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C O N T E N T S

Evaluation of peripheral neurovascular status among diabetics in a rural population

Bhupendra R. Mehra, Anand P. Thawait, Sangram S. Karandikar, Ravinder R. Narang

Department of Surgery, Mahatma Gandhi Institute of Medical Science, Sewagram, Wardha, Maharashtra, India

Most serious foot problems can be prevented by the patient's knowledge and awareness of risk factors. This study was initiated to know more about the peripheral neurovascular status among the diabetic population and its correlation with early diagnosis and control. **AIMS AND OBJECTIVES:** To obtain an initial and representative data sample and to identify the common peripheral neurovascular complaints among the diabetic population and to show their relationship with the duration, type, and control of diabetes. **METHODOLOGY:** A total of 500 diabetic patients (OPD and inpatient) were examined, out of which 52 patients had diabetic foot lesions; 448 patients did not have any foot lesion. Peripheral arterial pulsation, sensory-motor functional impairment, ankle-brachial pressure index, and percutaneous oxygen saturation were cross studied with the duration, type, and control of diabetes. The Chi square test was performed and a value of $P < 0.05$ was considered significant. **CONCLUSION:** The prevalence of peripheral neuropathy among diabetics in a hospital-based rural population was 10.4%; 18.8% had abnormal pulsation of the dorsalis pedis artery (cf 8.8% with abnormal posterior tibial artery pulsation). Loss of perception on 5.07 Semmes-Weinstein monofilament testing (sensory neuropathy), ankle-brachial pressure, and percutaneous oxygen unsaturation was more common in long-standing type II diabetes with poor glycemic control.

KEY WORDS: Peripheral neuropathy

Introduction

A foot in which arterial disease or neuropathy, or both, are present is liable to develop complications. In 60-70% of patients with diabetic foot ulcers the etiology can be attributed to peripheral neuropathy. Foot disease is a macrovascular neuropathic diabetic problem and for its prevention, tight glucose control is necessary in addition to patient education, risk factor modification and early recognition of complications.

Correspondence to **Dr. Bhupendra R. Mehra,**
Type III, Quater No. 8, Kasturba Health Society Campus, Mahatma Gandhi Institute of Medical Science, Sewagram, Wardha, Maharashtra, India. E-mail: drbhupi_mehra@rediffmail.com

Methodology

This study was conducted at the Kasturba Hospital attached to the Mahatma Gandhi Institute of Medical Sciences, Sevagram, from January 2002 to May 2003. A total of 500 diabetic patients (OPD and inpatient) were examined, out of which 52 patients had diabetic foot lesions and 448 patients were lesion free. The basic data on age, sex, and occupation was collected from all patients and a detailed history was obtained regarding the present complaints. All patients were interviewed regarding any past history of diabetes,duration of diabetes, type of diabetes, and type of treatment taken for control of the disease. A general physical examination was done. The patient was examined for abnormal distal pulsations, ankle blood pressure was recorded and percutaneous oxygen saturation was measured for assessing vascular status. Pin prick, vibration sensation and pressure perception by Semmes Weinstein monofilaments for neurological status of lower limb were also assessed. These parameters were cross studied and were found to be significant by the chi square test.

Observations

The most common age group aff ected was 41-60 years (48.1%) and the mean age of patients with diabetic lesions was 55.6 ± 12 years. Of the patients, 84.6% were males and 15.4% were females, with a M:F ratio of 5.5:1. Abnormalities (weak or absent pulsations) of the peripheral vascular system were more common in those with a long duration of diabetes (>5 years). Abnormal peripheral vascular pulsations also were more common

in type 2 diabetes mellitus (71%). Overall, the posterior tibial pulsations were abnormal in 8.8% and the dorsalis pedis pulsations in 18.8% [Table 1].

Loss of perception of 5.07 Semmes-Weinstein monofilament was the commonest manifestation of sensory neuropathy (39%) and was more common in those with long-standing diabetes. The percentage of abnormal tendon reflexes and wasting was highest among patients with diabetes of more than 10 years duration and in those with fasting blood glucose in the range of 200-400 mg% ($P < 0.05$). The prevalence of impaired pin-prick sensation (54.8%) and loss of perception on 5.07 Semmes-Weinstein monofilament testing (54.8%) was higher among patients with a fasting glucose of more than 400 mg/dl ($P < 0.05$) Overall, the findings suggest that diabetic neuropathy is more common among patients with poor glycemic control [Table 2].

