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Original Research Article

Burden of diabetic peripheral neuropathy in a rural demography of India is revealed by biothesiometry: a reliable screening tool

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ABSTRACT

Background: Diabetes mellitus (DM) is the most prevalent non-communicable disease in the world estimated to be 4.4% in 2030 globally. Among its complications, diabetic peripheral neuropathy (DPN) is the common disorder manifested as 'glove and stocking sensation' in the lower extremities. Aim to study the prevalence and to grade DPN in patients attending OPD.
Methods: Patients coming to the general surgery and plastic surgery outpatient department were selected. A total of 331 patients will be asked history by a simple questionnaire and symptoms are graded by modified neuropathy symptom score (MNSS) and clinical examination are done and graded by diabetic neuropathy examination (DNE) and vibration perception threshold (VPT) is measured by biothesiometry.
Results: Among the DPN patients, 57.40% are asymptomatic and 12.08% are having severe symptoms by MNDS score and about 27.49% having increased risk for pronation for foot ulcer by DNE score and about 43.2% having risk for foot ulcer by biothesiometry average from the most common site for loss of sensation involving over 1st, 3rd, 5th metatarsal head to the least involved site as midfoot.
Conclusions: This study reveals the impact of DPN in a rural area, so by implementing this type of screening method reduces the development of foot ulcers by about 60% in asymptomatic patients and leg amputations by 85% in patients with severe stage of DPN with proper foot care.

Keywords: Diabetic peripheral neuropathy, Diabetic foot ulcer, Biothesiometry

INTRODUCTION

Diabetes is one of the largest global public health concerns, imposing a heavy global burden on public health as well as socio-economic development. Although incidence has started to decrease in some countries, the prevalence of diabetes has increased in recent decades in most other developed and developing countries. DM is the most prevalent non-communicable disease in the world estimated to be 4.4% in 2030 globally, which leads to epidemic of its complications such as diabetic neuropathy, diabetic nephropathy, diabetic angiopathy. diabetic foot problems are commonly related to deformity, infection and ischaemia. DPN leads to changes in foot shape and deformity, all of which can increase the mechanical stress imposed on the foot. The combination of loss of protective sensation and elevated mechanical stress leads to tissue damage with the development of neuropathic diabetic foot ulcers (DFU) and a self-perpetuating cycle culminating with the development of Charcot neuroarthropathy (CN).[4] The combination of lack of protective sensation and delayed

presentation typical of this group of patients makes management more complex. Pressure ulcers are common complications in patients with peripheral neuropathy. Most peripheral neuropathy nowadays is related to DM, and can be found in up to 67% of patients with type 2 DM.[1] The annual incidence of ulcers in patients with DM is about 2% with global prevalence of DFU as high as 6.3% and ulcers having been implicated as a causative factor in up to 84% of diabetic foot amputations.[2,3] In the presence of sensory neuropathy and lack of protective sensation, an ulcer can develop in a foot with normal anatomy as result of an acute injury. But more frequently, abnormal pressure develops because of an anatomical deformity in the foot, frequently resulting from long standing muscular imbalance related to the neuropathy itself, even though this relationship is not straightforward.[7]

Although there are many possible causes of peripheral neuropathy, the most prevalent subtype, DPN can lead to significant complications ranging from paresthesia to loss of limb and life. Early assessment of symptoms of peripheral polyneuropathy helps avoid neuropathic foot ulcers to combat potential morbidity and mortality resulting from the pathophysiologic poor wound healing potential, which can lead to limb compromise, local to systemic infection, septicemia, and even death. DPN is primarily diagnosed clinically through history and neurological assessment of small fiber sensation with temperature changes or pinpricks, large fiber sensation with vibrations, and ulceration risk with pressure testing using a 10 g monofilament. Neurology consultation and specialized testing, including nerve conduction studies and intraepidermal nerve fiber density testing, are only indicated for patients with atypical clinical features (e.g., rapid symptom onset, severe neuromotor impairment, and asymmetrically abnormal sensation).

