THE DETECTION OF SUB CLINICAL NEUROPATHY IN PATIENTS WITH TYPE-II DIABETES MELLITUS USING BIOTHESIOMETER

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ABSTRACT:

Foot problems are an important cause of concern in patients with diabetes mellitus. Vascular and neurological complications contribute to this problem. Early recognition of neurological dysfunction is therefore crucial in order to prevent foot complications. The objectives of the study is to compare the vibration perception thresholds of patients with type II diabetes mellitus and age matched non-diabetic subjects using biothesiometer to determine its effectiveness in detecting sub-clinical neuropathy.

In the present study, 52 patients (30 males and 22 females) with type II diabetes mellitus and the same number of age-matched non-diabetic subjects (26 males and 26 females) were investigated for sub clinical neuropathy. All the subjects were tested for vibration perception threshold (VPT) on the plantar aspect of the great toe and prominent part of medial malleolus in a standardized environment using biothesiometer.

The data analysis was completed using an unpaired t-test to compare VPT values between diabetic and non-diabetic individuals and a paired t-test to compare the VPT values at the two different sites of the same side of the subject' body. There was a significant difference in the VPT values between diabetic and non-diabetic individuals ('P' value <0.001). It was observed that early neuropathic changes in diabetic individuals can be detected by testing VPT's using biothesiometer.

INTRODUCTION:

Foot problems are an important cause of concern in patients with diabetes mellitus. Vascular and neurological problems contribute to this problem[1]. Peripheral neuropathy is a common and most disabling complication of diabetes, with foot ulcers present in over 80% of the patients. It may impair both the large and small nerve fiber function and accordingly a variety of neuropathic disorders may be encountered[2]. Reduced pain sensitivity in diabetics often remains unnoticed, who may have serious consequences such as development of neuropathic ulcers, feet trauma and Charcot arthropathy. Early recognition of neurological dysfunction is therefore crucial in order to prevent foot complications. The quantitative assessment of nerve function may detect sensory changes in diabetics without clinical neuropathy[3].

Vibration perception threshold is commonly monitored in routine diabetic clinics as a means of measuring the progression of neuropathy[4]. The devices used to generate vibration utilize stimulators with constant frequency and adjustable amplitude. Frequencies around 200-300 Hz are optimal because Pacinian corpuscles; which are found in glabrous skin particularly in the finger tips, toes and sole; are most sensitive to vibration in this range.[5] Vibration sensation is transmitted along the sensory pathways to the spinal cord where impulses travel in the posterior column tract leading to the cerebrum via thalamus and peripheral cortex. One becomes conscious of vibratory sensation once they reach the thalamic level[6]. Abnormality of

vibratory sense is an indicator of either chronic neurological damage or reversible damage of axonal function. Williamson in 1922 first emphasized that impairment of vibration perception may be one of the signs of peripheral neuropathy in a patient with diabetes mellitus. [7]

Non-quantitative tools like tuning fork are not effective in the early detection of neuropathy. A biothesiometer is an efficient and reliable instrument that can be used in the early detection of peripheral neuropathy in diabetic individuals. It is more accurate than using a tuning fork, but it is more expensive and cumbersome. It produces sine wave vibrations of constant frequency but varied amplitude, and is one of the most commonly used devices for quantifying vibration perception thresholds. It can have a reading from 0-50v. The instrument used was handheld mains operated unit with a rubber tactor which vibrates at 100 Hz but varying amplitude. The linear scale shows the applied voltage, which is proportional to the square root of the amplitude of vibration. The risk of developing ulcers is higher if a person has reading more than 25v, and the risk is very high if some other factors like peripheral vascular disease, or coexisting abnormalities of` the foot are present.[8]

The ability to perceive vibratory stimuli from the lower extremities becomes impaired in most people during or after the fifth decade of life. Pacinian corpuscles show regressive changes, becoming small and irregular with advancing age. Arterial insufficiency is associated with the loss of vibration perception.[9]

Degenerative changes that accompany aging may lead to reduced blood flow to the peripheral nerves of the lower limb which could also be responsible for the impairment of vibration perception. Since vibration perception varies so much in the elderly, it becomes progressively harder to differentiate between normal and abnormal values.[10]

There are very limited studies on VPT, comparing age-matched individuals with and without diabetes. Therefore, the objective of the present study was to study vibration perception thresholds of diabetic and non-diabetic subjects to assess the effectiveness of using biothesiometry in detecting sub-clinical neuropathy in patients with type-II diabetes mellitus.

METHODOLOGY:

A sample of convenience was used in an observational study in which a biothesiometer was used to test the vibration perception thresholds of diabetic and non-diabetic subjects at standardized sites on the lower extremity.

A total of 52 patients with type-II diabetes mellitus (30 males and 22 females), who were evaluated and determined not to have clinical signs of neuropathy by physician, were studied and comparisons were made with the same number of age-matched non-diabetic subjects (26 males and 26 females). Any subjects with poor comprehension, endocrine disorders, vascular problems, dermatological problems at the VPT measurement sites, and neurological disorders were excluded from the study.

The subjects were tested on the plantar aspect of the great toe and the prominent part of the medial malleolus in a standardized environment. The subjects were first familiarized with VPT using biothesiometer before taking the actual readings. The probe was applied at an angle of 90 degrees and all measures were taken to prevent the displacement of the probe. The subject was asked to respond to the weakest perceived stimulus of vibration and tested by increasing the amplitude from zero. Three readings were taken over a period of 2 minutes and the lowest reading was taken as the final measurement. VPT values were considered abnormal if they exceed 15v.

Data analysis was undertaken using unpaired t-test to compare VPT values of the diabetic and non-diabetic groups; and a paired t test was used to compare VPT values at two different sites on the same side of each subject. A *p*-value less than 0.05 were considered significant.

