International Journal of Health Sciences and Research
www.ijhsr.org ISSN: 2249-9571

Original Research Article

A Study of Median Nerve Conduction Velocity in Diabetes Mellitus Type 2 in Neurologically Asymptomatic Patients

Rinku Garg[1*@], Avnish Kumar[2**], Usha Dhar[1**]

[*]Assistant Professor, [**]Professor
[1]Dept. of Physiology, Santosh Medical College, Ghaziabad
[2]Dept. of Physiology, Govt. Medical College, Patiala

[@]Correspondence Email: rgrinkigarg6@gmail.com

Received: 18/02//2013 *Revised: 23/03/2013* *Accepted: 23/05/2013*

ABSTRACT

Background: Diabetes mellitus, the common endocrine disorder, is characterized by metabolic abnormalities and by long-term complications like diabetic neuropathy,nephropathy,retinopathy and angiopathy.Diabetic peripheral neuropathy is the presence of symptoms and /or signs of peripheral nerve dysfunction in people with diabetes after exclusion of other causes and often develops as generalized asymptomatic dysfunction of peripheral nerve fibres.

Aims &Objectives: The aim of the present study was to study the effect of diabetes and its duration on motor and sensory nerve conduction velocity of median nerve in neurologically asymptomatic patients.

Material & Methods: Study was done in Goverment Medical College, Patiala and performed in accordance with ethical standards of the institute. The study was conducted on 100 subjects in age group of 30-60 years, out of which 50 cases of clinically diagnosed diabetes mellitus type 2 were taken and 50 age- matched healthy controls were taken. In diabetic patients, mean age, mean height, mean weight and mean duration of the diabetes were 42.5±7.90 yrs, 161.04±7.83 cms, 60.46±17.54 kgs, 9.02±5.53 yrs respectively. In healthy controls, mean age, mean height and mean weight were 42.88±8.87yrs, 159.10±7.47cms, 57.12±12.64kgs. For the nerve conduction velocity test , RMS EMG EP Mark II was used. RESULTS: Mean motor nerve conduction velocity (MNCV) in diabetics(52.55+/-5.77m/s,) was found to be less than mean MNCV of control subjects(59.62 +/-3.68m/s), which was statistically significant($p<0.005$). Mean sensory nerve conduction velocity(SNCV) in diabetics(52.28+/-5.44m/s)was found to be less than mean SNCV of control subjects(59.83 +/-3.56 m/s), again statistically significant($p<0.005$). Mean MNCV and SNCV was found to decrease with increase in duration of diabetes and the results were found to be statistically significant($p<0.005$).Thus nerve conduction velocity can be used as non-invasive method to assess early asymptomatic median mononeuropathy in diabetic patients.

