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A Comparative Study of Various Bedside Methods in Detection of Diabetic Polyneuropathy in Type 2 Diabetes Patients.

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ABSTRACT

The present study has evaluated the utility of bed side methods in the diagnosis of Diabetic Polyneuropathy and its effectiveness in preventing lower leg amputations. 285 million persons worldwide have diabetes, of these 51 million are in India. Diabetic peripheral neuropathy is a major micro vascular complication of diabetes. Conventional methods used for the diagnosis of diabetic peripheral neuropathy in clinical practice have limited effectiveness. Since peripheral sensory neuropathy is a pivotal element in the causal pathway to both foot ulceration and amputation, screening and early identification of neuropathy offer a crucial opportunity for the patient with diabetes to actively modulate the course of suboptimal glycaemic control to currently recommended targets, and to implement improved foot care before the onset of significant morbidity.

Keywords: diabetic polyneuropathy, diabetes, DPN.

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INTRODUCTION

Diabetic Poly neuropathy (DPN) is the most common of the heterogeneous group of diabetic neuropathies and contributes to 50 to 70% of non-traumatic amputations. Lower extremity disease, including peripheral neuropathy, foot ulceration, peripheral arterial disease, or lower extremity amputation, is twice as common in diabetic persons compared with non-diabetic persons and it affects 30 per cent of diabetic persons who are older than 40 yrs. Diabetic Neuropathy (DN) develops in about 4-10% of diabetic patients after 5 years and in 15% after 20 years [1-3].

Screening for diabetic poly neuropathy improves foot care and prevents morbidity. Current level of evidence for optimal screening method is limited. Many advances have taken place in the detection of DPN with respect to examination scores, electrophysiological techniques and quantitative sensory testing. A consensus indicates the need for abnormalities in at least two of five possible modalities to make the diagnosis for research purposes [4].

AIM AND OBJECTIVE

This study was carried out to evaluate the usefulness of simple bed side screening modalities for peripheral neuropathy like vibration perception threshold measurement with bio the siometer, 10g semmes-weinstein monofilament, diabetic neuropathy examination and symptom scores and ankle reflex testing in patients with diabetes mellitus and to seek an optimal screening method in diabetic clinic.

MATERIALS AND METHODS

Subjects included 100 consecutive patients with Type 2 diabetes. Patients were excluded from the study if they had other causes of neuropathy such as alcoholism, liver or renal disease, toxic exposure, other endocrine, metabolic or nutritional disorders, inflammatory diseases, or monoclonal gammopathy. Age, gender, duration of diabetes and history of foot ulceration were recorded. Blood glucose, serum creatinine, routine biochemical and hematological tests, and glycol sylated hemoglobin were done in all the subjects. All 100 patients were subjected to:

1. Diabetic Neuropathy Symptom Score
2. Diabetic Neuropathy Examination Score
3. Semmes-Weinstein monofilament examination
4. Vibration Perception Threshold

The DNE, DNS scores and monofilament test results were compared against vibration perception thresholds which are taken as a gold standard and the data analyzed.

Diabetic neuropathy symptom score:

All subjects were questioned regarding the presence or otherwise of symptoms, either positive or negative suggesting the presence of neuropathy. The questionnaire was the Diabetic Neuropathy Symptom DNS Score (5) adopted from the Neuropathy Symptom Score (NSS) of Dyck (6).

Diabetic neuropathy symptom Score:

The questions should be answered ‘yes’ (positive: 1 point) if a symptom occurred more times a week during the last 2 weeks or ‘no’ (negative: No point) if it did not.

1. Symptoms of unsteadiness in walking?
2. Do you have a burning, aching pain or tenderness of your legs or feet?
3. Do you have pricking sensations at your legs and feet?
4. Do you have places of numbness on your legs or feet?

Maximum score: 4 points; 0 points- PNP absent; 1-4 points - PNP present
(PNP = Poly neuropathy)

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Diabetic neuropathy examination score:

A thorough neurological examination was carried out and the neurological signs were scored following a DNE score, which is a modification of the Neuropathy Disability Score of Dyck [6]. The DNE score consists of eight items, two testing muscle strength, one a tendon reflex, and five sensations. The maximum score is 16. A score of >3 points is considered abnormal.

