High Prevalence Of Neuropathy And Peripheral Arterial Disease In Type 2 Diabetes In A Tertiary Care Centre In Eastern India

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Abstract

Background and Aims: Sensory neuropathy increases the risk of foot ulcerations by seven folds and peripheral arterial disease (PAD) by three folds in people with diabetes. The aim of the study was to assess the prevalence of sensory neuropathy and peripheral arterial disease in subjects with diabetes. Risk factors of development of sensory neuropathy and peripheral arterial disease were also evaluated. Materials and Methods: A total of 410 consecutive subjects with diabetes were evaluated in this cross-sectional study. Vibration perception threshold was measured by biothesiometer, pressure perception was assessed by 10 gm SWS monofilament and Ankle Brachial Index was measured by a hand held Doppler. Results: Consecutive subjects with type 2 diabetes (N=410) attending the OPD of this hospital were selected, of them 285 (69.5%) were males and 125 (30.5%) subjects were females. Insensitivity to monofilament testing at one or more sites was found in 265 subjects (64.6%) and 239 subjects (58.3%) had VPT ^{3} 25 V. Severe sensory neuropathy (MFT = <3) was detected in 127 (30.9 %) patients. Peripheral arterial disease (ABI <0.9) was detected in 141 patients (34.4 %). However, critical PAD (ABI < 0.6) was detected in 4 patients (0.9%). Increasing age and longer duration of diabetes, poor glycemic control and smoking were strongly associated with both neuropathy and PAD. Conclusions: Both sensory neuropathy and PAD are highly prevalent in our diabetic subjects, more so in persons with foot ulceration. Increasing age, duration of diabetes, poor glycemic control and smoking are strong risk factors for development of sensory neuropathy and PAD.

INTRODUCTION

Peripheral neuropathy is the major causal factors in the development of foot ulcerations among diabetic subjects. Diabetics with neuropathy have seven fold increased risk of foot ulcerations (1). Diabetics are also exposed to 15 fold higher risk of amputation of lower extremities compared to the general population (2).The Semmes-Weinstein monofilament is most widely used proven tool to screen for sensory peripheral neuropathy (3). Vibrartion perception has been shown to be strongly associated with foot ulceration. VPT determination by using a biothesiometer has been used to identify peripheral sensory neuropathy and subjects at risk of foot ulcerations (4).

Peripheral arterial disease (PAD) is a major cause of morbidity and mortality among diabetic population. It is a major risk factor for lower extremity amputation and also accompanied by high likelyhood of symptomatic cardiovascular disease and stroke (5). In people with diabetes, the risk of peripheral arterial disease is positively correlated with increasing age, duration of diabetes and peripheral neuropathy (6).There prevalence of peripheral arterial disease in diabetes has been difficult to determine because of asymptomatic nature and presence of neuropathy and also varies with methodology. Ankle Brachial Index (ABI) is a simple, non-invasive and good modality of screening PAD. ABI has been validated against the angiography and found to be 95% sensitive and 100% specific (7).

RESEARCH DESIGN AND METHODS

In between December 2007 to May 2008, a total of 410 consecutive subjects with type 2 diabetes attending diabetic clinic of SSKM Hospital, Kolkata were evaluated. Subjects with bilateral foot ulcerations or amputation were excluded.

Vibration perception threshold: we used a biothesiometer (DHANSAL) to test vibration perception. It consists of a hand held unit with a rubber tractor that vibrates at 100 HZ. The voltage range of the machine was 0 to 50 volts. Stylus

was placed on the tip of the great toe, in step and heals perpendicular to the surface. The voltage was gradually increased or decreased and the optimum voltage, which patient could perceive was recorded. A mean of three readings in each foot was used. Vibration perception threshold of more than 25 volts was considered abnormal.

Monofilament testing:we used 10 gm monofilament for pressure perception. It was applied to 6 sites on the plantar surface of foot - great toe, 1st, 2nd and 3rd metatarsals, mid foot and heel. With the eyes closed, patient was asked whether he or she could feel the filament. Inability to feel at one or more sites is considered abnormal and constitutes sensory neuropathy. A monofilament was not used more than 10 patients per day.

Ankle Brachial index (ABI):patient's ankle and brachial systolic blood pressure were measured by using a hand held doppler ultrasound (MINIDOP D500) and the ratio was calculated. The normal ABI is >1 and ABI <0.9 defines peripheral arterial disease (PAD). PAD is classified as below. ABI: 0.9 - 0.7 – mild PAD, 0.4 - 0.69 – moderate PAD and <0.4 severe PAD. ABI >1.3 indicates arterial calcification.

