FREQUENCY OF CARPAL TUNNEL SYNDROME IN PATIENTS WITH DIABETIC POLYNEUROPATHY

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ABSTRACT

Objective: The objective of this study is to determine the frequency of carpal tunnel syndrome in patients with diabetic polyneuropathy.

Study Design: Cross sectional study.

Place and Duration of Study: Department of Medicine, Combined Military Hospital Peshawar, from Sep 2012 to Feb 2013 over a period of six months.

Material and Methods: In this study, one hundred and sixty five diagnosed patients of diabetic polyneuropathy presenting to medical OPD with complaints of paresthesia/numbness/pain in hands were recruited. All patients fulfilled inclusion and exclusion criteria. They underwent electrophysiological examination according to American Association of Electro Diagnostic Medicine to determine the frequency of carpal tunnel syndrome. Statistical analysis was done on SPSS 17.

Results: Out of 165 patients, 112 (68%) were females and 53 (32%) were males with the age ranging from 37–60 years (mean age and SD 51.55 ± 6.3). The frequency of CTS in our patients was 40% (66 patients). Thirty seven (56.1%) patients had right hand involvement and it was bilateral in 22 (33.3%) patients, of the 66 subjects with CTS, 48 (72.7%) were females. In patients who had CTS, mean duration of diabetes was longer as compared to the remainder (12.09 ± 7.4 years vs. 9.07 ± 5.0 years, *p*=0.002).

Conclusion: Carpal tunnel syndrome was common finding in diabetic patients. On the basis of our results, we recommend that a search for possible coexistent CTS in patients with diabetic polyneuropathy should always be made.

Keywords: Carpal tunnel syndrome, Diabetic polyneuropathy.

INTRODUCTION

Diabetes mellitus (DM) is an important health issue worldwide. Over the past twenty years the prevalence of diabetes has increased dramatically. It is estimated that in 1980, 108 million people had diabetes, a figure that jumped to 422 million by 2014[1]. The worldwide prevalence of diabetes among adults who are over 18 years of age, has risen from 4.7% in 1980 to 8.5% in 2014[1]. There were approx. 6.6 million adults in Pakistan having diabetes in 2012 making the tenth largest nation with this problem worldwide[2]. The number of diabetics having diabetic neuropathy is also increasing and it is estimated that approx 45% diabetics will develop diabetic polyneuropathy (DPN)[3]. The most common clinical subtype, seen in clinical practice, is diabetic sensorimotor polyneuropathy (DSPN). It can be the most debilitating complication of diabetes as many of the patients do not have symptoms of neuropathy and this places them at a high risk for developing serious foot and hand complications before they develop symptoms of diabetic neuropathy[4]. Carpal tunnel syndrome (CTS) is the most common entrapment neuropathy encountered in diabetics. It is seen in 2% of the general population, 14% of diabetic patients without diabetic polyneuropathy, and 30% of diabetic patients with diabetic polyneuropathy[5]. The rate of symptomatic CTS in diabetes patients, as observed in different studies, ranges from 8.7% to 19.4%[6,7]. DPN may be a further risk factor for symptomatic entrapment syndrome[8]. Moreover, CTS and DPN often co-

exist, and this can lead to a decreased awareness of CTS symptoms, thus masking the clinical recognition of CTS[6]. Many epidemiologic and electrophysiological data on risk factors for CTS report a significant association between DM and CTS[8]. However some studies suggest that frequency of symptomatic CTS is not higher in diabetics as compared to the general population[6]. CTS is more common in females and also in obese people (BMI >30kg/m^{2})[5]. Nerve conduction study (NCS) confirms a clinical diagnosis of CTS with a high degree of sensitivity (>85%) and specificity (>95%)[7]. It is the only technique helpful in diagnosis of subclinical cases and also helps differentiate entrapment from DPN[5] DPN is diagnosed using combination of signs, symptoms and NCS findings[8]. The present study was designed to determine the frequency of CTS in patients with diabetic polyneuropathy. The prevalence of CTS varies from general population to diabetics and even within populations with DPN. This study is hope to provide us with local data about magnitude of CTS in patients with DPN. The results of this study is expected to be very useful in devising future ward and patient management protocols where CTS screening is not in practice.

