

Incidence of Diabetes Mellitus Type II and Pre-Diabetes among Hand Nerves Entrapment Neuropathy Patients: Epidemiological Study

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ABSTRACT

Objective: Measure the incidence of Diabetes Mellitus (DM)/pre-diabetes among patients with hand nerves entrapment syndromes.

Design: Prospective cross sectional.

Settings: Outpatient.

Participants: 412 patients presented with unilateral or bilateral hand numbness suspecting Carpal Tunnel Syndrome (CTS).

Exclusion criteria: Cervical spine or hand trauma history, nerve injury history.

Interventions: Each patient was subjected to the following; demographic data including occupation, body mass index, detailed medical history including DM history. Neck exam including Spurling test. Full neurological exam.

Main outcome measures: Upper extremities Nerve conduction studies and electromyography of segment pointing muscles. Laboratory testing including glycosylated hemoglobin (HgA1c), liver and kidney functions. Cervical spine MRI if possible.

Results: Mean age 59.4 ± 11.123 . All patients were right-handed, Male 37.1%, female 62.9%, Mean body mass index (BMI) 32.2 ± 8.2 . majority were manual workers (55.1%). HgA1c <5.5 has the fewest patients (7.3%), highest number of patients with HgA1c 5.5-6.0. significant relation between HgA1c categories and sensory CTS $p=0.001$ and sensory motor CTS $p=0.001$. No significant relation between HgA1c categories and demyelinating pathology $p=0.123$ but significant with demyelinating axonal pathology $p=0.017$. Significant relation between HgA1c and Guyon canal syndrome $p=0.001$ and polyneuropathy $p=0.001$. No significance between HgA1c and cervical radiculopathy $p=0.321$.

Conclusions: High incidence of DM and pre-diabetes among patients with hand nerve entrapment: CTS, Guyon syndrome together with polyneuropathy. EN may be the earliest neurophysiological abnormalities in DM, particularly in the upper limbs, even in the absence of a generalized polyneuropathy, or it may be superimposed on a generalized diabetic neuropathy. Due to the metabolic alterations consequent to abnormal glucose metabolism, the peripheral nerves show both functional impairment and structural changes, even in the preclinical stage, making them more prone to entrapment in anatomically constrained channels.

Keywords: Diabetes mellitus type II; Hand nerves entrapment; Neuropathy

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INTRODUCTION

Neuropathy is a common complication of diabetes mellitus (DM) with a wide clinical spectrum that encompasses generalized to focal and multifocal forms [1]. Entrapment neuropathies (EN), which are focal forms, are so frequent at any stage of the diabetic disease, that they may be considered a neurophysiological hallmark of peripheral nerve involvement in DM [1]. Indeed, EN may be the earliest neurophysiological abnormalities in DM, particularly in the upper limbs, even in the absence of a generalized polyneuropathy, or it may be superimposed on a generalized diabetic neuropathy [1]. The commonest form of entrapment is Carpal Tunnel Syndrome (CTS) [2,3] followed by ulnar entrapment neuropathy and peroneal neuropathy [1].

Cervical radiculopathy, particularly the sensory pattern is world-wide problem among middle aged people [4]. And commonly associated with entrapment neuropathy particularly CTS. Then this combination is labeled as Double Crush syndrome. Literature review revealed that DM is the most important risk factor for CTS [1-3], however, the direct relationship between DM and cervical radiculopathy was not clarified in the literature. The suggested mechanism of Double crush syndrome could be increase with DM due to impairment of axoplasmic flow with liability to multiple compression and metabolic neuropathy all related to DM [5].

The suggested mechanism is the metabolic alterations consequent to abnormal glucose metabolism, the peripheral nerves show both functional impairment and structural changes, even in the preclinical stage, making them more prone to entrapment in anatomically constrained channels [1-3].

This study aimed at measuring the incidence of diabetes mellitus/prediabetes among patients with suspected hand nerves entrapment.

Objective

Measure the incidence of diabetes mellitus (DM)/pre-diabetes among patients with hand nerves entrapment syndromes.

MATERIALS AND METHODS

This was a prospective cross-sectional study at outpatient settings. 412 patients presented with unilateral or bilateral hand numbness suspecting Carpal Tunnel Syndrome (CTS) were enrolled after signing informed consent for participation in the study.

Exclusion criteria

Cervical spine or hand trauma history, nerve injury history. Each patient was subjected to the following; demographic data including occupation, body mass index, detailed medical history including DM history. Neck exam including Spurling test. Full neurological exam.

Main outcome measures

Upper extremities nerve conduction studies and electromyography of segment pointing muscles. Laboratory testing including glycosylated hemoglobin (HgA1c), liver and kidney functions. Cervical spine MRI if possible.

