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COMPARATIVE ANALYSIS OF ELECTROPHYSIOLOGICAL CHANGES IN NORMAL AND TYPE 2 DIABETIC SUBJECTS

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ABSTRACT

Aim and Objective: Diabetic neuropathy is a common complication of diabetes mellitus. Effective blood glucose control retards changes in nerve conduction velocity in type 2 diabetes. This aim of the study was to analyze the relationship between glycemic control and electro physiologic changes in diabetic patients. **Material and Methods:** It was a cross-sectional comparative study were 37 diabetes mellitus patients with normal HbA1c levels and 63 diabetes mellitus patients with elevated HbA1c levels were selected, making it a total of 100 diabetes mellitus patients. 50 non-diabetic, healthy subjects were chosen as a control group. The Motor and sensory nerve conduction studies of right median, peroneal and sural nerves were tested in all the diabetic subjects and the healthy controls using RMS EMG EP MARK-II machine manufactured by the RMS recorders and medicare system, Chandigarh. Motor and Sensory Distal latency (DL), Amplitude (Amp) and Conduction Velocity (CV) were measured. **Results:** The analysis showed that the nerve conduction velocity progressively decreased from the controls to the diabetics with a good glycaemia control, to the diabetics with a poor glycemic control. There is a progressive neuronal involvement in the diabetic process which is accelerated by poor glycemic control. Therefore, nerve conduction studies can be employed for testing and for the early indication of neuropathy in diabetic patients. **Conclusion:** The estimation of both NCV and the HbA1c levels in diabetics is helpful in identifying the risk category for Diabetic neuropathy, which is one of the main causes for severe morbidity among the diabetes mellitus patients.

Key Words: Nerve Conduction Velocity; HbA1c; Diabetes Mellitus

INTRODUCTION

Diabetes mellitus, the most common endocrine disorder is characterized by metabolic abnormalities and in the long run with micro and macro vascular complications that cause significant morbidity and mortality. **(1)** Diabetes is fast gaining the status of a potential epidemic in India with more than 62 million diabetic individuals currently diagnosed with the disease. **(2, 3)** It is predicted that by 2030 diabetes mellitus may afflict up to 79.4 million individuals in India.**(4,5)** India leads the world with largest number of diabetic subjects earning the dubious distinction of being termed the "Diabetic capital of the world".**(6)**

Diabetic neuropathies are a disabling complication of diabetes mellitus. Development of which is a progressive process that has a long

subclinical stage,(**7**) the most common form is a chronic distal symmetric sensorimotor polyneuropathy [diabetic polyneuropathy (DPN)], which has a prevalence of about 50%.(**8,9**) DPN is thought to be due to vascular and metabolic derangements secondary to chronic hyperglycemia (**10**) and poor glycaemic control.(**11**)

The progression of neuropathy is predicted by poor metabolic control and may be prevented or retarded during the first 5 years by near normoglycemia. (**12**) It is important to identify neuropathy in the subclinical stages as the disease process progresses to the diabetic foot, a highly morbid condition that arises from the infection and the ulceration of the foot, finally leading to amputation. **(13)** Glycated haemoglobin (HbA1c) has not only been established as a marker of glycaemic control but it also indicates the risk of developing small vessel complications.**(14)** Therefore early identification and glycaemic control are the key factors for preventing DN.

The routine evaluation of DN is based on the symptoms of the patients and physical examination using Semmes-Weinstein monofilament and the 128-hertz tuning fork. However these screening tests are of limited value in diagnosing sub clinical neuropathy and also in elder patients. (**15, 16)**

Nerve conduction studies (NCS) are the most sensitive, specific and validated method to detect Diabetic polyneuropathy (DPN), **(14, 17, 18)** their use is recommended for quantitative confirmation DPN in clinical practice. (**12, 19, 20)**

Early access to NCS has the potential for early diagnosis and improved outcomes. (**17)** But sadly electro diagnostic tests are less utilized for the diagnosis or for the follow-up of DN. The primary aim of present study was to observe the effect of poor glycemic control on NCS by estimating HbA1c levels in asymptomatic Type 2 DM patients so that preventive measures can be instituted at the earliest.

