Journal of Cardiovascular Disease Research

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 02, 2023

ORIGINAL RESEARCH

Study of carpal tunnel syndrome in patient of diabetes mellitus

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Received: 11 February, 2023 Accepted: 14 March, 2023

Abstract

Background- Carpal tunnel syndrome (CTS) and ulnar nerve entrapment (UNE) at the elbow are the most commonly seen lesions in patients with Diabetes. We aimed to study CTS in patient of diabetes mellitus and to assess the correlation of CTS with duration of diabetes mellitus and level of blood glucose.

Methodology- This study was conducted as cross sectional observational study on 100 patients with diabetes mellitus presenting at Department of Medicine, GMC, Bhopal during the study period of 18 months. All the patients were subjected to detailed history taking and examination along with investigations including NCS for diagnosis of CTS.

Results- The study was conducted on a total of 100 cases with diabetes mellitus. Of them, carpal tunnel syndrome was present in 15 cases. Majority had bilateral upper limb involved (60%) and grade 2 (40%) carpal tunnel syndrome. Mean duration of diabetes was higher in patients with carpal tunnel syndrome (4.28±1.859 years) ($p<0.05$).

Conclusions- We found that the incidence of carpal tunnel syndrome in the diabetic population was high, and this was true across all age groups and genders. Carpal tunnel is linked to having diabetes and having poorly managed blood sugar levels. Therefore in normal diabetes follow-ups, it is important to screen for CTS in order to identify individuals at high risk of developing CTS for early therapy and prevention of additional problems. To better understand the connection between CTS and DM, more research is required.

Keywords- carpal tunnel syndrome, diabetes, tertiary centre, central India, ulnar nerve entrapment.

Introduction

Carpal tunnel syndrome (CTS) and ulnar nerve entrapment (UNE) at the elbow are the most commonly seen lesions in patients with nerve compression disorders.[1] Although both illnesses are caused by pressure on a nerve, they are very distinct in terms of the socioeconomic status of affected persons and the susceptibility and responsiveness of the individual nerve to trauma, all of which affect the success of surgical interventions.[2,3] According to Atroshi et al,[4,5] in Sweden, CTS affects 2.7% of the population (though this number varies depending on the terminology used) and occurs at a rate of 428 females and 182males per 100,000 adults per year. However, these rates may vary greatly across areas

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 02, 2023

and nations.[6-8] Moreover, CTS surgery is performed more frequently in the United States and Sweden on an annual basis than it is in other countries like the United Kingdom.[5]

CTS has a complex aetiology that includes both intrinsic (those things about the nerve itself) and extrinsic (those things about the environment around the nerve) factors. Endocrine conditions like hypothyroidism, pregnancy, menopause, obesity, diabetes, Hand Arm Vibration Syndrome (HAVS),rheumatoid arthritis, traumatic injuries like distal radius and carpal bone fractures and dislocations, and repetitive motions of the wrist are common causes of carpal tunnel syndrome. The genetic risks are associated with the environment of the carpal tunnel and the susceptibility of the median nerve fibres to compression, as recently reported by genome-wide association studies (GWAS) that identified 16 susceptibility loci for CTS.[9]

In addition to reduced joint mobility, Dupuytren's disease with contracture, and flexor tenosynovitis (i.e. trigger finger),[10,11] ulnar nerve compression at the elbow is also a portion of the diabetic hand (UNE).[12] Compression neuropathies are more common in people with diabetes,[13,14]and an underlying cause may be anatomical abnormalities in the peripheral nerve trunk, as shown in HAVS.[15-17]The double crush hypothesis accounts for this phenomenon, which states that a nerve that has already been compromised by pathology is even more vulnerable to compression.[15]

This research set out to examine the prevalence and risk factors for carpal tunnel syndrome among people with diabetes mellitus, as well as any associations between the two. In this study, we aimed to study CTS in patient of diabetes mellitus and to assess the correlation of CTS with duration of diabetes mellitus and level of blood glucose.

Methodology

This study was conducted as cross sectional observational study on 100 patients with diabetes mellitus presenting at Department of Medicine, Gandhi Medical College, Bhopal during the study period of 18 months i.e. from January 2021 to June 2022. All the patient of diabetic mellitus above age of 18 years willing to participate in the study were included whereas patients with systemic illness (like Inflammatory arthritis, Rheumatoid arthritis, Lipoma Ganglian amyolydesis, Hypothyroidism), pregnant women, on corticosteroids use and fracture of Forearm were excluded from the study.

