

Accuracy Of Vibration Test And Monofilament Examination Against Biothesiometer Test For The Identification Of Diabetic Peripheral Neuropathy Among Diabetic Patients

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Abstract: Diabetic peripheral neuropathy (DPN) has been identified as a key pathophysiologic precursor leading to diabetic foot ulcers, infections and subsequent lower extremity amputations. It is known to affect most diabetic patients and its progression is thought to be directly proportional to the duration and severity of the disease. The importance of prompt diagnosis of DPN and implementation of preventive strategies designated to reduce complications leading to limb loss has been recognized as an essential element in the care of patients with diabetes. So, it is very important to identify the complications of diabetes as early as possible. The present study was aimed to evaluate the accuracy of vibration test and monofilament examination against biothesiometer test for the identification of diabetic peripheral neuropathy among diabetic patients. The objectives were to assess DPN among diabetic patients by using vibration test and monofilament examination, evaluate the accuracy of both vibration test and monofilament examination. Through convenience sampling technique 60 diabetic patients who are undergoing biothesiometer test were selected for the study from Little Flower Hospital and Research Centre, Angamaly. The tool consisted of demographic proforma, 128 Hz tuning fork and Semmes-Weinstein 10 gm monofilament. The collected data were analyzed using descriptive and inferential statistics. The result showed that accuracy of vibration test was 84% and that of monofilament was 78%. Hence the study concluded that vibration test is more accurate than monofilament examination for identifying diabetic peripheral neuropathy among diabetic patients.

Keywords: Accuracy; Vibration test; Monofilament examination; Biothesiometer test; Diabetic peripheral neuropathy; Diabetic patients

I. INTRODUCTION

Diabetes has become one of the largest global health-care problems of the 21st century with 371 million people diagnosed with diabetes mellitus worldwide and a prevalence of 8.3% as per the Diabetes Atlas 2012. There are more than 3 million people diagnosed by DM, which unfortunately increases three times every 15 years. Diabetes is an important public health problem among one of four priority non-communicable diseases (NCDs) targeted for action by world leaders. Both the number of cases and the prevalence of diabetes have been steadily increasing over the past few decades.

Kerala is the diabetic capital of India with a prevalence of diabetic mellitus as high as 20% double the national average of 8%. In 2020, about 73000 (60%) of non-traumatic lower limb amputations were performed in adults aged 20 years or older with diagnosed diabetes mellitus.

Diabetic neuropathy is one of the most common complications of DM which has a lifetime prevalence of approximately 50% can cause motor/sensory dysfunction in diabetic patient. Peripheral sensory neuropathy is one of the strongest factors associated with the development of foot ulcers, amputations, Charcot Arthropathy, and other foot complications. Amputation is another severe complication of diabetes, which is preceded by a foot ulcer

Diabetic neuropathy complications include severe pain, loss of sensation, foot ulceration and amputation, burns, infection, cellulites, sleep disorder, impaired daily functioning, mood disorders, gangrene, involvement of different systems such as cardiovascular, gastrointestinal and reproductive systems. These complications, especially ulcer and amputation, affect the quality of patients' life, which in turn leads to repeated hospitalizations and increased health care costs.

Nerve conduction test is an effective method for diagnosing peripheral neuropathy but this method is time consuming and expensive. Many other alternative methods for screening diabetic peripheral neuropathy in patient with diabetes are available.

Nurses, by using simple bed side screening methods like tuning fork and monofilament examination can identify the risk of diabetic peripheral neuropathy and can prevent the formation of foot ulcer and amputation (such as the use of appropriate footwear, more precise control of blood sugar and fat, the monthly check of the incidence of neuropathy and increased blood sugar, and the use of walker) to those at risk of neuropathy. In other words, teaching patients about use of such simple test at home not only prevents from the complications, but also is a high motivational factor for patients in order to better control their blood sugar levels. It also reduces psychological problems followed by an early diagnosis of diabetic peripheral neuropathy in susceptible patients alongside increasing in patients' quality of life. Hence the researcher felt that it is paramount importance to evaluate these two tests and can be used as a simple bedside diagnostic tool for early detection of diabetic peripheral neuropathy among diabetic patients.

II. METHODOLOGY

RESEARCH DESIGN

A descriptive design was adopted for the present study.

SETTING OF THE STUDY

The study was conducted in the biothesiometer clinic of Little Flower Hospital and Research Centre, Angamaly. It works from Monday to Saturday. An average of 30 patients undergoes biothesiometer test monthly on in-patient as well as outpatient basis.