PATIENTS AND METHODS

This cross-sectional study was conducted at Combined Military Hospital, Peshawar from Sep 2012 to Feb 2013 over a period of six months after seeking approval from Hospital Ethical Committee. One hundred and sixty five diabetic patients aged 37 to 60 years including male and female with symptoms of polyneuropathy including hand symptoms, presenting to medical OPD were evaluated after written informed consent by non-probability consecutive sampling technique. Patients with other coexisting conditions (e.g., uremia, neurotoxic medications, hypothyroidism, rheumatoid arthritis, plexo-pathy) which could cause polyneuropathy or CTS were excluded. History and examination was done in all patients, and then each patient underwent electrophysiological examination for assessment of polyneuropathy. This included

NCS of peroneal, sural and tibial nerves in lower limbs; and NCS of median and ulnar nerves in upper limbs. NCS technique used was as per recommendations of American Association of Electro Diagnostic Medicine. At the end of this examination, only 165 patients who had clinical as well as electrophysiological proven diabetic polyneuropathy were included in the study.

Electrophysiological Criteria for Dpn

Abnormality of any attribute of NCS; prolonged distal latency, slow conduction velocity, reduced sensory nerve action potential or compound motor action potential amplitude; in two separate nerves, one of which had to be a lower limb nerve. The included 165 patients were further examined for presence of CTS according to the protocol.

NCS Protocol

Medtronic equipment was used for NCS. Surface electrodes were used for stimulating and recording. The motor latencies were measured from the onset of stimulus to the initial negative response, and sensory latencies were measured from the onset of stimulus to the negative peak. For motor NCS at wrist, median and ulnar motor nerves were stimulated, 7cm proximal to the active recording electrode. The sensory responses were obtained at digit-II for median nerve and digit-V for ulnar nerve, stimulating antidromically at 14 cm. The following nerve conduction parameters were used;

- Distal median motor latency (DMML), measured in ms
- Distal median sensory latency (DMSL), measured in ms
- Distal ulnar sensory latency (DUSL), measured in ms

The normal value of DMML was less than 4.0 ms, and value of antidromic DMSL was upto 3.6 ms.

Criteria for Diagnosis of CTS

- Absolute prolongation of DMML and/or DMSL; plus

- Additional conventional criteria of a difference between DMSL and DUSL exceeding 0.5 ms.7

Absolute prolongation for diagnosis of CTS meant DMML above 4.6 ms and DMSL above 4.0 ms. (prolongation of median distal motor and sensory latency conduction time by more than 0.40 ms).

Data Analysis

for the comparison of quantitative variables. A *p*-value <0.05 considered to be a significant value. Results were presented in the form of tables.

RESULTS

A total number of 165 patients were selected in our study of these. One hundred and twelve (68%) were females and 53 (32%) were males. The age among all subjects ranged from 37-60 years (mean age and SD 51.55 ± 6.3). Median and mode

Table-I: Involvement of right, left or both hands in carpal tunnel syndrome according to gender of patients.

CTS Present or not	Gender	Hand Involved (n)				Total (n)
		Right Hand	Left Hand	Both Hands	None	
Yes	Male	10	2	6		18
	Female	27	5	16		48
	Total	37	7	22		
No	Male				35	35
	Female				64	64
	Total				99	165

Table-II: Comparison of various variables between male and female (DMML=distal median motor latency; DMSL=distal median sensory latency).

	Gender	N	Mean	Std. deviation	*p*-value
Age (in years)	Male	53	51.92	6.20	0.396
	Female	112	52.70	5.13	
Duration of DM (in years)	Male	53	10.78	6.84	0.461
	Female	112	10.01	5.95	
Right DMML	Male	53	3.85	0.67	0.324
	Female	112	4.07	1.55	
Right DMSL	Male	53	3.78	0.65	0.063
	Female	112	4.18	1.49	
Left DMML	Male	53	3.69	68	0.54
	Female	112	3.83	1.59	
Left DMSL	Male	53	3.68	0.36	0.060
	Female	112	4.12	1.64	

All collected data was entered in SPSS version 17. For quantitative variables (age of patient and duration of diabetes) descriptive statistics, mean and standard deviation were calculated. For qualitative variables (gender and presence or absence of CTS) frequencies and percentages were presented. Chi square test was applied for the comparison of qualitative variables. Independent sample t-test was applied

was 53 years. Mean duration of diabetes was 10.28 ± 6.2 years, median was 9 years, and mode was 4 years, with range of 2-30 years. CTS was diagnosed in 66 (40%) patients. Out of these, right hand involvement was seen in 37 (56.1%) patients, while 7 (10.6%) had left hand CTS, and it was bilateral in 22 (33.3%) patients. A total of 330 hands were examined and underwent NCS. Out of these, CTS was found in 88 (26.7%) hands.