Muscle strength:

1. Quadriceps femoris: Extension of the knee
2. Tibialis Anterior: Dorsiflexion of the foot Reflex
3. Ankle reflex
4. Sensation: Index finger
5. Sensitivity to pinpricks
6. Sensation: Big toe
7. Sensitivity to pinpricks
8. Sensitivity to touch
9. Vibration perception
10. Sensitivity to joint position

Only the right leg and foot are tested.

If right leg is amputated, then left leg is tested.

Scoring from 0 to 2
0 = Normal
1 = Mild/moderate deficit
Muscle strength: MRC scale 3-4
Reflex: Decreased but present
Sensation: Decreased but present
2 = severely disturbed/absent
Muscle strength: MRC scale 0-2
Reflex: Absent
Sensation: Absent
Maximum score: 16 points

A score of > 3 indicates presence of polyneuropathy.

Semmes-Weinstein monofilament examination:

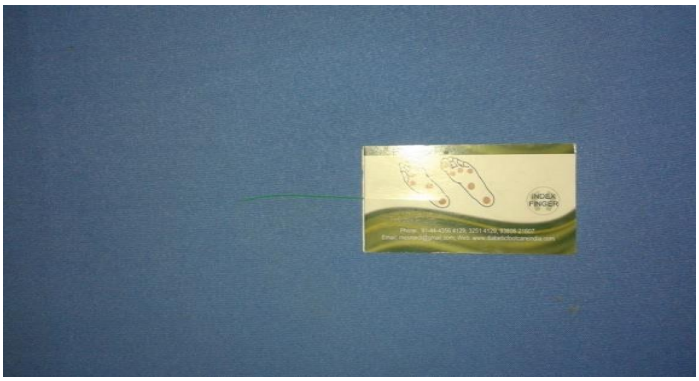

Figure 1: The Monofilament Used

Light touch/pressure perception was assessed using a 10 g monofilament. These were applied on both feet on the plantar surface of the hallux and centrally at the heel. The end of the filament was pressed on

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the plantar surface of the hallux and centrally at the heel with enough pressure to cause the monofilament to buckle. This was done six times at each point and the participant was blinded to the application of the monofilament during testing [7]. A 'yes-no' method was used, meaning that the patient says yes each time he/she senses the application of a monofilament. The ability to correctly sense the monofilament in six trials on both locations was defined as normal, whereas the inability to sense the monofilament correctly in one or more trials was defined as disturbed.fig (1, 2)

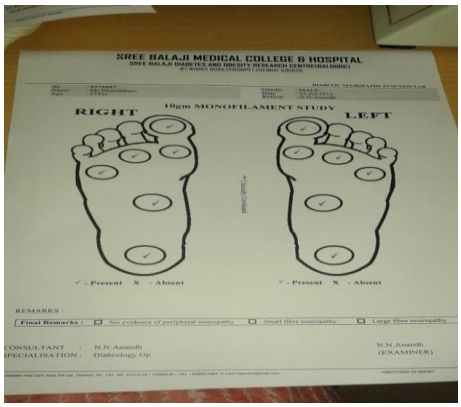

Figure 2: The evaluation sheet of monofilament test

Vibration perception threshold:

