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Role of Biothesiometry in the diagnosis of diabetic neuropathy

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Abstract

Introduction and Objectives: Increased incidence of neuropathy in diabetic patients motivated this present study to diagnose the diabetic neuropathy as early as possible. The present study was undertaken to determine the usefulness of biothesiometry in the early diagnosis of diabetic neuropathy.

Materials and Method: The present study was conducted on 60 subjects (30 male and 30 female) in the age group of 40 to 60 years in which 30 were type II diabetic and 30 were non diabetic. Vibratory perception threshold was measured by Vibro therm DX Neuropathy analyzer which measures vibratory sensation quantitatively.

Results: The mean VPT in the non-diabetic group was 14.4 whereas in the diabetic group it was 16.19. There was statistically significant difference between the non-diabetic group and diabetic group ($p<0.05$).

Conclusion: From this study we can conclude that all cases of diabetic patients irrespective of clinical symptoms of neuropathy should be advised to undergo biothesiometry on regular intervals as a part of routine diabetic checkup which can help in the early diagnosis of neuropathy & planning of future therapy to prevent progression of disease.

Keywords: Biothesiometry, Diabetic neuropathy, Diagnosis, Vibration perception threshold, Hyperglycaemia

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Introduction

Neuropathy in diabetes mellitus is multifactorial. The exact pathogenesis of diabetic peripheral neuropathy (PN) is unclear, the possible aetiologic factors suggested include, hyperglycaemia, polyol pathway, non-enzymatic glycation, free radical and oxidative stress. Diabetes Control and Complications Trial (DCCT) concluded that the long-standing hyperglycaemia is the main cause in the development of diabetic neuropathy. Early lesions of diabetic neuropathy may arise from exposure of peripheral nerves to hyperglycaemia. The glucose uptake into peripheral nerve is insulin independent; therefore it is proportionate to ambient blood glucose concentration. The excess glucose is shunted into polyol pathway where the glucose is converted into sorbitol and fructose by the enzyme aldose reductase and sorbitol dehydrogenase together with deficiencies of myoinositol and diacylglycerol all may combine as potent metabolic factors responsible for structural breakdown of nerves and slowed conduction velocity.[1,2] Use of the vibration perception threshold (VPT) is a simple way of detecting large-fiber dysfunction. Therefore the diabetic neuropathy can be detected by the use of Vibration perception threshold (VPT) measured by Biothesiometer.

Contradictory reports regarding VPT testing in peripheral neuropathy has been reported. One study stated that in diabetes patients without clinical evidence of neuropathy there were no correlations between either vibratory threshold or thermal threshold.[3] Many studies had been done on the reliability of biothesiometry in diabetic neuropathy.[4,5,6] But very few studies were documented in India. The present study aimed at the usefulness of biothesiometry in the diagnosis of diabetic neuropathy.

Materials and Method

The present study was conducted on 60 subjects (30 male and 30 female) in the age group of 40 to 60 year in which 30 were type II diabetic and 30 were non diabetic. All the subjects were clearly explained about the aim and objective of the study and the procedure which is going to be carried out on them. Patient consent was obtained from all the subjects and Institutional ethical clearance was taken to start and carryout the study. Vibratory perception threshold was done by Vibro therm DX Neuropathy analyser (Madras Engineering Services, Chennai make) which measures vibratory sensation quantitatively. Probe was applied to patient's hand to explain the feel of vibration clearly. Then patient is asked to concentrate on feet & tell as soon as he starts feeling the vibration and value is noted. During recording, the voltage was increased from 0 to 50 volts. Grading of VPT was recorded as follows - Normal VPT was from 0 to 15 volts, Grade I was 16 to 25 volts and 26 to 50 volts was graded as grade II.

Results

The normal value of vibratory perception threshold as per the specification of instrument and the standardization of procedure was 14. In the present study the mean VPT in the non-diabetic group was 14.4 whereas in the diabetic group it was 16.19. The data was tested by student t tested to check the level of

significance and found that there was statistically significant difference between the non-diabetic group and diabetic group ($p<0.05$) (Fig. 1).