Table-I shows the involvement of right, left, or both hands in CTS according to gender of patient. Out of the 66 subjects with CTS, 48 (72.7%) were females while 18 (27.3%) were males. However, no significant difference in the frequency of CTS among females and males was observed (42.86% vs 34%; *p*-value=0.28). There was no difference in means of different NCS parameters between males and females. A comparison between males and females for different variables is given in

with DM[9]. As compared to the general population, prevalence of CTS is considered to be higher in patients with diabetic poly-neuropathy[10]. We diagnosed CTS by absolute criteria of prolongation of distal motor and/or sensory latencies of the Median nerve, and by the relative criteria of a difference of median to ulnar sensory conduction latencies of >0.5 ms. This method of sensory and motor NCS across the wrist compared to another nerve segment

Table-III: Comparison of various variables between patients with and without CTS (DMML= distal median motor latency; DMSL= distal median sensory latency; DUSL= distal ulnar sensory latency).

	CTS	N	Mean	Std. deviation	*p*-value
Age (in years)	Yes	53	51.90	5.16	
	No	112	52.74	5.67	0.362
Duration of DM (in years)	Yes	53	13.03	6.07	
	No	112	8.76	5.83	<0.001
Right DMML	Yes	53	5.10	1.64	
	No	112	3.39	0.51	<0.001
Right DMSL	Yes	53	5.11	1.69	
	No	112	3.48	0.30	<0.001
Left DMML	Yes	53	4.64	1.90	
	No	112	3.32	0.56	<0.001
Left DMSL	Yes	53	4.95	1.93	
	No	112	3.44	0.31	<0.001
Right DUSL	Yes	53	3.09	0.40	
	No	112	2.98	0.95	0.42
Left DUSL	Yes	53	2.92	0.43	
	No	112	2.83	0.35	0.155

table-II. In diabetics having CTS, mean duration of DM was found to be 12.09 ± 7.4 years, which was significant (*p*=0.002) as compared to 9.07 ± 5.0 years in subjects without CTS. Significant difference in age between patients with and without CTS (52.67 ± 5.6 years vs. 50.58 ± 6.64 years; *p*=value 0.037) was also observed. DMML and DMSL were significantly prolonged in patients with CTS. The NCS parameters for median and ulnar nerve distal latencies in patients with and without CTS are given in table-III.

DISCUSSION

Carpal tunnel syndrome (CTS) and diabetic polyneuropathy are commonly seen in patients

which does not pass through the carpal tunnel (i.e. radial, or ulnar) is considered one of the most sensitive and accurate techniques[11]. Prevalence of CTS varies from 5-16%, depending upon the criteria used for the diagnosis. The frequency of CTS in our sample of diabetic patients was 40%. In a study by Dyck et al. symptomatic CTS in patients with diabetes was found to be 11% in type 1 and 6% in type 2 diabetic patients, but these subjects did not have DPN[12].

However, Perkins et al reported the prevalence of CTS in 14% and 30% of diabetic patients without and with diabetic poly-neuropathy, respectively; a finding almost similar to our finding[10]. In a Spanish study, CTS was

detected in 30% of the patients having diabetic polyneuropathy[13]. A comparative prospective study involving 120 adult patients having diabetes (60 non-insulin dependent, 60 insulin dependent) and 120 non-diabetic adults as controls, demonstrated a 15-25% frequency of CTS in the diabetic population[14]. As for the high frequency of CTS in diabetic patients, it is postulated that endoneural ischaemia, likely caused by underlying diabetic neuropathy, leads to increased susceptibility of the median nerve to the pressure effects in the carpal tunnel leading to CTS in this population[10]. Another study by Celiker et al included 55 diabetic patients and 20 healthy subjects. Frequency of CTS was 33.7% in their diabetic patients which is similar to our observation. However, they found that 38.8% of their CTS patients were asymptomatic[15]. Likewise, Dyck et al reported that among diabetic patients, one quarter have electrophysiological abnormalities suggesting CTS, without any symptoms of CTS. Little is known about the cause of absence of the symptoms[12]. Stamboulis et al. discovered asymptomatic median neuropathy in 28% of their study population. It was more common in women. Majority of the patients were over 50 years old and disease correlated with the severity of DPN[16]. Kim et al found that 6.8% of the diabetic subjects had asymptomatic CTS on electrophysiological studies. The less frequent CTS in their study was attributed to narrow inclusion criteria. One possible explanation for asymptomatic CTS is an increase in sensory threshold in diabetic patients[17]. Although asymptomatic CTS is common in diabetics, it is important to differentiate entrapment of median nerve under carpal tunnel from early polyneuropathy. Kim et al observed that conduction delay in the distal segment of the median nerve was more remarkable than that in the distal segment of the ulnar nerve in DM patients with asymptomatic CTS, differentiating it from polyneuropathy; thus suggesting that CTS in diabetics is associated with increased susceptibility to entrapment at the carpal tunnel[17]. In our study, age range of patients who