The exact cause of DPN is not known. Proposed theories include metabolic, neurovascular, and autoimmune pathways have been proposed. Mechanical compression (e.g., carpal tunnel), genetics, and social and lifestyle factors such as chronic alcohol consumption and smoking have all been implicated. Perpetually high blood serum glucose leads to insulin resistance, promoting oxidative stress, inflammation, and cell damage. First, the distal sensory and autonomic nerve fibers are damaged; the damage continues with proximal progression, leading to a gradual loss of protective sensation in the skin and foot joints. DPN management consists of several strategies, including preventative measures (e.g., patient education, proper foot care, correct shoe wear, and annual foot exam), glucose control, dietary modifications, weight loss, and pain control.

Half of the diabetic peripheral neuropathies may be asymmetric. If not recognized and preventative foot care is not implemented, patients have an increased risk of injury due to their insensate feet.

Aims and objectives

Aim and objectives were to study the prevalence and to grade DPN in patients attending OPD, to find the most common sites of loss of sensation in foot due to DPN and to predict the risk of pronation for diabetic foot ulcer in DPN.

Materials

Patients visiting the general surgery and plastic surgery outpatient department in government Villupuram medical college and hospital, Tamil Nadu, India were selected. A total of 331 diabetic patients who fulfilled the inclusion criteria were enrolled in this study. Written and informed consent was obtained from all of them.

All patients underwent detailed examinations according to the proforma approved by the institutional ethics committee of our institution.

Sample size

Sample size of the study was calculated based on the incidence of DPN which is 41% with a confidence interval of 95% and a margin of error of 3.5%, the estimated sample size is 331.

Study design

Study design was prospective observational study.

Place of study

Study conducted at government Villupuram medical college and hospital.

Duration of study

Study conducted from September 2022 to September 2023.

Study population

Diabetic patients visiting the general surgery and plastic surgery outpatient department in government Villupuram medical college and hospital, Tamil Nadu, India who met the inclusion criteria were enrolled.

Inclusion criteria

Patients of age 18-60 years, patients with type 1/ type II DM, patients with healed/old diabetic foot ulcer and with a palpable distal pulse of foot were included.

Exclusion criteria

Patients more than 60 years of age, peripheral vascular disease, patients with active diabetic foot ulcer, patients

having known neurological disorders due to vitamin deficiencies, hereditary neuropathy disorders etc were excluded.

METHODS

All patients fulfilling the inclusion criteria were selected and history was elicited by a simple questionnaire. Their symptoms were graded by MNSS which ranges from asymptomatic with score (0-2) to severe stage (7-10). Further, clinical examination done and findings were graded by DNE score to predict the risk for pronation in patients having diabetic foot ulcer. Patients with a score greater than 3 are at higher risk of pronation of foot.

VPT is measured by biothesiometer as 0V-50V, where patients rested in supine position and are allowed to feel and familiarize with the vibration from the probe on their palms, then the probe is placed and VPT is measured on six points over each foot such as big toe, 1st metatarsal head, 3rd metatarsal head, 5th metatarsal head, midfoot and heel and with an average score of 15 or greater as diagnosed DPN and average score of greater than 25 have increased risk for pronation for foot ulcer.

MNSS

This is a questionnaire that assesses the presence and absence of neuropathy symptoms and assigns a score based on the number of symptoms present. Presence of a symptom gives a score of either 2 or 1 (as given below) absence gives a score of zero.

Hence, the total score is calculated to assess the severity of symptoms.

Symptomatology: lower leg/foot: Burning sensation-2, numbness-2, paraesthesia-2, feeling of weakness-1, cramps-1 and pain-1.

Localisation: Feet-2, lower leg-1 and elsewhere-0.

Exacerbation: Present at night-2, present during day and night-1, present only during day-0 and patient is awakened by the symptoms-1.

Symptoms improvement when **w**alking-2, standing-1 and sitting or lying down-0.