MATERIALS AND METHODS:

The present study was conducted in the Department of Physiology in collaboration with the Department of Medicine of J.J.M Medical College Davangere, Karnataka, after obtaining ethical clearance from the institute.

Male patients with established type 2 diabetes of 5 to 10 years duration and those who were on treatment were tested for glycated haemoglobin (HbA1c) levels. Based on the HbA1c levels, 37 diabetic patients with HbA1c levels of <7.0 and 63 patients with HbA1c levels of >7.0 were selected and grouped into group A and group B categories respectively. 50 age matched male, healthy volunteers, were selected as controls and were grouped as group C. Patients having any other type of neuropathy, chronic musculoskeletal disorders, retinopathy, nephropathy, any other chronic disease, alcoholics and smokers were excluded from the study. Detailed family and medical history were taken from all the subjects followed by their physical and clinical examination. The written informed consent was taken from each of the subjects and the procedure was explained to them in their own vernacular language.

Motor nerve conduction study of median and peroneal nerve and Sensory nerve conduction study of median and sural nerve were performed on right upper and lower limb using computerized RMS EMG EP MK II machine using surface electrodes. Motor and Sensory

Distal latency, Amplitude (Amp) and Conduction Velocity (CV) were measured.

RESULTS:

The study included 50 healthy controls and 100 diabetics. Both the cases and the controls were aged between 30 to 55 years. Table 1 shows Mean ± SD of age, height, weight, body surface area and HbA1c in 100 diabetics and 50 healthy controls.

Table-2 and Table-3 shows the Mean ± SD of motor and sensory nerve conduction velocity (NCV), motor and sensory distal latency and amplitude in group A, B and C. The motor and sensory nerve conduction velocity of median nerve, motor nerve conduction velocity of peroneal nerve and sensory nerve conduction velocity of sural nerve showed a progressive decrease with the HbA1c levels in controls, in diabetics with normal HbA1c levels and in diabetics with raised HbA1c levels respectively. Distal latency of median, peroneal and sural nerve showed a significant increase with poor glycaemic control in the diabetics when compared to controls.

DISCUSSION:

Present study reveals alteration in electrophysiological parameters of median, peroneal and sural nerve in diabetics with normal and raised HbA1c levels. Diabetic neuropathy is a common complication of diabetes mellitus with severe

Table 1: Basic characteristics of the study group

Basic characteristics	**Case (n=100)**		**Control Group C (n=50)**
	Group A (n=37)	Group B (n=63)	
Age in years	46.73 ± 5.96	45.94 ± 4.76	46.75 ± 6.06
Height in cm	164.27 ± 7.97	164.77 ± 7.17	164.18 ± 7.85
Weight in kg	68.03 ± 11.55	69.42 ± 11.98	66.25 ± 11.90
BSA in m^2	1.73 ± 0.16	1.74 ± 0.21	1.71 ± 0.17
Hb1Ac	5.3 ± 0.8	8.2 ± 1.6	4.5 ± 0.5

Groups	**Age (years) Mean ± SD**	**BMI (kg/m^2) Mean ± SD**	**Hb1Ac**
A vs B	2.000 NS	3.000 NS	< 0.01*
A vs C	0.168 NS	2.000 NS	< 0.55
B vs C	0.486 NS	0.424 NS	< 0.001**

Table 2: Mean ± SD of Motor nerve conduction velocity (NCV), Motor distal latency and CMAP in groups A, B and C

Parameters	Median Nerve			Peroneal Nerve		
	Group A	Group B	Group C	Group A	Group B	Group C
Motor Distal latency (msec)	9.14±1.25	10.24±2.43	6.81±1.90	5.34±.46	5.52±.42	4.19±.71
CMAP (mv)	6.18±2.09	5.19±2.12	8.76±2.71	3.26±1.32	2.54±2.17	4.34±1.16
NCV (m/s)	45.52±6.51	42.83±5.11	57.32±4.03	37.34±5.89	34.29±5.50	46.19±5.11

