Comparative Assessment of Motor Nerve Conduction Velocity among Non-Diabetic, Diabetic Non-Smoker and Sub Groups of Diabetic Smoker.

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ABSTRACT

Background: Neuropathy is one of the most common complications affecting individuals with diabetes mellitus. The best evidence indicates that the etiology of neuropathy is multifactorial and is a key area of current research. Hence, this study was undertaken to test the hypothesis of alteration in MNCV (motor nerve conduction velocity) of nerves before the actual manifestation of neuropathy in type II diabetic patients and also to analyze the effect of smoking on MNCV in diabetic subjects. **Methods**: In the present study, 120 diagnosed diabetics were taken as cases while 30 non diabetic healthy subjects were taken as controls. Case group was divided into diabetic non-smokers and diabetic smokers. Diabetic smokers were further subdivided into light, moderate and heavy smokers, according to smoking index. After detailed history and physical examination MNCV of median and ulnar nerve in upper limb and common peroneal nerve in lower limb was performed. **Result:** The MNCV of median and ulnar nerves in upper limb showed no significant bilateral decreased in diabetic non-smokers and subgroup of diabetic smokers when compared with control. However, there was a significant bilateral decrease in MNCV of common peroneal nerves in the lower limb of diabetic heavy smokers when compared with control. A negative, but statistically non-significant correlation was found between MNCV and smoking index. The decrease in MNCV was dependent on smoking index by 3%, 1%, 1%, 1%, 3% and 1% in median nerve (right), median nerve (left), ulnar nerve (right), ulnar nerve (left), common peroneal nerve (right) and common peroneal nerve (left) respectively. **Conclusion:** The present study indicates that MNCV is more resistant to hyperglycemia induced local metabolic and microvascular changes. However, the coalition of diabetes and smoking can augment their effects many folds and can lead to motor neuropathy, reiterating the fact that smoking itself is an independent risk factor for diabetic neuropathy.

Keywords: Diabetes mellitus, Diabetic Polyneuropathy, Motor nerve conduction velocity, Smoking Index, Cigarette Smoking.

INTRODUCTION

Diabetes mellitus has emerged as an important health concern in the developing nations and its complications are associated with high morbidity and mortality. Neuropathy is considered to be the most common micro-vascular complication of both type I and II diabetes mellitus.[1] It is delineated that prevalence of neuropathy exhibits global variation, and this is in part due to the difference in sampling methods as well as due to lack of consensus on diagnostic criteria.[2] Hence, it is empirical for comparative purposes to deploy studies that utilize similar diagnostic criteria. The observed variations in prevalence could also be due to predisposition and differential exposure to risk factors.

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Although the dementing metabolic effects of chronic hyperglycemia are well known yet the lesser-known risk factors like cigarette smoking, hypertension, obesity, hyperlipidemia and micro albuminuria have also been implicated as potential risk markers.[3] However, these factors have not been studied in detail to corroborate their role in the development of diabetic neuropathy. Thus, this study was designed to find the alteration in electro physiologic parameters of nerve before the actual manifestations of neuropathy in type II diabetic subjects appear and to assess the effect of smoking on MNCV in them.

MATERIALS AND METHODS

The present study was conducted in the Department of Physiology, National Institute of Medical Sciences (NIMS) Medical College and Hospital, Jaipur between October 2013 and April 2015. After approval of the institutional ethical committee valid consent was taken from all the participants of the study. 150 male subjects in the age group of 30-60 years, comprising of 120 diagnosed diabetics were taken as cases and 30 non-diabetics were selected as controls by simple random sampling method. Subjects who never had any addiction related to tobacco and no history of any major illness were taken as a control group. Case group was divided into diabetic non-smokers and diabetic smokers. Active smoking with the history of smoking

filtered cigarettes for more than five years were taken as smokers. According to smoking index[4], they were classified into; light smokers (smoking index < 100), moderate smokers (smoking index 101-200) and heavy smoker (smoking index ≥ 201). Smoking index is used to determine smoking exposure on the body quantitatively. It is simply calculated by multiplying the average number of cigarettes smoked per day in last seven days with the duration of smoking in years. Exclusion criteria include no previous history of any systemic condition related to peripheral neuropathy (hypertension. malnutrition, alcoholic neuropathy, renal failure), any neuromuscular disorders such as myopathy, familial polyneuropathy or chronic polyneuropathy, GB syndrome, neuropathies associated with exogenous toxic agents, metals or drugs. Subjects with skin lesions, swelling and trauma that would interfere with nerve conduction study (NCS) were also excluded. After detailed history and physical examination motor nerve conduction velocity (MNCV) of median and ulnar nerve in upper limb and common peroneal nerve in lower limb was performed in the Neurophysiology laboratory of the Department of Physiology, NIMS Medical College and Hospital, Jaipur. Medicaid System's EMG/NCV machine equipped with Neuroperfect software was used to perform nerve conduction study.