Interpretation: Normal-1-2, mild symptoms-3-4, moderate symptoms-5-6 and severe symptoms-7-10.

DNE score

The patients are examined further for their muscle power, reflexes and various sensations such as touch, pin prick, vibration perception and joint position.

Muscle strength: Quadriceps femoris-extension on knee and tibialis anterior-dorsiflexion of foot.

Reflex: Ankle reflex

Sensation in index finger: Sensitivity to pin prick

Sensation in big toe: Sensitivity to pin prick, sensitivity to touch, sensitivity to joint position and vibration perception

Only the right limb is tested. Scoring is from 0-2, 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.

Interpretation: <3-no risk of pronation, >3-risk of pronation, (Clinical diagnosis of distal diabetic polyneuropathy by neurological examination scores).

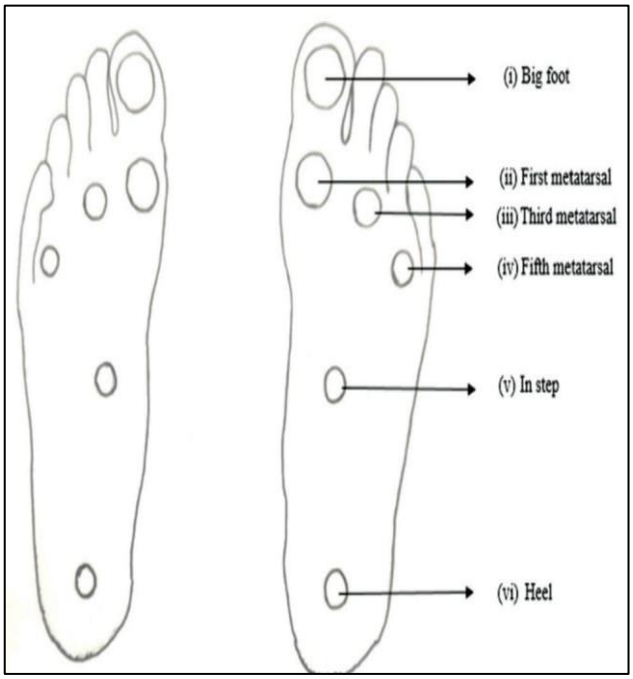

Figure 1: Biothesiometry-VPT.[32]

<15v-normal, 15-20v-grade I, 21-25v-grade II and 26-30v-grade III, grade III has increased risk of ulcer formation.

Data were entered in Microsoft excel and analysed using SPSS software version 24.

RESULTS

In 331 patients, 190 patients (57.40%) are asymptomatic and 40 patients (12.08%) are having severe symptoms by MNSS score (Table 1).

In 331 patients, by DNE Score, 91 patients (27.49%) are at risk of developing foot ulcers (Table 1).

In 331 patients, by biothesiometry, 143 patients (43.2%) are at risk of developing foot ulcers (Table 1).

By this, about 39.88% patients in right and 38.97% patients in left foot have increased threshold of perception over ball of great toe, thereby increasing the risk of ulceration over ball of great toe (Table 2).

By this, about 37.74% patients in right and 35.64% patients in left foot have increased threshold of perception over first metatarsal head, thereby increasing the risk of ulceration over first metatarsal head (Table 3).

By this, about 36.25% patients in right and 32.02% patients in left foot have increased threshold of perception over 3rd metatarsal head, thereby increasing the risk of ulceration over 3rd metatarsal head (Table 4).

By this, about 31.11% patients in right and 33.53% patients in left foot have increased threshold of perception over 5th metatarsal head, thereby increasing the risk of ulceration over 5th metatarsal (Table 5).

By this, about 24.47% patients in right and 29.90% patients in left foot have increased threshold of perception over mid foot, thereby increasing the risk of ulceration over mid foot (Table 6).

By this, about 29.60% patients in right and 29.90% patients in left foot have increased threshold of perception over hind foot, thereby increasing the risk of ulceration over hind foot (Table 7).