Keywords: Diabetes, Neuropathy, nerve conduction

INTRODUCTION

Diabetes mellitus, the most common endocrine disorder, is characterized by hyperglycemia causing polyuria, polydipsia, polyphagia, weight loss, impairment of growth and increased susceptibility to infections. [1] Type I insulin dependent diabetes mellitus(IDDM), is due to autoimmune mediated destruction of beta-cells of the pancreas ,resulting in absolute deficiency of insulin secretion, whereas type II diabetes mellitus, non-insulin dependent diabetes mellitus(NIDDM), is characterized by resistance to insulin action and inadequate compensatory insulin secretion, resulting in hyperglycemia . Diabetes mellitus is characterized by long -term complications like neuropathy, retinopathy, nephropathy, and vasculopathy. [2] Diabetic neuropathies, one of the most common complication, are heterogenous group of disorders which affect different parts of the nervous system and present with various different clinical manifestations. Diabetic neuropathy is defined as the presence of symptoms and /signs of peripheral nerve function in people with diabetes after exclusion of other causes. [3] Diabetic neuropathies include peripheral neuro-pathies, polyneuropathies, mononeuritis multiplex and autonomic neuropathy.[4] Peripheral neuropathy is a common, distressing and disabling complication of diabetes mellitus, [5, 6] it affects upto 50% of the type II diabetic patients, which often develops as generalized asymptomatic dysfunction of peripheral nerve fibres. [7] Mononeuropathies may involve peripheral nerves like median, ulnar, peroneal, sural, sciatic and femoral nerves or cranial nerves III,IV,VI and VII.[8] Diabetic mono-neuropathy may occur independently of peripheral, autonomic and polyneuropathies. [9] Study by Stambolius E et al found that asymptomatic median mononeuropathy was present in 18.1% diabetic patients without any evidence of diabetic Polyneuropathy. [10] It has been shown by Zahed Ali et al [11] that median nerve has the highest electro-diagnostic abnormalities in diabetic patients with early neuropathy. Study of median nerve conduction across the carpal tunnel in diabetic patients can provide new insight into the pathophysiology of diabetic neuropathy. [12] Although the role of diabetes in the causation of mononeuropathies is uncertain, but it is considered that the diabetic mono-neuropathies like median mononeuropathy may be caused by (a) metabolic factors like hyperglycemia making the median nerve more susceptible to entrapement in carpal tunnel and increased incidence of vasculitis causing hypoxia leading to nerve infarction. [13] Sulaiman AAA et al showed that decrease in nerve conduction velocity before other parameters (like amplitude), might be due to demyelinating nature of the diabetes mellitus. [4] Nerve conduction abnormalities exist in subclinical stages of neuropathy, [14] that can be detected at an early asymptomatic stage by various electro-diagnostic test. Because peripheral nerves have the capability to regenerate, [15] therefore, early diagnosis and timely therapeutic intervention will reduce the morbidity and mortality in diabetes mellitus type 2. [16] Moreover, any therapeutic intervention will be more effective if started in early stage of the disease. [17] Nerve conduction studies are the most sensitive, reliable and reproducible measures of nerve function and electrophysiologic finding usually correlate with morphologic changes on nerve biopsy. [6] It has been shown by various studies that upper limb sensory nerve conduction studies are more sensitive in detecting than lower limb nerve conduction studies[13] as electro-physiological abnormalities are most commonly found in the median nerve(59%) as compared to ulnar nerves(28%), peroneal nerve(28%),and sural (8%). [4] The present study was aimed to investigate the effect of diabetes mellitus type II and its duration on median nerve conduction velocity in neurologically asymptomatic patients.

MATERIALS AND METHODS

The study was conducted on 100 subjects in age group of 30-60 years, out of which 50 cases of clinically diagnosed diabetes mellitus type 2 (according to American Diabetic Association), [18] neurologically asymptomatic patients were taken and 50 age- matched controls were taken. Study was done in government medical college, Patiala and performed in accordance with ethical standards of the institute. Correct procedure of the test was explained to all subjects and findings were recorded on predesigned proforma. Informed consent was taken from all diabetic patients and healthy controls.

Testing Equipment

For the nerve conduction velocity test, RMS EMG EP Mark II was used. Test was performed using standardized techniques. Subjects were allowed to acclimatize in testing room for 10 minutes.

Setting of RMS EMG MARK II for recording of conduction velocity of median nerve.

Parameter	MNCV	SNCV
Senstivity	2Mv	50MV
Low Frequency Filter	2 Hz	2Hz
High Frequency Filter	10 KHz	5 KHz
Sweep Speed	5ms/division	5 ms/division
Mode	Single	Single
Duration	0.1ms	0.1ms
Control	Remote	Remote
Range	100mA	25Ma
Count	Infinite	Infinite

The subject was made to sit comfortably on a chair in a fully relaxed state. Thenar area and the skin overlaying the median nerve at wrist and elbow were cleaned.

Placement of electrodes for median nerve: Surface electrodes were used.

i. MNCV record

Stimulating electrodes:

S1 –was placed at wrist between palmaris longus and flexor carpi radialis tendons at the second crease (approximately 1 cm proximal to most distal crease).

S2–was placed at elbow crease, medial to biceps tendon and brachial artery.

Ground electrode- was placed over the dorsum of the hand.

Recording electrodes: The active electrode was placed over the belly of the Abductor Pollicis Brevis .The reference electrode was over the tendon of this muscle (3cm distal at first metacarpophalangeal joint .