RESULTS:

There was a significant difference of VPT values between diabetic and non diabetic individuals. There is a significant difference between the VPT values taken at medial malleolus than great toe both the sides. But there are no significant differences between the individual sites in both diabetics and non-diabetics.

DISCUSSION:

The distribution of abnormal VPT values was observed in the present study. Twenty one diabetics had

increased VPT values at one or more sites. In accordance with previous studies those diabetics who had increased VPT values were proved to have sub clinical sensory neuropathy and therefore more chances of ulcer in the future of the normal subjects, only 5 had mild increase in the thresholds which can be explained by neuropathic damage associated with age.

The important finding of this study is that VPT values are increased in those without the signs and symptoms of neuropathy, as compared to non-diabetic subjects (Table 1). These findings suggest that altered nerve function may be an early sign of sub-clinical neuropathy in diabetes. The sensory thresholds to thermal and vibratory stimuli are elevated in diabetics without clinical neuropathy[11.] The study of elevated VPT values at the initial stages of the disease or before the occurrence of symptoms of disease will have good diagnostic value. The testing can provide a reasonable estimate of the presence of neurovascular disorders or their likely occurrence in the future.

It has been shown that vibratory sensitivity is age dependent. This is important when separating the normal and pathological thresholds for diagnostic purposes. We studied the normal age group of more than forty years and used those values for comparison with the diabetic individuals for more appropriate diagnosis.

The VPT values were found higher at medial malleolus as compared to great toes in both diabetics and normal adults. The variation is significantly higher in diabetic individuals as compared to non diabetics. This indicates that sensory variation is more at medial

malleolus than great toe and this could be the reason for higher occurrence of ulcerations at medial malleolus (table 2 & 3). The unpredicted variability in diabetic individuals reflects the neuropathic damage, which is presumably patchy and asymmetric in most cases[12].

During the study, the chronicity of diabetes and the incidence of neuropathy in uncontrolled diabetic patients who were not on medications were not taken in to consideration. The future research may concentrate on these areas.

CONCLUSION:

Vibration Perception Threshold values are higher in patients with type 2 diabetes mellitus (without signs of clinical neuropathy) than in non-diabetic age matched individuals. Early neuropathic changes in diabetic individuals can be detected by testing VPT's using biothesiometer.

TABLE NO: 1
COMPARISON OF VPT VALUES BETWEEN DIABETICS AND NON DIABETICS
(Independent sample 't' test)

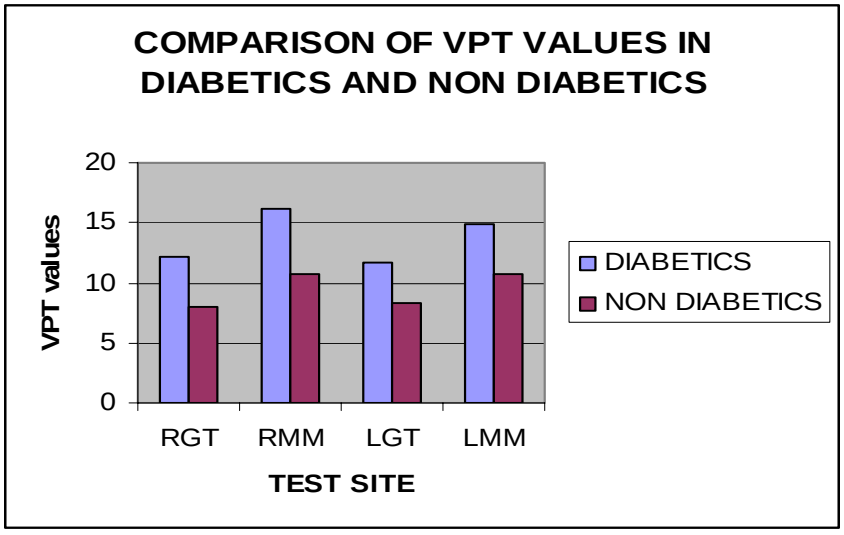
Test site	Diabetics		Normal		P
	Mean	Standard deviation	Mean	Standard deviation	
Right great toe	12.2115	5.3991	8.0192	2.5857	<0.01
Right medial malleolus	16.2115	7.2662	10.7500	2.7502	<0.01
Left great toe	11.6346	4.9270	8.4038	3.1202	<0.01
Left medial malleolus	14.9615	6.7300	10.7692	3.3232	<0.01

TABLE NO: 2
COMPARISON OF VPT VALUES BETWEEN TWO SITES IN NON DIABETIC INDIVIDUALS
(Paired 't' test)

Test sites	mean	Standard deviation	P value
Right great toe vs. right medial malleolus	8.0192	2.5857	0.000
	10.7500	2.7502	
Left great toe vs. left medial malleolus	8.4038	3.1202	0.000
	10.7692	3.3232	
Right great toe vs. Left great toe	8.0912	2.5857	0.000
	8.4038	3.1202	
right medial malleolus vs. left medial malleolus	10.7500	2.7502	0.000
	10.7692	3.3232	

TABLE NO: 3
COMPARISON OF VPT VALUES BETWEEN TWO SITES IN DIABETIC INDIVIDUALS
(Paired "t" test)

Test sites	mean	Standard deviation	P value
Right great toe vs. right medial malleolus	12.2115	5.3991	0.000
	16.2115	7.2662	
Left great toe vs. left medial malleolus	11.6346	4.9270	0.000
	14.9615	6.7300	
Right great toe vs. Left great toe	12.2115	5.3991	0.000
	11.6346	4.9270	
right medial malleolus vs. left medial malleolus	116.2115	7.2662	0.000
	14.9615	6.7300	



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