By this, around 80 ulcers (96.38% of total old ulcers) have been seen in about 125 severe diabetic neuropathic patients (37.76%) who fall under the category of severe diabetic neuropathy by biothesiometry in the left foot. Among 331 patients, around 41 severe diabetic neuropathic patients with old ulcers (12.38%) have increased risk of recurrence of a new ulcer in left foot (Table 8).

Table 1: MNSS scoring analysis among patients, (n=331).

MNSS score	N (%)	Frequency of risk of ulcer by DNE score (>3 score), total=91 (%)	Frequency of risk of ulcer by biothesiometry (grade II- >25V), total=143 (%)
Normal (1-2)	190 (57.4)	9 (4.7)	38 (20)
Mild symptoms (3-4)	47 (14.2)	14 (29.7)	22 (46.8)
Moderate symptoms (5-6)	54 (16.3)	35 (64.8)	44 (81.4)
Severe symptoms (7-10)	40 (12.1%)	33 (82)	39 (97.5)

Table 2: VPT in ball of great toe.

VPT (in volts)	Right ball of great toe frequency	Percentage (%)	Left ball of great toe frequency	Percentage (%)
<15	90	27.2	96	29
15-20	47	14.2	45	13.6
21-25	62	18.7	61	18.4
26-30	132	39.9	129	39
Total	331	100	331	100

Table 3: VPT in first metatarsal head.

VPT (in volts)	Right 1st metatarsal frequency	Percentage (%)	Left 1st metatarsal frequency	Percentage (%)
<15	94	28.4	98	29.6
15-20	46	13.9	46	13.9
21-25	76	23	69	20.8
26-30	115	34.7	118	35.6
Total	331	100	331	100

Table 4: VPT in 3rd metatarsal head.

VPT (in volts)	Right 3rd MT frequency	Percentage (%)	Left 3rd MT frequency	Percentage (%)
<15	95	28.7	98	29.6
15-20	48	14.5	54	16.3
21-25	68	20.5	73	22.1
26-30	120	36.3	106	32
Total	331	100	331	100

Table 5: VPT in 5th metatarsal head.

VPT (in volts)	Right 5th MT frequency	Percentage (%)	Left 5th MT frequency	Percentage (%)
<15	100	30.2	97	29.3
15-20	44	13.3	51	15.4
21-25	84	25.4	72	21.8
26-30	103	31.1	111	33.5
Total	331	100	331	100

Table 6: VPT in midfoot.

VPT (in volts)	Right MF frequency	Percentage (%)	Left MF frequency	Percentage (%)
<15	104	31.4	112	33.8
15-20	59	17.8	52	15.7
21-25	87	26.3	68	20.5
26-30	81	24.5	99	29.9
Total	331	100	331	100

Table 7: VPT in hindfoot.

VPT (in volts)	Right HF frequency	Percentage (%)	Left HF frequency	Percentage (%)
<15	93	28.1	96	29
15-20	56	16.9	58	17.5
21-25	84	25.4	78	23.6
26-30	98	29.6	99	29.9
Total	331	100	331	100

Table 8: Severity of DPN in left foot and frequency of old ulcers in each site of left foot.

Severity of DPN in left foot by biothesiometry	Frequency of old ulcers in left ball of toe	Frequency of old ulcers in left 1st metatarsal head	Frequency of old ulcers in left 3rd metatarsal head	Frequency of old ulcers in left 5th metatarsal head	Frequency of old ulcers in left midfoot	Frequency of old ulcers in left heel	Total
Asymptomatic (84 patients)	0	0	0	0	0	0	0
Mild DPN (45 patients)	0	1	0	0	0	0	1
Moderate DPN (77 patients)	1	1	0	0	0	0	2
Severe DPN (125 patients)	9	25	22	14	6	4	80
Total	10	27	22	14	6	4	83

Table 9: Severity of DPN in right foot and frequency of old ulcers in each site of left foot.