Figure 3: The VPT test done

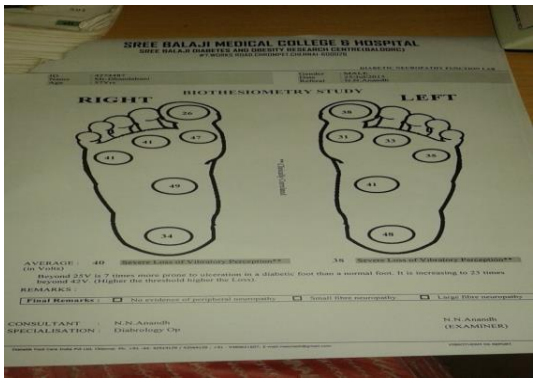

Figure 4: Evaluation report of VPT

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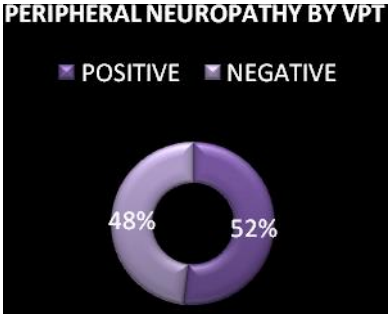
VPT was tested using a hand-held biothesiometer. After explaining the procedure, the button is applied to various parts of both the feet with the patient relaxed, in the supine position in a quiet room. The vibration is increased gradually from the minimum voltage and the transition from no vibration to the onset of perceiving vibration is taken as VPT. The Yes/No method is used. The VPT is tested on six areas on the plantar aspect of both feet- the hallux, the first metatarsal head, the third metatarsal head, the fifth metatarsal head, the instep and the heel. An average of all the areas tested is taken as the VPT of the subject. The voltage is gradually increased until the patient senses the vibration by the Yes or No. The VPT is measured in volts. In the present study, a voltage of more than 15 V was taken as presence of neuropathy. (4) (fig 3, 4)

RESULTS

Out of 100 patients taken for the study, 75 were females representing 75% of the study group and 25 were males representing 25% of the study group. The prevalence of peripheral neuropathy was 52 percent based on vibration perception threshold (VPT) with the biothesiometer. When compared with VPT, ankle reflex was the most sensitive (84.56%) but had a poor specificity (50.29%). The monofilament examination had lower sensitivity (73%) but better specificity (89.56%) and accuracy (80%). DNE and DNS Scores had a sensitivity of 78.77% and 82.60% with a specificity of 85.42 and 43.75% respectively. Significant correlations were observed between the VPT score and the DNE(r = 0.654, P =.000) and DNS (r = 0.312, P =.002) scores, monofilament sensation (r = 0.650, P =.000) and ankle reflex (r = 0.475, P =.000).(CHART1), (BAR DIAGRAM 1),(Table 1)

Graph 1



Bar diagram 1

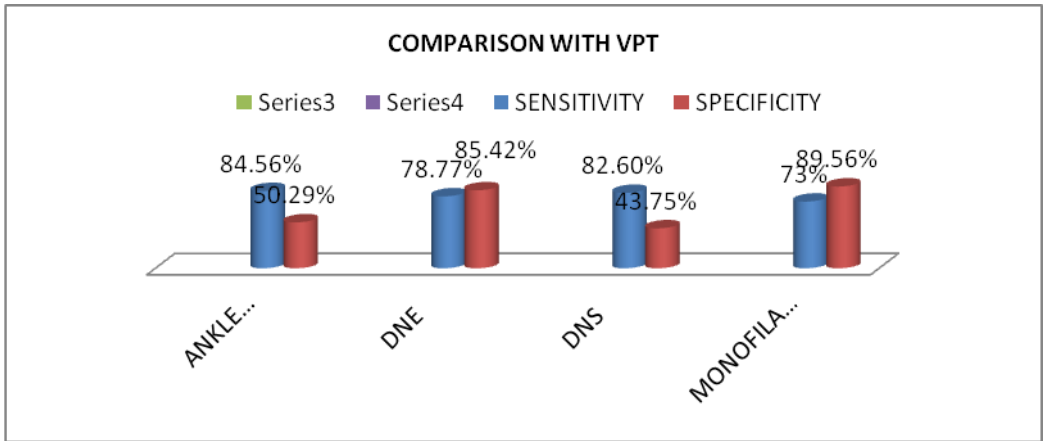


Table 1: Significant correlations were observed between the VPT score

Correlation with VPT	R value	P value
DNE	0.654	.000
DNS	0.312	.002
Monofilament	0.650	.000
Ankle reflex	0.475	.000

