Discussion. While diabetes mellitus is quite frequent in Saudi Arabia⁷, very little information is available on the magnitude of CTS in diabetic Saudi patients. The frequency of diabetic neuropathy was found to be 24% and 47% in 2 cross-sectional studies^{8,9} but the frequency of CTS *per se* was not mentioned. Al Sulaiman et al¹⁰ found that the median nerve was involved electrophysiologically in 17 out of 29 patients recently discovered to have type 2 DM. Our study shows that CTS was present in almost 40% of Saudi patients with type 2 DM after an 11.5 years mean duration of the disease. In comparison, Dyck et al¹, in a American community-based cross-sectional study, found a prevalence of 32%. In the "Early Diabetes Intervention Trial", Albers et al², using electromyographic criteria similar to ours, found CTS in 23% of their type 2 diabetic patients. However, the mean duration of DM in their cases was 8 years only and patients with severe diabetic neuropathy were excluded from their study. The reason for the high frequency of CTS in diabetic patients is still unknown. One possibility is an increased susceptibility to focal trauma of diseased nerves, as it is frequently observed that entrapment neuropathies precede overt diabetic neuropathy.¹¹ Enhanced ischemia of the nerves already stressed by chronic endoneurial hypoxia may be a factor.^{12,13}

This study also shows that the 3 main symptoms and signs of CTS i.e. numbness of the hands, Tinel's

and Phalen's signs have relatively poor sensitivity in diabetic patients (63%, 54% and 37% respectively) while their specificity is high (75%, 85% and 91%). This would suggest that diabetic patients are more tolerant to the CTS associated symptoms, probably because of the insidious onset of the disorder and the co-existence of other non specific musculo-skeletal aches and pains. This decreased awareness could delay the diagnosis and prevent effective and timely treatment. On the other hand, when present in diabetic patients, these symptoms and signs are highly suggestive of CTS.

The strongest association with CTS in our patients was the duration of diabetes independent of the patients' ages. This is consistent with the findings of others.^{1,2} The presence of CTS correlated also with insulin treatment and the presence of sensorimotor neuropathy on univariate analysis but these 2 factors lost their power as independent risk factors on multivariate analysis. Female gender increased the risk for CTS by about two-fold in diabetics, as it does for idiopathic CTS and shown in our previous study on CTS in Saudis.⁴ Predisposition for female gender was also found in the "Early Diabetes Intervention Trial"² but not by Dyck and associates.¹ In our population, women do a substantial amount of work at home which may contribute to their increased risk for CTS.⁹

Obesity is another known contributing factor for CTS. In a cross-sectional study by Werner et al.¹⁴ the risk ratio for CTS in obese persons (BMI >29) was 2.5 when compared to slender individuals (BMI <20). Obesity increased the risk of CTS by a factor of 2.3 in our previous study on CTS in general but this risk was higher in females. Similar results were found in this study. As in idiopathic CTS, overweight and obesity increased the risk of CTS in diabetics and

there was a trend suggesting that high BMI operates as a risk for CTS more in women than in men.

In conclusion, CTS is quite frequent in type 2 diabetic patients, affecting more than a third of such patients after a decade of disease duration. Its clinical diagnosis may be difficult because of the poor sensitivity of classical symptoms and signs. A high index of suspicion is needed especially in obese diabetic women with long illness duration. Electrodiagnostic studies are desirable in these patients because the earlier the diagnosis, the more successful will be the result obtained by decompressive surgery, even in patients with underlying peripheral neuropathy.¹³

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