All patients underwent complete history and physical examinations. Baseline biochemical parameters including lipid profile were determined.

Data obtained were subjected to statistical analysis using statistical package for social sciences 10.0 (SPSS) software. Probability (p) values of less than 0.05 were taken as significant.

RESULTS

Total subjects (n) - 410 Age (yrs) - 51.5 + 13.6 Duration of diabetes (yrs) - 9.4 + 7.6 Dyslipidemia (%) - 44.8 (n=184) Smoking (%) - 26.6 (109) Foot ulceration (n) - 63 (15.3%) Sex (M/F) - 285/125

MONOFILAMENT IMPAIRMENT

265 (64.5%) subjects had monofilament impairment at one or more sites implying mild sensory neuropathy. 201 (49%) subjects had monofilament insensitivity at four or more sites and 127 (30.9 %) had monofilament impairment at three or more sites indicating severe neuropathy. Results are shown in table 1.

Figure 1

Table 1. 10g monofilament readings (n=410)

Monofilament score	No. of subjects	Percentage
≤5	265	64.5
≤4	201	49.0
≤3	127	30.9
>5	145	35.4

RISK FACTORS FOR MONOFILAMENT IMPAIRMENT

Older age, longer duration of diabetes, taller heights, smoking and poor glycemic control were associated with monofilament impairment. Dyslipidemia was not associated with monofilament impairment. Table 2 shows the risk factors of impaired MFT in diabetic subjects.

Figure 2

Table 2. Risk factors for monofilament impairment

Risk factors	MFT score > 5	MFT score ≤ 5	P value
Age (yrs)	46 ± 16.7	54.1 ± 10.7	<0.005
Duration of diabetes (yrs)	8.2 ± 6.9	10.0 ± 7.9	<0.05
Height (meters)	1.58 ± 0.1	1.61 ± 0.1	<0.05
Smoking (%)(n)	17.9 (83)	31.3 (26)	<0.05
Dyslipidemia (%)(n)	46 (122)	42.7(62)	NS
HbA1C (%)	7.2	8.7	<0.05

MFT: monofilament, NS = not significant

VIBRATION PERCEPTION THRESHOLDS

Among 410 subjects, 239 (58.3%) had vibration perception thresholds more than or equal to 25 volts and 92 (22.4 %) had VPT scores in between 15-24 volts and 79 (19.2 %) had VPT scores less than15 volts. Results are shown in table 3.

Figure 3

Table 3. Vibration perception thresholds (n=410)

Vibration perception thresholds (V)	No of subjects	Percentage
<15	79	19.2%
15-24	92	22.4%
≥25	239	58.3%

V = volt

RISK FACTORS FOR INCREASED VIBRATION PERCEPTION THRESHOLDS

Older age, longer duration of diabetes, taller heights, smoking and poor glycemic control were associated with increased vibration perception thresholds. Dyslipidemia was not associated with increased vibration perception thresholds. Table 4 shows the relations between risk factors and vibration perception thresholds. Table 4 shows the risk factors of increased VPT in diabetic subjects.

Figure 4

Table 4. Risk factors for increased vibration perception thresholds

Risk factors	VPT <25	VPT ≥25	P
Age (yrs)	45.7 ± 14.9	55.6 ± 10.9	<0.005
Duration of Diabetes (yrs)	8.24 ± 6.9	10.23 ± 7.9	<0.009
Height (meters)	1.58 ± 0.1	1.62 ± 0.1	<0.05
Smoking (%)	21.6 (37)	30.1 (72)	<0.05
Dyslipidemia(%)(n)	42.6 (73)	46.4 (111)	NS
HbA1C (%)	7.2	8.8	<0.05

VPT = vibration perception threshold

PERIPHERAL ARTERIAL DISEASE

141 (34.4%) patients had peripheral arterial disease (ABI<0.9). Among these patients 114 (27.8%) had mild PAD, 23 (5.6 %) had moderate PAD and 4 (0.9 %) had severe PAD.

Figure 5

Table 5 shows ABI in diabetic subjects.