Statistical Analysis:

Statistical analysis was done using SPSS (Statistical Package for the Social Sciences, version 19). One-way Analysis of variance (ANOVA) was used for comparing MNCV between controls, diabetic non-smoker and subgroup of diabetes smokers. The Bonferroni post hoc test was subsequently used for studying multiple comparisons. The Pearson correlation test was used to correlate MNCV with smoking index and simple linear regression analysis was done to predict MNCV on the basis of smoking index.

RESULTS

The motor nerve conduction velocities (MNCV) in non-diabetics and sub groups of diabetics have been shown in [Table 1]. The mean values of MNCV of median and ulnar nerves in upper limb were found bilaterally decreased in diabetic non-smokers and subgroup of diabetic smokers when compared with control but statistically it was non-significant. However, there was a significant bilateral decrease in MNCV of common peroneal nerves in the lower limb of diabetic heavy smokers when compared with control. There was no significant difference in MNCV of median, ulnar and common peroneal nerves when diabetic non-smoker and subgroup of diabetic smokers were compared with each other. However, the MNCV of the aforementioned nerves decreased at all instances and this diminution is consistent in both the upper and lower limb bilaterally. As per [Table 2], a negative but statistically non-significant correlation was observed between MNCV and smoking index. This relationship between MNCV and smoking index was further analyzed using simple linear regression analysis [Table 3]. The slope of the best-fitted regression line 'ß' indicates that for each increase in smoking index there was decrease in MNCV of right median nerve by (0.053 m/sec), left median nerve (0.034m/sec), right ulnar nerve (0.036 m/sec), left ulnar nerve (0.017 m/sec), right common peroneal nerve (0.006 m/sec) and left common peroneal nerve (0.019 m/sec). The decrease in MNCV was dependent on smoking index by 3%, 1%, 1%, 1%, 3% and 1% in median nerve (right), median nerve (left), ulnar nerve (right), ulnar nerve (left), common peroneal nerve (right) and common peroneal nerve (left) respectively.

Table 1: Comparison of Motor Nerve Conduction Velocity (MNCV) of various nerves between control, diabetic non-smokers and subgroups of diabetic smokers.

Parameter		Control (n=30) M ± SD (m/s)	Diabetic Non Smoker (n=30) M ± SD (m/s)	Diabetic Light Smoker (n=30) M ± SD (m/s)	Diabetic Moderate Smoker (n=31) M ± SD (m/s)	Diabetic Heavy Smoker (n=29) M ± SD (m/s)
Median MNCV	**Right**	55.89±3.21	54.16 ±3.29*	54.02 ± 3.32*#	53.89 ± 3.34*#f	52.57 ± 2.99*#f%
	Left	55.82±3.19	54.31±3.31*	54.18 ± 3.46*#	53.12 ± 2.91*#f	52.19 ± 3.19*#f%
Ulnar MNCV	**Right**	60.23±4.10	59.29±4.05*	59.24 ± 4.15*#	58.19 ± 4.14*#f	58.15 ± 4.21*#f%
	Left	60.21±4.08	59.20±4.06*	58.41 ± 3.65*#	58.37 ± 3.59*#f	58.26 ± 3.70*#f%
Common Peroneal Nerve	**Right**	52.52±4.46	50.23±4.53*	49.45 ± 4.22*#	49.03 ± 4.18*#f	44.29 ± 4.10**#f%
	(Left)	52.49±4.23	50.38±4.50*	49.26 ± 4.16*#	49.20 ± 4.22*#f	44.17 ± 4.26**#f%

Data was presented as mean ± standard daviation.Analysis was done using one-way ANOVA followed by post hoc Bonferroni test. The * depicts comparison with control, # depicts comparison with diabetic non-smoker, *f* depicts comparison with diabetic light smoker, % depicts comparison with diabetic moderate smoker. ** P<0.05, ## P<0.05, *ff* P<0.05, %% P<0.05.

Table 2: Pearson correlation between MNCV and smoking index.