After obtaining ethical clearance from Institute's Ethical committee, all the patients fulfilling inclusion criteria and giving consent for the study were included. Detailed history regarding socio demographic variables, clinical parameters (type of diabetes, duration of diabetes etc.) were obtained from all the study participants using proforma. All the patients were then subjected to detailed physical, clinical and systemic examination. Hematological investigations such as complete blood picture, Random blood glucose, Lipid profile, liver function tests, and renal function tests were done in all the cases.Nerve conduction velocity was done using sensory inching method. For this, the median nerve was stimulated at the cubital portion with 8 channel recording electrodes placed along the nerve across the carpal tunnel. The grading of CTS was done as follows

- Normal (grade 0);
- Very mild (grade 1), CTS demonstrable only with most sensitive tests;
- Mild (grade 2), sensory nerve conduction velocity slow on finger/wrist measurement, normal terminal motor latency;
- Moderate (grade 3), sensory potential preserved with motor slowing, distal motor latency to abductor pollicis brevis (APB) < 6.5 ms;
- Severe (grade 4), sensory potentials absent but motor response preserved, distal motor latency to APB < 6. 5 ms;

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- Very severe (grade 5), terminal latency to APB > 6.5 ms;
- Extremely severe (grade 6), sensory and motor potentials effectively unrecordable (surface motor potential from APB < 0.2 mV amplitude).

Statistical Analysis

Data was recorded in Microsoft Excel programme and statistical analysis was performed by the SPSS program for Windows, version 25 (SPSS, Chicago, Illinois). Continuous variables were presented as mean±SD, and categorical variables were presented as absolute numbers and percentage. Data was checked for normality before statistical analysis. Descriptive analysis was performed to obtain general characteristic of the study population. Categorical variables were analysed using either the chi square test or Fisher's exact test. Continuous variables were assessed using ANOVA or independent sample t-test. P<0.05 was considered statistically significant.

Results

The study was conducted on a total of 100 cases with diabetes mellitus. Of them, carpal tunnel syndrome was present in 15 cases (figure 1).

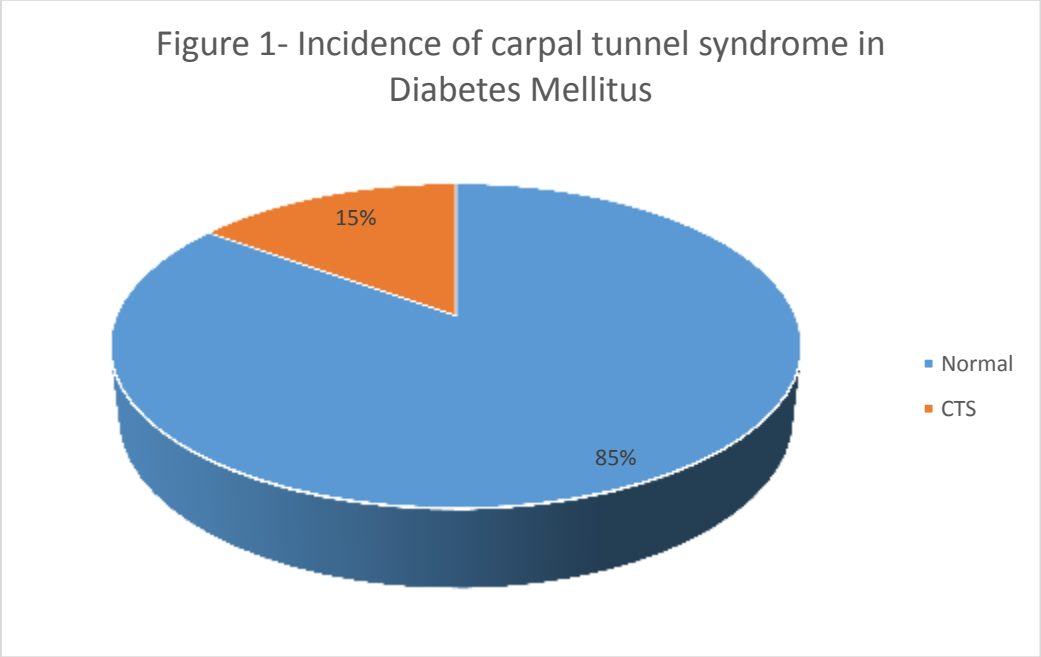

Table 1- Distribution according to involvement of limb and grading of CTS

Characteristics of CTS		Frequency (n=15)	Percentage
Upper limb involved	Bilateral	9	60
	Right	3	20
	Left	3	20
Grading of CTS	Very mild	3	20.0
	Mild	6	40.0
	Moderate	5	33.3
	Severe	1	6.7

Out of 15 patients with carpal tunnel syndrome, majority had bilateral upper limb involved (60%) whereas 20% patients each had right and left limb involved.Majority had grade 2 (40%) carpal tunnel syndrome whereas 5 (33.3%) patients had grade 3 carpal tunnel syndrome (Table 1).