Parameters	Median Nerve			Peroneal Nerve		
	Motor Distal latency (msec)	CMAP (mv)	NCV (m/s)	Motor Distal latency (msec)	CMAP (mv)	NCV (m/s)
A vs B	0.01*	0.02*	0.02*	0.04*	0.07	0.01*
A vs C	0.001**	0.0001**	0.0001**	0.0001**	0.0001**	0.0001**
B vs C	0.001**	0.0001**	0.0001**	0.0001**	0.0001**	0.0001**

Unpaired t test, *Significant, ** Highly Significant

Table 3: Mean ± SD of Sensory nerve conduction velocity (NCV), Sensory distal latency and amplitude of SNAP in groups A, B and C

Parameters	Median Sensory Nerve			Sural Sensory Nerve		
	Group A	Group B	Group C	Group A	Group B	Group C
Sensory SNAP DL (ms)	4.14± .25	4.34±.43	3.21±.16	3.84±.46	3.52±.42	2.19±.71
Amplitude of SNAP(µv)	3.88±1.09	3.49±1.12	4.36±1.27	5.96±3.32	5.24±3.17	9.64±3.56
CV (m/s)	35.52±3.51	33.83±4.11	47.32±4.03	37.34±5.89	36.29±5.50	46.19±5.11

Parameters	Median Sensory Nerve			Sural Sensory Nerve		
	Sensory SNAP DL (ms)	Amplitude of SNAP(µv)	NCV (m/s)	Sensory SNAP DL (ms)	Amplitude of SNAP(µv)	NCV (m/s)
A vs B	0.01*	0.09	0.04*	0.0001**	0.28	0.37
A vs C	0.06	0.0001**	0.0001**	0.0001**	0.0001**	0.0001**
B vs C	0.0001**	0.0001**	0.0001**	0.0001**	0.0001**	0.0001**

Unpaired t test, *Significant, ** Highly Significant

morbidity, compromising the quality of life. An intensive treatment of neuropathy at the sub clinical level decreases the risk of neuropathy. **(21)**Therefore, there is a need of methods to identify the at-risk diabetic patients for neuropathy. Electrophysiological studies are sensitive in determining peripheral and central neuropathy in diabetic patients. Decreased nerve conduction velocity has been demonstrated in many patients with normal clinical examination.

In our study, it was observed that the motor and sensory nerve conduction velocity of median, peroneal and sural nerves progressively decreased from the group C (controls) to group A (diabetics with good glycaemic control), to group B (diabetics with poor glycaemic control) and the difference was statistically significant ($p<0.0001$). Similar findings were obtained by previous studies.[22,23,24]Also Motor Distal latency and CMAP of median and peroneal nerve were significantly reduced ($p<0.0001$) in group B with poorly controlled diabetes as compared to group A and C. Sensory SNAP DL and amplitude of median and sural nerve were progressively decreased from the group C (controls) to group A (diabetics with good glycaemic control), to group B (diabetics with poor glycaemic control) and the difference was statistically significant ($p< .0001$). These findings are in accordance with those of previous researchers.[25]Bansal et al (2006) have suggested that the slowing of NCV indicates the ongoing damage to the myelin sheaths and they are also of the opinion that the amplitude decreases with the rising HbA1c levels, thus suggesting the onset of axonopathy.[26]Therefore, the monitoring of diabetic patients with NCS may help in predicting the onset of DN. Since this was a cross sectional study, follow-up studies and interventional studies are required to emphasize the importance of the NCV estimation.

CONCLUSION:

In conclusion, there is a tendency toward deterioration of diabetic neuropathy with poor blood glucose control in type 2 diabetes. Furthermore, a serum HbA1c of more than 7 % will result in significant deterioration in electrophysiology. The estimation of both NCV and the HbA1c levels in diabetics is helpful in identifying the risk category for DN, which is one of the main causes for severe morbidity among the diabetes mellitus patients.

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