DISCUSSION

The present study has used VPT of > 25 mV as the standard for the diagnosis of neuropathy and the prevalence of peripheral neuropathy was 52 per cent. VPT is considered as a gold standard for diagnosis of diabetic peripheral neuropathy. The measurement of vibration perception using a biothesiometer is a long-established method of screening diabetic patients for neuropathy [3]. A raised VPT has been found in diabetic patients with foot ulceration compared with nondiabetic and diabetic patients without foot ulcers4. VPTs are regularly measured in diabetic patients attending hospital clinics and have been shown to equate with clinical scoring systems of neuropathy [5,9]. Many studies have taken VPT as a gold standard, comparing SWME, and clinical examination with VPT. The use of VPT for the diagnosis of neuropathy has been well validated by clinical studies with a sensitivity and specificity of 80 and 98 per cent respectively [10]. This is further substantiated by large epidemiological prospective studies showing that a VPT more than 25 mV had a sensitivity of 83 per cent, a specificity of 63 per cent, a positive likelihood ratio of 2.2 (95% CI, 1.8-2.5), and a negative likelihood ratio of 0.27 (95% CI, 0.14-0.48) for predicting a foot ulceration over 4 years(11).Nasseri K and co-workers compared the reproducibility of nerve conduction studies and VPT and concluded that both NCS and VPT are reproducible methods to assess diabetic neuropathy. Since peripheral sensory neuropathy is a pivotal element in the causal pathway to both foot ulceration and amputation, selecting a quick, inexpensive, and accurate instrument to evaluate the high-risk patient is essential to make decisions. So, apart from VPT, we also assessed monofilament, ankle reflex, the DNS and DNE scores for evaluation of peripheral neuropathy. Sensitivity and specificity of the DNE and DNS scores, SWME and ankle reflex were calculated, taking VPT as gold standard. 52 of 100 subjects had neuropathy confirmed by VPT, while 48 did not have neuropathy. The DNE and DNS scores gave a sensitivity of 78.77 and 82.60% with a specificity of 85.42% and 43.75% respectively. The sensitivity of SWME was 73% and specificity was 89.56%. Ankle reflex yielded a sensitivity of 84.56% and a specificity of 50.29%. The present study showed significant correlations between the VPT score and the DNE ($r = 0.661$, $P<0.001$) and DNS ($r = 0.312$, $P = 0.002$) scores, monofilament sensation ($r= 0.650$; $P<0.001$) and ankle reflex ($r = 0.654$, $P<0.001$). The findings are similar to a study conducted by Jaya prakash et al in 2011 in which the prevalence of peripheral neuropathy was 34.9% with VPT as measured with biothesiometer and significant correlations were observed between the VPT score and the DNE ($r = 0.532$, $P<0.001$), monofilament sensation ($r= 0.573$; $P<0.001$) and ankle reflex ($r = 0.377$, $P= 0.01$)9.Our study agrees with this study [11]. Similarly, Mythili A et al in 2010 in a comparative study assessed hundred consecutive patients with type 2 diabetes. Sensitivity and specificity of for the DNE, SWME and VPT were calculated, taking NCS as gold standard. 71 of 100 subjects had neuropathy confirmed by NCS, while 29 did not have neuropathy. The DNE score gave a sensitivity of 83% and a specificity of 79%. The sensitivity of SWME was 98.5% and specificity was 55%. VPT yielded a sensitivity of 86% and a specificity of 76%. The study concluded that a simple neurological examination score is as good as VPT in evaluation of poly neuropathy in a diabetic clinic. It may be a better screening tool for diagnosis of diabetic poly neuropathy in view of the cost effectiveness and ease of applicability [12]. The findings were very similar to our study.

CONCLUSION AND INTERPRETATION

The present study concludes that peripheral neuropathy is a common complication of type 2 diabetes mellitus with an insidious and often irreversible progression leading to foot ulceration and amputation. The severity of the disease is further aggravated by older age and duration of diabetes. Thus early and comprehensive neurological investigations for screening and early diagnosis of peripheral neuropathy in patients with diabetes are warranted. This stresses the need and the usefulness of various bedside methods like a simple clinical examination score, ankle reflex and monofilament testing which are simple, quick, easy to perform, accurate and are inexpensive and correlate well with the biothesiometer which requires expensive equipment.

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