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Table 2- Association of nerve conduction studies with baseline variables

Baseline variables		Nerve conduction studies		Total (n=100) (%)	P value
		Normal (n=85) (%)	CTS (n=15) (%)		
Age group (years)	≤20	3 (3.5)	0 (0)	3 (3)	0.455
	21-30	4 (4.7)	1 (6.7)	5 (5)	
	31-40	12 (14.1)	2 (13.3)	14 (14)	
	41-50	31 (36.5)	2 (13.3)	33 (33)	
	51-60	23 (27.1)	6 (40)	29 (29)	
	>60	12 (14.1)	4 (26.7)	16 (16)	
Sex	Male	33 (38.8)	8 (53.3)	41 (41)	0.292
	Female	52 (61.2)	7 (46.7)	59 (59)	
BMI (mean±SD)		21.32±3.26	22.89±6.71	22.1±4.98	0.136
Duration of diabetes (years)		2.15±1.21	4.28±1.86	3.22±1.53	0.01
Type of diabetes	Type I	2 (2.4)	0 (0)	2 (2)	0.548
	Type II	83 (97.6)	15 (100)	98 (98)	

Majority of the patients with carpal tunnel syndrome belonged to 51-60 years (40%) followed by 26.7% cases belonging to more than 60 years. Carpal tunnel syndrome was not reported in patients younger than 20 years.However, we observed no significant association of CTS with baseline variables ($p>0.05$) Mean duration of diabetes was higher in patients with carpal tunnel syndrome (4.28±1.859 years) as compared to those without carpal tunnel syndrome (2.15±4.213 years) ($p<0.05$). No significant difference was observed in terms of diabetes type between patients with and without carpal tunnel syndrome ($p>0.05$)(Table 2).

Table 3- Association of nerve conduction studies with blood investigations

Investigations	Nerve conduction studies		P value
	Normal (n=85)	CTS (n=15)	
Hemoglobin	11.911±1.68	11.79±1.45	0.800
WBC	6820.94±2848.70	6553.33±1550.51	0.724
Platelets	2.29±1.10	2.12±0.38	0.562
Total Cholesterol	152.78±44.15	164.27±53.07	0.370
Serum Triglycerides	164.66±94.85	168.60±95.34	0.882
S Bilirubin	0.55±0.25	0.63±0.21	0.244
SGOT	39.4±22.84	46.47±30.67	0.300
SGPT	35.65±20.0	43.53±21.48	0.167
ALK.PO4	114.91±90.63	125.60±99.27	0.191
S. Creatinine	1.54±1.74	0.94±0.88	0.433
S. Urea	46.46±31.56	39.86±16.91	0.844
S. Sodium	136.34±14.15	135.60±9.17	0.764
S. Potassium	6.03±15.10	3.95±0.55	0.596
RBS	150.68±53.90	254.42±86.91	**0.012**

Amongst various investigations, mean RBS was found to be significantly higher in cases with CTS as compared to patients with normal nerve conduction studies ($p<0.05$). However, we found no significant difference in other investigations between diabetic patients with normal and abnormal nerve conduction studies ($p>0.05$) (Table 3).

Discussions

Several musculoskeletal conditions have been connected to diabetes mellitus. Despite the fact that these conditions often get overlooked, they may serve as an early warning sign of life-threatening microvascular problems.[18] Carpal tunnel syndrome is a common complication of

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 02, 2023

diabetes mellitus, characterized by tingling, numbness, and pain in the thumb, index, middle, and lateral half of the ring fingers along the path of the median nerve. Symptoms are typically worse at night and improved by resting the arm or shaking the hand.[19]

The median nerve can be compressed due to swelling within the carpal tunnel, and the inflammation that results in even more nerve compression. It is one of the most common entrapment neuropathies of the upper limb, and it is called carpal tunnel syndrome.[20] Our study findings were supported by the findings of Islam et al, where 15% of patients with diabetes also suffered from carpal tunnel syndrome.[20] Similarly, the prevalence of CTS was 20% and 29.2% in studies of 96 and 301 diabetic patients in the United Kingdom and Ethiopia, respectively.[21,22]The prevalence found in these other studies were all higher than the one found in the current study. It's possible that the evaluation tools and diagnostic criteria utilised in this study may have underestimated the prevalence of CTS, which could account for these differences. There is a chance that the discrepancies are due to genetic and lifestyle differences between the people of Ethiopia and those countries.