Statistical analysis of the data

Data were fed to the computer using IBM SPSS software package version 24.0. Qualitative data were described using number and percent. Comparison between different groups regarding categorical variables was tested using Chi-square test. Quantitative data were described using mean and standard deviation for normally distributed data. For normally distributed data, comparison between two independent population were done using independent t-test while more than two population were analyzed F-test (ANOVA) to be used. Significance test results are quoted as two-tailed probabilities. Significance of the obtained results was judged at the 5% level.

RESULTS

Table 1 demonstrates the demographic data of the studied patients. Mean age 59.4 ± 11.123. All patients were right-handed, Male 37.1%, female 62.9%, Mean Body Mass Index (BMI) 32.2 ± 8.2. majority were manual workers (55.1%). HgA1c <5.5 has the fewest patients (7.3%), highest number of patients with HgA1c 5.5-6.0. among the studied patients, 78.4% had pure sensory CTS and 21.6% had sensory-motor CTS (significant p=0.045). Demyelinating pathology was detected in 96%, while Demyelinating-axonal was found in 4% (significant p=0.001). 51.9% of sensory CTS patients had associated cervical radiculopathy i.e., Double crush syndrome (p=0.001) and 56.1% of sensory CTS had Guyon canal syndrome (p=0.019). Polyneuropathy were detected in only 19 patients with sensory CTS which was non-significant. Tables 2 and 3 presents the relationship between sensory CTS, Sensory-motor CTS with HgA1c categories respectively. Both Sensory CTS and sensory motor CTS, significantly related to the rising categories of HgA1c (p=0.005, 0.001 respectively).

Table 1: Demographic and clinical data of the studied group.

	Number	Percent
Sex		
Male	153	37.1
Female	259	62.9
Age (years)		
<50	69	16.4
50-60	125	29.7
60-70	157	37.3
More than 70	61	14.5
Range	23-90	

Mean ± S.D.	59.4 ± 11.123	
Occupation		
Clerk	3	0.7
housewife	123	29.9
labor	45	10.9
manual	227	55.1
retired	11	2.7
security	3	0.7
HgA1c category		
<5.5	30	7.3
5.5-6.0	162	39.3
6.0-7.0	104	25.2
>7	115	28.2
Total	412	100

Table 2: Relation between HgA1c category and sensory CTs.

HgA1c category	Sensory CTs				Total
	Negative		Positive		
	No.	%	No.	%	
< 5.5	7	53.8	23	5.8	30
5.5-6.0	3	23.1	159	39.8	162
6.0-7.0	4	30.8	100	25.1	104
>7	0	0	116	29.1	116
Total	13		399		412
X ²	12.66				
P value	0.005				

Table 3: Relation between HgA1c category and sensory motor.

HgA1c category	Sensory motor				Total
	Negative		Positive		
	No.	%	No.	%	
<5.5	26	8	4	4.7	30

5.5-6.0	142	43.6	20	23.3	162
6.0-7.0	98	30.1	6	7	104
>7	60	18.4	56	65.1	116
Total	326		86		412
X ²	16.6				
P value	0.001				

No significant relation between HgA1c categories and demyelinating pathology p=0.123 but significant with demyelinating-axonal pathology p=0.017. Significant relation between HgA1c rising categories and Guyon canal syndrome p=0.001 and polyneuropathy p=0.001 (Tables 4 and 5 respectively). No significance between HgA1c and cervical radiculopathy p=0.321.

Table 4: Relation between HgA1c category and Guyon canal syndrome.

HgA1c category	Guyon canal syndrome						Total		
	No		Right		Left		Bilateral		
	No.	%	No.	%	No.	%	No.	%	
<5.5	18	7.6	3	8.8	0	0	9	6.7	30
5.5-6.0	111	46.8	12	35.3	6	100	33	24.4	162
6.0-7.0	47	19.8	9	26.5	0	0	48	35.6	104
>7	61	25.7	10	29.4	0	0	45	33.3	116
Total	237		34		6		135		412
X ²	30.86								
P value	0.001								

Table 5: Relation between HgA1c category and polyneuropathy.

HgA1c category	Polyneuropathy				Total
	Negative		Positive		
	No.	%	No.	%	
<5.5	30	7.6	0	0	30
5.5-6.0	159	40.5	3	15.8	162
6.0-7.0	101	25.7	3	15.8	104
>7	103	26.2	13	68.4	116

Total	393	19	412
χ^2	16.43		
P value	0.001		

DISCUSSION

The present study showed high incidence of diabetes mellitus as well as prediabetes among patients with carpal tunnel syndrome whether it is pure sensory or sensory-motor carpal tunnel as evaluated by electrophysiological testing. In addition to also high incidence of DM/ Prediabetes among patients with Guyon canal syndrome which is considered the second most common hand entrapment neuropathy after CTS, as well as generalized polyneuropathy, although the number of detected cases of polyneuropathy are considered limited in this study.