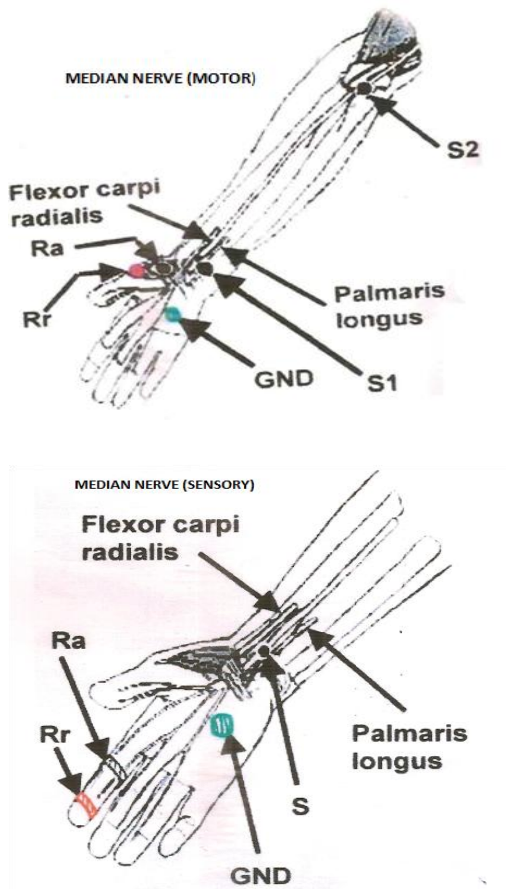

Fig. 1. Placement of electrodes for MNCV(above) &SNCV (below)

ii **SNCV Record**

Stimulating electrodes

Antidromic stimulation was performed at the wrist between the Palmaris

Longus and Flexer Carpi Radialis tendon at the second distal most crease.

Ground: Ground was placed over the dorsum of the hand.

Recording electrodes used were ring electrodes. The active electrodes were placed around the proximal interphalangeal joint of the second digit.

The reference electrode was around the distal phalanx of the same digit.

A supramaximal stimulation was given at wrist (3 cm proximal to the distal wrist crease) and at elbow (near the volar crease of the brachial pulse).

For SNC test, stimulation was given at the wrist, minimum current was adjusted on which smooth potentials was recorded. When a clear wave form appeared on the screen, wave was captured. Conduction velocity was recorded as follows:

$$MNCV = \frac{D}{PL - DL} \text{ m/s}$$

PL = Proximal latency in milliseconds

DL = Distal latency in millisecondss

D = distance between proximal and distal stimulation in millimeters.

$$SNCV = \frac{D(mm)}{Latency(ms)}$$

D- distance between proximal and distal stimulation in mm.

Measurement of latency difference between the two points of stimulations eliminates the effect of residual latency. SNCV may be measured by stimulating at a single stimulation site; because the residual latency which comprises of neuromuscular propagation time is not applicable in sensory nerve conduction. [19]

RESULTS

Stastistical analysis was done using software SPSS version 17.0.Values were expressed as Mean±S.D. Comparisons were made between groups by unpaired ‘t’ test. p-values < 0.05, was considered as significant.

Table 1. **Comparative evaluation of mean and standard deviation of demographic data in diabetic and control subjects.**

Parameters	Diabetics	Controls	t value	p value	Significance
Age(yrs)	42.5±7.90	42.88±8.87	-0.538	>0.05	Not significant
Height(cms)	161.04±7.83	159.1±7.47	1.291	>0.05	Not significant
Weight(kgs)	60.46±17.54	57.12±12.64	1.208	>0.05	Not significant

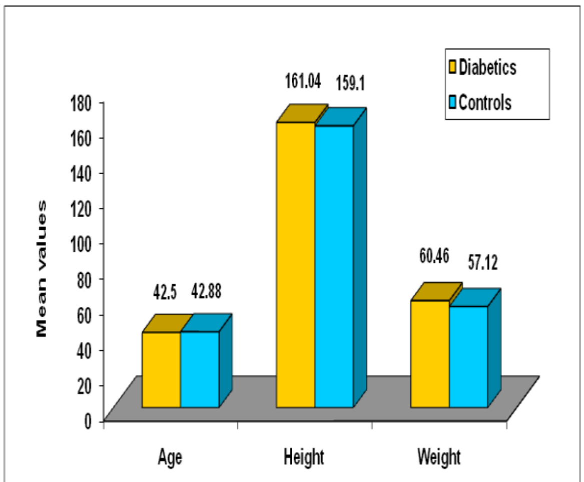

Fig. 2. Bar diagram showing mean of anthropometric parameters in diabetic and control subjects.