In our study, we found no correlation of CTS with sex and age. The onset of carpal tunnel syndrome was not seen in patients less than 20 years old. However, a study of 432 diabetic patients in Iran found that CTS was substantially linked with old age ($p=0.032$).[23] It's possible that the large sample sizes utilised in the prior study are to blame for these discrepancies. Bekele et al., discovered that the highest incidence of CTS occurred in people aged 45 and higher (1.9%).[24] Bekele et al. found no link between sex and CTS in their investigation.[24] In contrast, Kianiet al[23] found that CTS was strongly linked with female sex (p0.002). However, investigations by Wamisho et al.[25] and Fasikaet al.[21] demonstrated a substantial relationship of male sex with musculoskeletal diseases among diabetes patients. There may be differences since prior studies have included all musculoskeletal illnesses as end variables, which may influence the connection between CTS and risk factors.

We find no statistically significant differences between the groups in terms of various investigations such as complete blood picture, LFT, RFT and lipid profile ($p>0.05$).Carpal tunnel syndrome was significantly but inversely related with body mass index in a study of diabetics by Bekele et al.[24] Studies in Bangladesh and Italy both demonstrated a positive connection between BMI and CTS ($p<0.05$), therefore these results should be interpreted with caution.[26] Perhaps these variations come from the fact that the clinical diagnostic instrument utilised in this investigation missed some CTS diagnoses among participants with normal body mass index.

We discovered a robust correlation between CTS and aberrant random blood sugar levels. Further, contrary to the current findings, a comparable investigation found that CTS was significantly linked with poor glycemic control ($p<0.05$).[23]This discrepancy may be because to the larger sample size employed in the former study. An abnormal random blood sugar level was found to be a risk factor for the development of carpal tunnel syndrome in our investigation.

The results of the current investigation confirmed the existence of a correlation between CTS and DM persistence. Patients with carpal tunnel syndrome had a longer mean duration of diabetes (4.28years) than those without the condition (2.15years). However, Bekele et al.[24] indicated no correlation between CTS and the length of time someone had DM. Consistent with our result, a study involving 432 diabetic patients in Iran found a strong correlation between CTS and DM duration ($p=0.007$).[23] A study from India found no link between DM and CTS ($p=0.13$), which contradicts our own findings.[27] Possible explanations for the dissimilarities include the fact that the majority of the research participants in both studies have had DM for 5–10 years, during which time the CTS may be asymptomatic.

Additionally, in contrast to the two earlier investigations, practically all participants in the current study had type 2 diabetes, and the proportion of participants with a diabetes diagnosis

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for more than 10 years was high. We found no correlation between CTS prevalence and DM subtype. When compared to type 1 diabetics, type 2 diabetics make up a far larger proportion of people diagnosed with carpal tunnel syndrome. Wamisho et al. and Fasika et al. found a higher prevalence of CTS in type 1 DM patients, which runs counter to our findings.[21,25] Zimmerman et al. found that CTS is more prevalent in type 1 than type 2 diabetics.[28] Sixty percent of the 15 individuals with carpal tunnel syndrome had both their right and left upper limbs affected. As observed by Islam et al., carpal tunnel syndrome is among the most common entrapment neuropathies affecting the upper limb.[20] Indeed, this accords with the results of our investigation.

Fifteen individuals were diagnosed with carpal tunnel syndrome; of these, 60% had grade 2 symptoms and one patient (6.7%) had severe carpal tunnel syndrome. A large proportion of patients in a study of Toney et al, (40, 65.5%) with or without diabetes mellitus revealed bilateral carpal tunnel syndrome, with larger prevalence in group I (57.5%), albeit this difference was not statistically significant.[29] Electrophysiological confirmatory diagnosis of CTS was not included in this study since it was not readily available in the study location. Instead, clinical diagnosis was used. Second, there is no evidence of a causal link between BMI and CTS in this study. The study was additionally constrained by the inherent flaws in the diagnostic tools used.

Conclusions

We found that the incidence of carpal tunnel syndrome in the diabetic population was high, and this was true across all age groups and genders. Carpal tunnel is linked to having diabetes and having poorly managed blood sugar levels. Therefore, in normal diabetes follow-ups, it is important to screen for CTS in order to identify individuals at high risk of developing CTS for early therapy and prevention of additional problems. To better understand the connection between CTS and DM, more research is required.

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