had CTS with diabetes was 40-60 years (mean 52.67 ± 5.6 years). In the study by Becker et al, the age range for CTS was 41-60 years, and was more common among females[18]. Moreover, no significant difference was noticed in the frequency of CTS between males and females in our study; 43% females had CTS as compared to 34% males (p= 0.28). Like our findings, Dyck et al, found no relationship between CTS and gender or age, while in a study from Singapore, 81.3% of the CTS patients were females and mean age of presentation was found to be 53.6 years[19]. However, most studies report a higher frequency of CTS among females; Niazi et al reported that CTS was four times more common in women and in the fourth or fifth decade of life[20]. A higher frequency of CTS in females as compared to male patients (34% vs. 19%; p=0.008) was demonstrated in a study by Albers et al found. They proposed that this difference may be due to other covariates of nerve conduction measures, such as body size[21]. Our finding of bilateral CTS in 22 (33.3%) patients was consistent with reports from other studies. Becker et al demonstrated that DM was a significant risk factor for bilateral CTS[18] Bilateral CTS was reported in 108 (80.6%) and unilateral CTS in 26 (19.4%) by Tay et al. However, in their study 35 patients (32.4%) with bilateral CTS had unilateral symptoms[19]. In another study, Shah et al. found that out of 50 patients with electrodiagnostically proven CTS, 39 (78%) patients had bilateral CTS[22]. In our study, 28 (56.1%) patients had right hand involvement and 7 (10.6%) patients had left hand CTS. Thus overall right hand involvement was seen in 59 (89.4%) patients. Dominant hand involvement was present in 92.3% patients in the study by Tay et al[19]. Our results are also comparable to another study from Pakistan, Niazi et al found that CTS most commonly affected the dominant hand in 255 patients (40%); bilateral in 224 patients (35%) and left sided in 156 patients (25%)[20]. We found that the mean duration of diabetes in patients having CTS was longer (12.09 ± 7.4 years) as compared to subjects without CTS (9.07 ± 5.0 years; p-value=0.002). In

the study by Perkins et al diabetic patients with CTS had diabetes for a mean of 14.0 ± 12.5 years while those without CTS had diabetes for 10.8 ± 10.7 years[10]. Studies suggest that the incidence of CTS rises with duration of DM and is associated with other micro-vascular complications of diabetes such as nephropathy, retinopathy and peripheral neuropathy[23]. Various factors, considered to be responsible for the entrapment syndromes in diabetes include compression, myoinositol deficiency and accumulation of sorbitol and advanced glycation end products[24]. Fibrosis or thickening of the flexor synovium within the carpal tunnel has also been proposed as a cause of CTS in diabetes. Treatment of CTS in patients with DM includes splinting, nonsteroidal anti-inflammatory drugs and corticosteroid injections. If conservative measures prove unsuccessful Carpal tunnel decompression (CTD) surgery is an option. The outcomes for both open and endoscopic CTD are equivalent. About 75% of patients are cured or become minimally symptomatic, irrespective of diabetes status[25].

CONCLUSION

We found a high frequency of CTS in patients with diabetic polyneuropathy. Since CTS can be successfully treated by surgery, even in patients with diabetes, therefore, establishing the right diagnosis is of vital importance. Both these conditions have analogous clinical features and the usual neuro-physiological studies show very similar results.

Therefore, nerve conduction studies should be considered for diagnosing CTS in all diabetics who have hand symptoms and are classified as having polyneuropathy on clinical grounds.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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