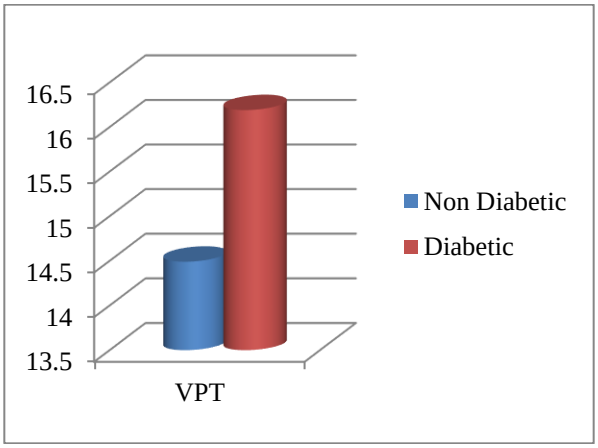

Fig. 1: Bar diagram showing the Mean values of VPT in diabetic and non diabetic groups

Type II diabetic and Non diabetic subjects were classified according to their VPT. Normal VPT was from 0 to 15 volts, Grade I was 16 to 25 volts and 26 to 50 volts was graded as grade II. Chi-square test has been applied between the parameters. 76.6% of the non diabetic subjects and 46.6% of diabetic patients had normal VPT. 53.3% type II diabetic patients had abnormal VPT whereas 23.3 % of the non diabetic subjects had abnormal VPT. In type II diabetic group 40% had grade I and 13.33% had grade II severity whereas in non- diabetic group 23.3% had grade I and 0% grade II severity. Chi-square test results showed statistically significant difference among the groups (Table 1).

Table 1: Showing Chi-square statistics between the type II diabetic and non-diabetic subjects in relation to VPT grades

Group	Type II diabetic	Non-Diabetic	Row total
Normal	14 (18.50) [1.09]	23(18.50) [1.09]	37
Grade I	12 (9.50) [0.66]	7(9.50) [0.66]	19
Grade II	4 (2.00) [2.00]	0(2.00) [2.00]	4
X^2 = 7.505 p = 0.0235 (Statistically significant as P<0.05)			

Pearson correlation test was done to check the correlation between the duration of diabetes and the vibratory perception threshold and also between the age and VPT of diabetic and non diabetic groups. There was a statistically significant positive correlation between the duration of diabetes and the vibratory perception threshold. There was a positive correlation between the age of the non diabetic subjects and VPT of non diabetic group but in diabetic group negative correlation was observed between age and VPT.

Discussion

The relationship between elevated VPT and DN has been documented for almost 100 years. When tested in the 50- to 300-Hz range, VPT reflects the activation of mechanoreceptors namely Pacinian and Meissner corpuscles, conduction in large-diameter myelinated peripheral axons, and transmission through the dorsal column spinal pathways. Multiple studies have documented the relation between loss of vibration sensation and the progression of a variety of indicators of DPN. The neuropathy associated with impaired glucose tolerance (IGT) is milder than the neuropathy associated with newly diagnosed diabetes, and small nerve fiber involvement may be the earliest detectable sign of neuropathy.[7,8,9]

According to Boulton et al., VPT provides a strong indication of "risk" for future ulceration across a wide range of ages and durations of diabetes. In another study the patients with baseline threshold elevated above a fixed value (i.e., 25 V with the biosthesiometer) were seven times more likely to develop foot ulcers.[10,11]

The present study results were correlating with Van Deusen RW et al., who stated that in mild to moderate diabetic neuropathy the biothesiometer VPT shows excellent reliability and serves as an appropriate screening tool.[12] In the present study there was a statistically significant difference between the VPTs of diabetic and non diabetic patients. In diabetic group 40% had grade I and 13.33% had grade II severity whereas in non- diabetic group 23.3% had grade I and 0% grade II severity. Dipa Saha et al., found that among the diabetic patients with clinical neuropathy 73.2% had abnormal VPT and, 26.6% & 46.6% shows grade I & grade II severity respectively, whereas, 26.6% show normal VPT. Interestingly even in diabetic patient without clinical neuropathy, 60% show grade I severity with VPT testing. So, maximum patients with clinical neuropathy show grade II severity with vibration perception threshold. But they did not find any significant difference between the symptomatic and asymptomatic cases.[13] The present study results shows statistically significant positive correlation between the duration of diabetes and the vibratory perception threshold and also shows negative correlation between the age of the individual and the VPT.

Conclusion

The vibration perception threshold levels were elevated in all the cases of type II diabetic neuropathy. Within the limitations of the present study we conclude that the duration of diabetes plays an important role in triggering the neuropathy. So we can recommend advising the long standing diabetic patients to undergo

biothesiometry on regular intervals as a part of routine diabetic checkup which can help in the early diagnosis of neuropathy & future therapy to prevent progression of disease which leads to diabetic ulcers. Further studies can be carried out on detecting neuropathy with biothesiometry in children and adolescents of type I diabetes in Indian population.

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