Severity of DPN in right foot by biothesiometry	Frequency of old ulcers in right ball of toe	Frequency of old ulcers in right 1st metatarsal head	Frequency of old ulcers in right 3rd metatarsal head	Frequency of old ulcers in right 5th metatarsal head	Frequency of old ulcers in right midfoot	Frequency of old ulcers in left heel	Total
Asymptomatic (73 patients)	0	0	0	0	0	0	0
Mild DPN (45 patients)	0	0	0	0	0	1	1
Moderate DPN (92 patients)	1	4	1	0	0	1	7

Continued.

Severity of DPN in right foot by biothesiometry	Frequency of old ulcers in right ball of toe	Frequency of old ulcers in right 1st metatarsal head	Frequency of old ulcers in right 3rd metatarsal head	Frequency of old ulcers in right 5th metatarsal head	Frequency of old ulcers in right midfoot	Frequency of old ulcers in left heel	Total
Severe DPN (121 patients)	7	14	8	11	7	8	55
Total	8	18	9	11	7	10	63

By this, around 55 old ulcers (87.30% of total old ulcers) have been seen in about 121 severe diabetic neuropathic patients (37.76%) who fall under the category of severe diabetic neuropathy by biothesiometry in right foot. Among 331 patients, around 29 severe diabetic severe neuropathic patients with old ulcers (8.76%) have increased risk of recurrence of a new ulcer in right foot (Table 9)

DISCUSSION

Diabetes is a serious chronic disease that significantly impacts the well-being of people worldwide. It is also one of the top ten causes of main death in adults, with an estimated four million deaths worldwide. The global diabetes prevalence reached 9.3% (463 million people) in 2019 and is expected to increase to 10.2% (578 million) by 2030 and 10.9% (700 million) by 2045. The increasing prevalence of diabetes has increased the incidence of chronic diabetic complications. The development of ulcer is a definitive marker of diabetic complications and financial burden.[28] Diabetic patients are 15 times more likely to be amputated than non-diabetic patients and diabetic patients of South Asian origin have less chances of getting amputated than from European origin.[29-31]

According to The San Antonio conference on diabetic neuropathy, it is recommended that in full classification of diabetic neuropathy at least one measure of each of the following categories is suggested such as neurological symptoms, clinical examination, quantitative sensory test, electrodiagnostic study, autonomic function test. In our study due to lack of feasibility in OPD setup in rural area, electrodiagnostic studies and autonomic function tests were not done and could not be assessed in diabetic patients.[18]

A study conducted by Barbano et al emphasised that absence of neurological symptoms in diabetic patients does not rule out diabetic polyneuropathy, around 50% of diabetic patients who are asymptomatic are still at a risk of diabetic foot ulcer.[17] In our study, Table 1, in about 331 patients, 190 patients (57.4%) are asymptomatic by MNSS scoring system among them 9 patients (4.7%) are at risk of developing diabetic foot ulcer by DNE clinical examination and 38 patients (20%) are at risk of developing foot ulcer by Biothesiometry as quantitative sensory test. Followed by in about 47 mild diabetic peripheral neuropathic patients by MNSS, 14 patients (29.7%) are at increased risk for diabetic foot ulcer by DNE score and 22 patients (46.8%) are at increased risk for diabetic foot ulcer by biothesiometry. Among 54 moderate diabetic peripheral neuropathic patients (16.3%) by MNSS, around 35 patients (64.8%) by DNE score and around 44 patients (81.4%) by biothesiometry are at increased risk of ulcer. Among 40 severe diabetic peripheral neuropathic patients by MNSS, 33 patients (82%) by DNE score and 39 patients (97.5%) by biothesiometry are at increased risk for diabetic foot ulcer. Hence, in regular screening for DFU in OPD setup, along with neurological symptom assessment like MNSS, clinical examination like DNE score and a quantitative sensory test by biothesiometry is required for early intervention in asymptomatic diabetic patients.