Table 2. shows no.of male and female subjects in diabetic and control subjects.

Gender	Diabetics	Controls
Male	32	31
Female	18	19

Table 3. Comparison of Mean ±SD of MNCV and SNCV in diabetics and control groups and their statistical analysis

Parameters	Diabetics Mean ±SD	Control Mean±SD	't'	'p'	Significance
MNCV(m/s)	52.55±5.77	59.62±3.68	-7.521	<0.005	significant
SNCV(m/s)	52.28±5.44	59.83±3.56	-9.229	<0.005	significant

Table 3 shows that there is decrease in motor nerve conduction velocity in diabetics (52.55+/-5.77 m/s) as compared to control groups(59.62+/-3.68 m/s which is statistically significant (p <0.005) and there is also significant reduction in sensory nerve conduction velocity in diabetics(52.28+/-5.44 m/s) as compared to control groups (59.28+/-3.56m/s) which is statistically significant(p<0.005).

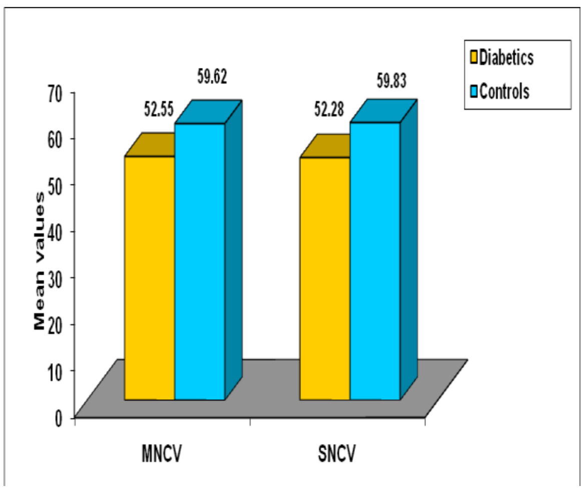

Fig. 3. Bar diagram showing mean of MNCV and SNCV in diabetic and control subjects

Table 4 (A). Mean ± SD of MNCV according to duration of diabetes intervals

Group	Duration of diabetes (in Yrs.)	No.of subjects	Mean±SD of MNCV(m/s)
I	1-7	24	57.47±3.44
II	8-14	15	49.81±2.68
III	15-22	11	45.55±1.59

Table 4 (B). Statistical analysis of MNCV according to duration of diabetes intervals

Group	t	P	Significance
I&II	12.42	<0.005	significant
II&III	9.66	<0.005	significant
III&I	-22.24	<0.005	significant

Table 4(a) shows that there is progressive decrease in motor nerve conduction velocity with increase in the duration of diabetes. Group III showed the maximum decrease in velocity as compared to groupII which had lesser motor nerve conduction velocity than group I.Table 4(b) shows statistically significant results on comparing group I &group II (t=12.42,p<0.005),group II & group III(t=9.66,p<0.005), group II &III(t=-22.24,p<0.005).

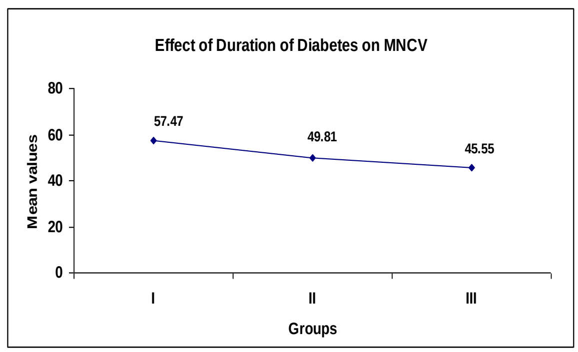

Fig. 4. Graph showing the decrease in MNCV with increase in duration of diabetes

Table 5 (A). Effect of duration of diabetes on SNCV in diabetics according to duration of diabetes intervals