ABI	No of subjects	Percentage
Normal (≥0.9)	269	65.6
Abnormal (<0.9)	141	34.4
a) 0.79-0.89	114	27.8
b) 0.69-0.79	23	5.6
c) <0.7	4	0.9

Figure 6

Table-6. Ankle Brachial index (n=410)

Risk factors	ABI ≥0.9 (n=269)	ABI <0.9 (n=141)	P
Age (yrs)	49.76 ± 14.9	54.1 ± 11.00	<0.005
Duration of DM	8.89 ± 7.6	10.1 ± 7.6	<0.05
Height (MT)	1.6 ± 0.1	1.6 ± 0.1	NS
Smoking (%)(n)	21.1(57)	36.8(52)	<0.05
Dyslipidemia (%)(n)	57.4 (81)	38.3 (103)	<0.05
HbA1C (%)	7.3	8.8	<0.05

RISK FACTORS OF PERIPHERAL ARTERIAL DISEASE

Age, duration of diabetes, smoking, dyslipidemia and poor glycemic controls were associated with increased occurrence of PAD. CAD was more prevalent in subjects with PAD than without PAD. Table 6 shows the risk factors of Peripheral Arterial Disease.

Table-6. Risk factors of Peripheral Arterial Disease

SUBJECTS WITH FOOT ULCERS

Subjects with foot ulcerations had neuropathy in 81% of cases compared to 61% in subjects without foot ulceration. 46% of subjects with foot ulcerations had peripheral arterial disease compared to 32.7% of subjects without ulceration. Mean MFT and ABI were significantly lower and mean VPT was higher in subjects with foot ulcers. Table 7 shows compares mean VPT, mean MFT and mean ABI in subjects with and without foot ulcers.

Figure 7

Table-7. Mean VPT, mean MFT and mean ABI in subjects with and without foot ulcers.

Risk factors	NO FOOT ULCER (n=347)	FOOT ULCER (n=63)	P
VPT (mean) Volts	27 ± 13	35 ± 15	<0.05
MFT (mean)	4.4 ± 1.6	3.1 ± 1.9	<0.05
ABI (mean)	0.91 ± 0.1	0.87 ± 0.1	<0.05

DISCUSSION

The most common neuropathy in diabetes is distal symmetrical sensory neuropathy. It occurs in 25-75% of cases in different studies (8, 9). In our study, using the monofilament as modality of testing, 64.5 % of patients had sensory neuropathy.

The measurement of vibration perception using a biothesiometer is a long established me- thod of screening neuropathy (10). Young et al showed that risk of foot ulceration increases with increasing vibration perception thresholds. In diabetic subjects who had vibration threshold of greater than 25 volts, had 19.8% risk of foot ulcerations over a period of 3 years (11). In our study, 239 patients (58.3%) had VPT more than or equal to 25 volts. Therefore a high percentage of our patients had neuropathy and hence increased risk of foot ulceration.

The accurate assessment of prevalence of peripheral arterial disease in diabetes is confounded by various factors. The condition is asymptomatic, peripheral neuropathy may also alter the pain perception. In studies using the ankle-brachial index (ABI) which is the preferred screening technique, the prevalence of peripheral arterial disease (defined as an ABI <0.9) in diabetics ranges from 20-30% (12). In the UKPDS, the prevalence of peripheral arterial disease at diagnosis was 1.2% and after 6 years it increased to 11% (13).

In CUPS study conducted in south India, prevalence of peripheral arterial disease was 11.8% (14). In our study, prevalence of peripheral arterial disease was 34.4% which

was higher compared to other studies. Most of the patients (34.4%) had mild peripheral arterial disease i.e. ABI (0.7-0.89) and were asymptomatic. 6.5% of subjects had moderate to severe peripheral arterial disease, who had intermittent claudication.

This can not be explained solely due to higher percentage of complicated patients attending in a tertiary centre like our hospital. There is one study from Greece which noticed even higher prevalence (42%) of peripheral arterial disease (15).

Increasing age, longer duration of diabetes, smoking, dyslipidemia were strongly associated with peripheral arterial disease in our study, similar to other studies (16).

Our study showed that prevalence of neuropathy and peripheral arterial disease was much higher in diabetics with foot ulcer refurbishing their role in etiology of foot ulcerations.

CONCLUSION

Both sensory neuropathy and peripheral arterial disease are highly prevalent in our diabetic populations, more so in subjects with foot ulcerations. Increasing age, longer duration of diabetes, poor glycemic control and smoking are the strong risk factors for sensory neuropathy and peripheral arterial disease. High prevalence of neuropathy and peripheral arterial disease denotes high percentage of diabetics at risk of foot ulceration and amputation as well as cardiovascular disease.

Detection of these neuro-ischaemic patients with subsequent education and footcare advice are essential to prevent foot ulceration and thereby to reduce morbidity and mortality in subjects with diabetes.

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