According to a study conducted by Meijer et al DNE as clinical examination is fast, easy to perform, hierarchical and sensitive for DPN. In this study, DNE was modified from NDS which is a widely accepted clinical examination, in the goal of attaining clinical examination score for distal symmetrical peripheral neuropathy. DNE has 8 items for examination, of those 8, two attributed to muscle strength, one attributed to reflex and five attributed to sensory functions which each item valued a score of 2 with total score 16 and measured only in the right limb. With a patient having an amputated right limb, examination is done in the left limb. In our study, DNE is preferred for clinical examination as it is easy and reliable in outpatient clinics.[19]

In a study conducted by Kamel et al in about 30 patients, 30% of them are prone to develop DFU by modified NDS score whose scores were 6 or greater.[20] In our study, Table 1, among 331 patients, 91 patients (27.3%) were at increased risk of developing ulcer by DNE score whose scores were 3 or greater.

In a study conducted by Asad et al showed DNE score have sensitivity of 18%, specificity of 100%, positive predictive value 100% and negative predictive value 40% when it was assessed against nerve conduction study, meaning DNE score is not effective for screening early stage of DPN.[21] As compared with our study, Table 1, DNE score predicted lower diabetic foot ulcer risk percent as 4.7% in asymptomatic diabetic neuropathic

patients compared with biothesiometry which predicted 20% of asymptomatic diabetic neuropathic patient having risk of foot ulcer. Hence, using biothesiometry as a screening tool significantly improves the early intervention for DFU in early stages of DPN.

Several studies have been implicated for early diagnosis of DPN in order to reduce complications and prevent foot ulceration and thereby amputations. Of those, in a study conducted in Kerala in 2018 attempts to measure the clinical, etiological outcomes of diabetic foot where it suggests, a large number of patients had a biothesiometry VPT in the severe range. This test can help to follow the patient to examine the course of risk. Age-corrected VPT measurements are objective, simple tests for use in clinical practice and are useful for predicting the risk of foot complications. The VPT measured by biothesiometer in patients attending outpatient clinics are comparable with clinical scoring systems of DPN.[23,24] The biothesiometer and the neuropathy disability score have high sensitivities. The biothesiometer and the modified neuropathy disability score tend to be more sensitive than the 10 gm monofilament for the assessment of risk for foot ulcers. However, some data suggest that the 10 gm monofilament may not be the optimum method for identifying patients at risk of foot ulcers. Ankle reflex is a more sensitive but less specific test.

As per study by Veves et al measuring high dynamic plantar foot pressure found to have determined increased risk of foot ulcer.[22] But incorporating high dynamic foot pressure for predicting ulcer risk in diabetic neuropathy patients in outpatient clinics is difficult and not feasible and it is principally a research tool.

A study by Boulton et al found strong association of diabetic foot ulcer with increased VPT with odds ratio 10.77 ($p<0.001$) and suggesting DPN being important etiology for pathogenesis of diabetic foot ulcer than peripheral vascular diseases. In our study among 331 diabetic patients, 66 patients (19.9%) developed DFU. A VPT <15V is less likely to be associated with DPN and a VPT >25V found to be associated with severe DPN and increased risk for diabetic foot ulcer.[25] In our study, Table 2-7 we found the frequency of severity of DPN according to the VPT grading in each of 6 sites being ball of toe, head of 1st metatarsal, head of 3rd metatarsal, head of 5th metatarsal, midfoot, heel of both foots. According to the tabular values from 2-7 in left foot, around 129 patients (38.97%) developed severe DPN (>25V) in left great ball of toe being the most common site affected with increased risk of diabetic foot ulcer, followed by left head of 1st metatarsal (118 patients- 35.64%) , left head of 5th metatarsal (111 patients-33.5%) and least common site of severe DPN being left midfoot and heel (99 patients-29.9%). In right foot, Table 2-7 around 132 patients (39.87%) developed severe DPN in right great ball of toe being the most common site involved, followed by right head of 1st metatarsal (120 patients-36.2%), right head of 3rd metatarsal (115 patients-34.74%) and least common site for severe DPN being right midfoot (81 patients-24.47%).