Motor Nerves (Upper limb and Lower limb)		'r' value
Median Nerve	Right	-0.013
	Left	-0.022
Ulnar Nerve	Right	-0.005
	Left	-0.003
Common Peroneal Nerve	Right	-0.067
	Left	-0.071

Data was analysed using 'Pearson' correlation between MNCV and smoking index, 'r' representing Pearson' correlation coefficient.

Table 3: Simple Linear Regression Analysis for MNCV and smoking index.

Motor Nerves (Upper limb and Lower limb)		'ß' value	R Square	'p' value
Median Motor Nerve	Right	-0.053	0.003	>0.05
	Left	-0.034	0.001	>0.05
Ulnar Motor Nerve	Right	-0.036	0.001	>0.05
	Left	-0.017	0.001	>0.05
Common Peroneal Motor Nerve	Right	-0.006	0.003	>0.05
	Left	-0.029	0.001	>0.05

Data was analysed using simple linear regression for MNCV & smoking index. 'ß' representing slope of best-fitted regression line; R Square re-presenting coefficient of determination

DISCUSSION

Diabetic peripheral neuropathy is one of the most common complications of type II diabetes mellitus due to hyperglycemia induced local metabolic and microvascular changes. Typically, neuropathy is diagnosed based on specific symptoms and signs on clinical examination. Although various tests are implicated to confirm neuropathy and its severity in context of grade, yet the assessment of nerve conduction velocity remained the gold standard for diagnostic purpose as it can detect even the subclinical cases of diabetic sensorimotor polyneuropathy.

In the current study, when MNCV of diabetic non-smokers and controls were compared, a bilateral but statistically non-significant decrease was seen in the MNCV of upper (Median and Ulnar nerves) and lower limb (common peroneal nerve) of diabetic non-smoker. This is in concordance with Tupkovic E[5] who found that there was no significant reduction in the MNCV of diabetic subjects when compared with controls, however he found significant reduction in sensory nerve conduction velocity. The above findings can be elucidated on the basis of structural variability between the motor and sensory nerves. Motor nerves, unlike sensory are thicker with longer internodal distance and as a rule thicker nerves are affected much later than thinner nerves by any damage.[6] But, in contrast to the abovementioned discussion Cerriza M[7] observed deterioration of motor nerve conduction velocity in type II diabetic patients. This discrepancy can be due to the difference in patient selection criteria and techniques deployed in the method of assessment. When MNCV was compared among controls, diabetic non-smokers and subgroup of diabetic smokers, no significant decrease was observed in the upper limb, however in lower limb, diabetic heavy smokers exhibited significant reduction when compared with control. The increased susceptibility of lower limb nerve can perhaps be explained on the basis of length of nerve fibers, metabolic effect of diabetes and effect of smoking on nerve conduction velocity. This is in close agreement with Kulkarni et al[8] who observed that nerves of lower limbs are more commonly affected as compared to upper limb suggesting that long nerves are more susceptible to diabetic assault.

The pathological mechanisms implicated in diabetic neuropathy, include microvascular damage[9], metabolic disorders[10], and changes in the interactions between neuronal and immunological systems along with glial cell activation.[11] A population based study by Christiansen JS[12] found that adolescent smokers were more likely to report neuropathy symptoms than non-smokers when they develop diabetes in later life. Smoking decreases blood supply to nerves and induces subclinical changes in myelin sheath leading to demyelination of nerves and a subsequent decrease in conduction velocity.[13] The demylinated axons have poor electrotonic conduction.[14] Also, it was found that heavy smokers have high carbon monoxide level which leads to hypoxia which is detrimental to peripheral nerves.[15]

In conclusion, we investigated the relationship of two exposures, cigarette smoking and hyperglycemia to the risk of reduction in MNCV. MNCV was more resistant to hyperglycemia induced local metabolic and microvascular changes. There was a negative, but statistically non-significant correlation observed between MNCV and smoking index. The decrease in MNCV was dependent on smoking index by 3%, 1%, 1%, 1%, 3% and 1% in median nerve (right),

median nerve (left), ulnar nerve (right), ulnar nerve (left), common peroneal nerve (right) and common peroneal nerve (left) respectively. However, the coalition of diabetes and smoking can augment their individual effects many folds and can lead to motor neuropathy. Thus, the hypothesis that cigarette smoking as an independent risk factor for neuropathy should be investigated both prospectively and also in a more representative population of diabetic individual

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