Group	Duration of diabetes (in Yrs.)	No. of subjects	Mean ± SD of SNCV(m/s)
I	1-7	24	56.89±2.71
II	8-14	15	49.98±2.86
III	15-22	11	45.32±2.09

Table 5 (B). Statistical analysis of mean of SNCV according to duration of diabetes intervals

Group	t	p	Significance
I&II	12.40	<0.005	Significant
II&III	9.30	<0.005	Significant
III&I	-23.90	<0.005	Significant

Table 5(a) shows that there is progressive decrease in sensory nerve conduction velocity (SNCV) with increase in the duration of diabetes. Group III showed the maximum decrease in velocity as compared to group II which had lesser motor nerve conduction velocity than group I. Table 5(b) shows statistically significant results on comparing group I &group II (t=12.40,p<0.005),group II & group III(t=9.30,p<0.005), group II &III(t=-23.90,p<0.005)

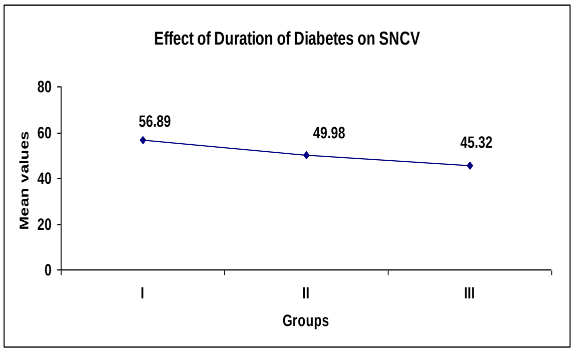

Fig. 5. Graph showing the decrease in SNCV with increase in duration of diabetes.

DISCUSSION

The present study showed that there was significant decrease in both motor and sensory nerve conduction velocity in the median nerve of the diabetic patients with no clinical features of neuropathy as compared to healthy controls.

Similar results were shown by Cerriza M et al where mean conduction velocity of median nerve was significantly lower in diabetics than in controls. [20] Imada M et al also showed that 40% of the diabetic patients had decrease in sensory nerve conduction velocity. Rota E et al also studied that 42% of newly diagnosed diabetic type 2 patients had distal medial mononeuropathy.14.3% of diabetic patients were found to have asymptomatic carpal tunnel syndrome without any neuropathy symptoms. The present study findings are comparable to study [7] which showed subclinical neuropathy in 57% of the diabetic patients. Decrease in sensory nerve conduction velocity finding are consistent with study of Tupkovic E et al [21] which showed that sensory nerve conduction velocity was higher in control group as compared to diabetics whereas motor nerve conduction velocity findings are inconsistent where there was no significant difference in conduction velocity of diabetics and control groups. Median mononeuropathy in diabetes mellitus type 2 might be due to metabolic factors (a)hyperglycemia affecting myelin sheath or affecting blood vessels causing hypoxia and ischemia or (b) due to entrapment of median nerve in carpal tunnel, entrapment being more common in the diabetic population due to connective tissue stiffness and repetitive shear forces. [8, 22] Findings are inconsistent with Fraser et al where no relationship was found between onset of mononeuropathy and duration of diabetes. [9]

Further both motor and sensory nerve conduction velocity decreased with the increase in the duration of diabetes mellitus type 2. Findings are consistent with Bertora P et al where a longer duration of diabetes was found in patients with subclinical neuropathy with respect to non-neuropathic patients. Patients with median mononeuropathy had a longer duration of diabetes [23] and therefore, patients with diabetes require special consideration with regard to neuropathy. [4] El-Saleem et al showed that 52% of patients had subclinical neuropathy in neurologically asymptomatic patients. [14]

CONCLUSION

It is proposed that median nerve conduction velocity can be used to assess early asymptomatic neuropathy in diabetes mellitus type 2.

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How to cite this article: Garg R, Kumar A, Dhar U. A study of median nerve conduction velocity in diabetes mellitus type 2 in neurologically asymptomatic patients. Int J Health Sci Res. 2013;3(5):1-6.

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