We had analyzed the data in relation to different categories of HgA1c which is the standardized method of evaluating and diagnosing diabetes mellitus type 2 and the results showed that the incidence is significantly proportionate with the rising categories of HgA1c with highest incidence among those with HgA1c ≥ 7 , still detected significant incidence among those categorized as pre-diabetes.

Revising literature regarding the incidence of all types of polyneuropathy including entrapment neuropathy among diabetes, Rota et al. reported high incidence of all type of polyneuropathy among diabetic patients. They suggested that entrapment neuropathies, with the commonest CTS occurred even more frequently among diabetic and this even could proceed the full-blown picture of the diabetes [1].

This agreed with our results were the incidence of both diabetes as well as prediabetes were significantly high among all included patients with entrapment neuropathy and the highest form of entrapment detected was CTS.

Calcndruccio et al. reported that diabetes mellitus is one of the most common co-morbidities associated with incidence of CTS [6].

Pourmemari et al. also documented in their study that both types of Diabetes type I and II are risk factor for carpal tunnel syndrome [7].

Smith had listed different types of neuropathy complications of diabetes mellitus including; mononeuritis multiplex, polyradiculo-neuropathy, generalized polyneuropathy [8].

Hsuan et al. had reported very high incidence of diabetic hand syndrome among diabetics and carpal tunnel syndrome is considered the major component of this syndrome [9].

Oktayoglu et al. also reported high incidence of CTS among DM, hypothyroid, and acromegaly [10].

Zyluk et al. considered CTS the most common complication of DM [11].

In this study, we detected, also significant incidence of Guyon canal syndrome associated with sensory CTS and significantly correlated also with the rising level of HgA1c.

Guyon canal syndrome is listed as the second most common hand entrapment neuropathy after CTS, that is also part of neurological complications of DM [1].

Murata et al. listed Guyon canal syndrome or ulnar tunnel syndrome as the most commonly associated entrapment with CTS [12].

Zimmermun et al. reported high incidence of ulnar entrapment syndrome in DM [13].

In this study also we had detected significant number of cases with double crush syndrome i.e., CTS and cervical radiculopathy, but the relationship between Hai categories and incidence of cervical radiculopathy was non -significant.

As diabetes is risk factor for all types of polyneuropathy and carpal tunnel considered to be the first most common form as this also documented from this study and previous literature. It was suggested before that compression of a nerve at one site predispose it to compression at multiple other sites based on interference with axoplasmic flow [5]. Also hypothesized that one of the constraints of axoplasmic flow could be the metabolic neuropathy which is evident in case of CTS with diabetes [5].

This suggested mechanism can implicitly explain what we found in this study from significant incidence of Double crush syndrome and still could be related to diabetes although the insignificant result between HgA1c and cervical radiculopathy solely but overall, as with CTS still could be explained in light of diabetes predisposition.

The last form of neuropathy combination we found in this study, the combination of polyneuropathy and sensory CTS that were found in only 19 patients which was non -significant, but polyneuropathy showed significant relationship with rising HgA1c categories. The low number of cases of polyneuropathy detected could be the reason of non-significant value. But the significant relation between polyneuropathy and level of HgA1c could be explained in light of the severity of DM as reflected by high level of HgA1c could affect more profoundly the nerves all over the body resulting, hence more tendency to result in polyneuropathy. Low number of detected polyneuropathy cases in this study because the inclusion criteria were mainly hand numbness rather than generalized sensory presentations.

The last pathological findings that were reported in this study was related to the pathological extent of carpal tunnel and its significant relationship with HgA1c. The pure demyelinating pathology of CTS was not significant, whereas the axonal-demyelinating pathology of CTS showed significance with rising HgA1c categories. This could be explained in light of severity of the disease as the usual progression of carpal tunnel from demyelinating pathology to demyelinating- axonal entitle more severe and prolonged compression. This could be explained by presence of high blood glucose level and uncontrolled DM as reflected by higher level of HgA1c hence lead to extensive and more severe pathology.

CONCLUSION

High incidence of DM and pre-diabetes among patients with hand nerve entrapment: CTS is considered the most commonly encountered entrapment neuropathy associated with DM, followed by Guyon canal syndrome. Diabetes/Prediabetes state also predisposes to multiple entrapment combinations like CTS/Guyon Canal syndrome; CTS/Cervical radiculopathy i.e. Double crush syndrome. As well as CTS and polyneuropathy. The combination of multiple hand nerve entrapment i.e CTS and Guyon canal syndrome EN may be the earliest neurophysiological abnormalities in DM, particularly in the upper limbs, even in the absence of a generalized polyneuropathy, or it may be superimposed on a generalized diabetic neuropathy. Due to the metabolic alterations consequent to abnormal glucose metabolism, the peripheral nerves show both functional impairment and structural changes, even in the preclinical stage, making them more prone to entrapment in anatomically constrained channels.

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