In a study by Young et al cumulative incidence of first ulcer over 4 years is measured in 3 groups being <15V group, 16V-24V group, >25V group. There was found no significant difference in incidence between <15V group (2.9%) and 16V-24V (3.4%) group with odds ratio (1.21, 0.24 6.15, 95% confidence interval [CI], NS). But in the group >25V there is significant cumulative incidence of first ulcer over 4 years 19.8%, odds ratio 7.99 (3.65-17.5), ($p<0.01$). Recurrence of ulcers appears only in the group >25V.[26] In our study, follow up of patients to find the incidence of ulcers is not possible as it takes years. Hence, prevalence of old ulcers in 331 patients was found and compared with severity of DPN.

According to a study by Barth et al recurrent foot ulcers are associated with old ulcers.[27] In Table 8 and 9 comparing the average of VPT of each 6 sites of both feet resulting in the severity of DPN of both feet of 331 patients with the prevalence of old ulcers in each site of both feet. In Table 8, among 331 patients, in the left foot, a total of 83 old ulcers appeared, in that around 80 old ulcers (96.38%) appeared in 125 (37.76%) severe left foot diabetic peripheral neuropathic patients. Left head of 1st metatarsal being the most common site associated with old ulcers (25 old ulcers-31.25%), followed by left 3rd metatarsal (22 old ulcers-27.5%), head of 5th metatarsal (14 old ulcers-17.5%) and least common site being left heel (4 old ulcers-5%). In Table 9 among 331 patients, in the right foot, a total of 63 old ulcers appeared, in which around 55 old ulcers (87.3%) appeared in 121 (36.5%) severe right foot diabetic peripheral neuropathic patients. Right head of 1st metatarsal is being the most common site involved (14 old ulcers-25.45%) followed by right head of the 5th metatarsal (11 old ulcers-20%), right head of the 3rd metatarsal and right heel (8 ulcers-14.5%) and the least common site involved being right great ball of toe and right midfoot (7 old ulcers-12.7%). This high prevalence of old ulcers in severe diabetic peripheral neuropathic patients can be explained as these old ulcers are cumulative numbers of ulcers occurred over the years which is presented at the time of study rather than determining the stage of DPN at which the first ulcer is appeared and gradually progressed to this severe diabetic neuropathy. Among 331 patients, 42 (12.68%) severe left diabetic neuropathic patients with old ulcers have increased risk for developing recurrent ulcer in left foot and 29 (8.7%) severe right diabetic neuropathic patients with old ulcers have increased risk of recurrent ulcers in right foot.

Hence implementing biothesiometry as a screening tool in outpatient clinics not only helps in early intervention for asymptomatic DPN but also helps in management of severe DPN to prevent recurrent ulcers as these groups have higher morbidity and mortality.

Inference from this study is that, among the DPN patients, 57.40% are asymptomatic and 12.08% are having severe symptoms by MNSS score and about 27.49% having increased risk for pronation for foot ulcer by DNE score and about 43.2% having risk for foot ulcer by biothesiometry average from the most common site for loss of sensation involving over great ball of toe, 1st, 3rd, 5th metatarsal head to the least involvement site as midfoot.

Limitations

Scores evaluated here namely the MNSS and VPT are subjective, based on patients perception. So, there can be bias on that. Follow up of these patients who are intended to develop foot ulcers based on this study is beyond scope as it takes more number of years.

CONCLUSION

This study reveals the impact of DPN in a rural area, as DPN is insidious in onset and lack of awareness among the people leads to increased prevalence of it. So, by implementing this type of screening method for DPN on OPD basis in India helps in early interventions, prevention of the development of foot ulcers by 60% in asymptomatic patients and leg amputations by 85% in patients with severe stage of DPN with proper foot care.

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