POPULATION

In this study, diabetic patients in L.F hospital were considered as population.

SAMPLE AND SAMPLING TECHNIQUE

Sample consist of sixty diabetic patients who are undergoing biothesiometer test in L.F hospital.

Convenient sampling was adopted.

INCLUSION CRITERIA

- ✓ Patients attending diabetic clinic with unknown neuropathy status.
- ✓ Patients referred to the biothesiometer test for suspected neuropathy.

TOOL/INSTRUMENTS

The tool was prepared based on the objectives of the study, which included:

- ✓ Demographic proforma of diabetic patients undergoing biothesiometer test
- ✓ 128 Hz tuning fork for vibration test
- ✓ Semmes-Weinstein 10 gm monofilament for monofilament examination

RELIABILITY OF THE TOOL

Reliability of the tool was found out by inter-rater reliability.

Reliability testing of tuning fork. r value was 0.67 for tuning fork.

Reliability testing of monofilament. r value was 0.83. It indicates there is a positive correlation between the findings of two judges.

This indicated that indicates both the tools are reliable. Bot instruments are standardized.

DATA ANALYSIS

In this study, Semmes-Weinstein 10 gm monofilament and tuning fork at various points of the right and left leg of diabetic patients. It is found that the sensitivity and specificity of the vibration test was 85 %, 79 % respectively. The sensitivity and specificity of the monofilament was 75 % and 92 % respectively. The accuracy of the vibration test and monofilament was 84%, and 78% respectively. The accuracy is more for vibration test than the monofilament. Thus according to the obtained results, vibration test is found to be effective.

III. DISCUSSION

The findings were discussed in terms of objectives and assumptions of the study and in comparison, with other study findings.

The study result showed that more than half (59.17%) of the subjects have been identified as positive for DPN by vibration test. The findings of the study are consistent with the cross-sectional study conducted by Dipika B, Kapil G, Harini M Hari P, Ramya N, Anil B on prevalence and risk factors of development of peripheral diabetic neuropathy in type 2 diabetes mellitus in a tertiary care setting. The higher prevalence was observed in KDM compared with NDDM (33.7%) vs 9.2%. Prevalence of mild, moderate, and severe neuropathies was 8.06, 14.55 and 6.63%, respectively. Regression analysis showed age ($p < 0.001$), duration of diabetes ($p < 0.001$), dyslipidemia ($p = 0.03$), glycated

hemoglobin ($p < 0.001$), the presence of other micro vascular complications ($p < 0.001$), macro vascular complications ($p = 0.003$) and alcoholic status ($p < 0.033$) to be associated. No sex-specific differences were observed in the mean age at diagnosis of diabetes, mean age at the diagnosis of neuropathy, and duration taken for DPN development among females and males.

Study assessed diabetic peripheral neuropathy among diabetic patients using Semmes-Weinstein 10 gm monofilament. The study result showed that more than seventy two percent (72.5%) of the subjects are found to be negative for DPN by monofilament examination.

A cross-sectional study was to investigate the prevalence and correlates of diabetic peripheral neuropathy (DPN) in a Saudi population. By Dong D, Balkees A, Frank B, Hasan A.

The study population consisted of 552 diabetic participants with an average age of 53.4 years. Among this population, 62.7% were male and 94.9% had type 2 diabetes. Result showed that the prevalence of DPN in this population was 19.9% (95% CI, 16.7%-23.5%).

Another objective of the study was to evaluate the accuracy of vibration test for the identification of diabetic peripheral neuropathy among diabetic patients. The present study result showed that vibration test using 128 Hz tuning fork is more accurate than the monofilament examination for the identification of diabetic peripheral neuropathy among diabetic patients.

Study evaluated the accuracy of monofilament examination for the identification of diabetic peripheral neuropathy among diabetic patients. The study findings showed that monofilament is not much accurate as vibration test in detecting diabetic peripheral neuropathy among diabetic patients.

The above finding was supported by a study on The Semmes Weinstein monofilament examination as a screening tool for diabetic peripheral neuropathy by Yuzhe F, Felix J, Bauer J. Of the 764 studies identified, 30 articles were selected, involving 8365 patients. There was great variation in both the reference test and the methodology of SWME. However, current literature suggests that nerve conduction study (NCS) is the gold standard for diagnosing DPN. Four studies were identified which directly compared SWME with NCS and encompassed 1065 patients with, and 52 patients without diabetes mellitus. SWME had a sensitivity ranging from 57% to 93%, specificity ranging from 75% to 100%, positive predictive value (PPV) ranging from 84% to 100%, and negative predictive value (NPV) ranging from 36% to 94%. It is concluded that there is great variation in the current literature regarding the diagnostic value of SWME as a result of different methodologies.

IV. FINDINGS

DESCRIPTION OF DEMOGRAPHIC VARIABLES OF DIABETIC PATIENTS UNDERGOING BIOTHESIOMETER TEST

This section deals with the demographic variables of diabetic patients who undergone biothesiometer test which includes age, gender, and duration of diabetes.

Majority of the samples belongs to the age group of 41-60 years and 40% of patients have diabetes since 11-15 years

FREQUENCY AND PERCENTAGE DISTRIBUTION OF DIABETIC PATIENTS BASED ON THE PRESENCE OR ABSENCE OF DPN USING BIOTHESIOMETER TEST, VIBRATION TEST AND MONOFILAMENT EXAMINATION

This section depicts the frequency and percentage distribution of diabetic patients affected with diabetic peripheral neuropathy by biothesiometer test, vibration test, and monofilament examination.

For the purpose of this study, each foot was treated as a single statistical element. This was deemed appropriate because some patients may have had normal test results on one foot and abnormal results on the other.

DPN	Biothesiometer test		Vibration test		Monofilament examination	
	Frequency (f)	Percentage (%)	Frequency (f)	Percentage (%)	Frequency (f)	Percentage (%)
Both legs	102	85	26	21.67	5	4.17
Single leg	0	0	45	37.5	28	23.33
Not Developed	18	15	49	40.83	87	72.5

Table 3: Frequency and percentage distribution of diabetic peripheral neuropathy development among diabetic patients

Table 3 shows that, on biothesiometer test, majority 102 (85%) of diabetic patients are found to be affected with diabetic peripheral neuropathy on both legs where as on vibration test 26 (21.67%) are found to be affected with diabetic peripheral neuropathy on both legs. In monofilament examination 87 (72.5%) of them are found to be unaffected.

ACCURACY OF VIBRATION TEST AND MONOFILAMENT EXAMINATION

This section describes the sensitivity, specificity, PPV, NPV, and accuracy of vibration test and monofilament examination

	Sensitivity (%)	Specificity (%)	PPV* (%)	NPV* (%)	Accuracy
Vibration test	85	79	61	20	84
Monofilament examination	75	92	25	10	78

*PPV: Positive Predictive Value

**NPV: Negative Predictive Value

Table 4: This table depicts the accuracy of vibration test and monofilament examination

Table 7 shows that accuracy of vibration test is 84 % and that of monofilament is 78 %. It indicates vibration test is more accurate for identifying diabetic peripheral neuropathy than monofilament examination.

V. CONCLUSION

The study was on accuracy of vibration test and monofilament examination against biothesiometer test for the identification of diabetic peripheral neuropathy among diabetic patients in Little Flower Hospital and Research Centre, Angamaly. In the present study, the sample was 60 diabetic patients who undergone biothesiometer test. The investigator evaluated the accuracy of vibration test using 128 Hz tuning fork and monofilament examination was assessed using Semmes-Weinstein 10 gm monofilament. In this study, it was found that majority of the subjects (85%) have been found to be affected with DPN by biothesiometer test. More than half (59.17%) of the subjects have been identified as positive for DPN by vibration test. More than seventy two percent (72.5%) of the subjects are found to be negative for DPN by monofilament examination. Accuracy of vibration test and monofilament examination was found out by sensitivity, specificity, and prevalence of the disease. Sensitivity and specificity of vibration test was 85% and 79% respectively. Sensitivity and specificity of monofilament examination was 75% and 92% respectively. Accuracy of vibration test was 84%. Accuracy of monofilament examination was 78%. From the study result it is concluded that vibration test is more accurate than monofilament examination for the identification of diabetic peripheral neuropathy among diabetic patients. The study has implication in nursing education, nursing practice, nursing administration and nursing research. The study has various recommendations like;

- ✓ It can be conducted in large samples to obtain more accurate results.
- ✓ More instruments other than tuning fork and monofilament can be checked for the early identification of DPN
- ✓ Develop further research and meta- analysis on the same study.

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