Ankle-brachial pressure index (ABPI) was more abnormal (< 0.8) in long-standing diabetes (12.5%), type II diabetes, and diabetics with poor glycemic control. ABPI < 0.8 showed no correlation with type of diabetes and control of diabetes ($P > 0.05$) and ABPI 0.8-1 showed no association with control of diabetes ($P > 0.05$) [Table 3].

Per cutaneous oxygen saturation was increasingly abnormal in long duration diabetes, type I diabetes, and in those with poor glycemic control (FBG > 400 mg%) [Table 4].

Discussion

Any foot with arterial disease or neuropathy is liable to develop complications. Faris[1] gave the signs of ischemia as a history of intermittent claudication or rest pain with coldness of foot, absence of ankle pulses, and dependent rubor. The evidence of neuropathy included clawing of toes, callus over pressure areas, neuropathic joint, dry foot, loss of light touch and pain sensation, loss of perception of vibration on the foot, and absence of ankle and patellar tendon reflexes. All this can cause chronic skin ulcer. Among patients with diabetic foot ulcers, 60-70% have peripheral neuropathy as the etiology.

Foot disease is an important complication affecting diabetes patients. Comparison of peripheral vascular disease in the diabetic population has been done in different studies. In the present study, clinical examination of the peripheral vessels showed that 8.8% of the diabetic patients had weak or absent posterior tibial pulsations

Table 1: Relationship of abnormal peripheral arterial pulsation with duration, type of diabetes, and control of diabetes

Arteries of the foot	Duration of diabetes (years)				Type of diabetes			Control of diabetes (FBG)			
	<5 (%) *n* = 319	5-10 (%) *n* = 125	>10 (%) *n* = 56	*P*	1 (%) *n* = 145	2 (%) *n* = 355	*P*	<200 mg%	200-400 mg%	>400 mg%	*P*
Impaired posterior tibial artery (PT) *n* = 44	7 (2.2)	24 (19.2)	13 (23.2)	$P < 0.05$	10 (6.9)	34 (9.5)	>0.05	11 (5.2)	23 (10.6)	10 (13.7)	$P < 0.05$
Impaired dorsalis pedis artery (DP) *n* = 94	28 (8.7)	47 (37.6)	19 (33.9)	$P < 0.05$	16 (11)	78 (22)	>0.05	30 (14.2)	43 (19.9)	21 (28.7)	$P < 0.05$

Table 2: Relationship of sensory-motor functional impairment with duration, type, and control of diabetes

	Duration of diabetes (years)				Type of diabetes			Control of diabetes			
	<5 (%) *n* = 319	5-10 (%) *n* = 125	>10 (%) *n* = 56	*P*	1 (%) *n* = 145	2 (%) *n* = 355	*P*	<200 mg (%) *n* = 211	200-400 mg (%) *n* = 216	>400 mg (%) *n* = 73	*P*
Pinprick *n* = 183 (36.6%)	67 (21)	82 (65.6)	34 (60.7)	<0.05	25 (17.2)	158 (44.5)	<0.05	51 (24.1)	92 (42.6)	40 (54.8)	<0.05
Vibration *n* = 169 (33.8%)	69 (21.6)	62 (49.6)	38 (67.8)	<0.05	26 (17.9)	143 (40.2)	<0.05	52 (24.6)	92 (42.6)	25 (34.2)	<0.05
Semmes-Weinstein monofilament *n* = 195 (39%)	72 (22.5)	82 (65.5)	41 (73.2)	<0.05	30 (20.7)	165 (46.4)	<0.05	55 (26)	100 (47.4)	40 (54.8)	<0.05
Wasting *n* = 73 (14.6)	17 (5.3)	30 (24)	26 (46.4)	<0.05	14 (9.6)	59 (16.6)	<0.05	22 (10.4)	42 (19.4)	9 (12.3)	<0.05
Abnormal Achilles tendon reflex *n* = 131 (26.2%)	35 (11)	60 (48)	36 (64.2)	<0.05	17 (11.7)	114 (32.1)	<0.05	38 (18)	73 (33.8)	20 (27.4)	<0.05

Table 3: Relation of ankle-brachial pressure index with duration, type, and control of diabetes

		Duration of diabetes (years)				Type of diabetes			Control of diabetes (FBG)			
		<5 (%) *n* = 319	5-10 (%) *n* = 125	>10 (%) *n* = 56	*P*	1 (%) *n* = 145	2 (%) *n* = 355	*P*	<200 mg (%) *n* = 211	200-400 mg (%) *n* = 216	>400 mg (%) *n* = 73	*P*
Ankle-brachial index	>1 *n* = 273 (54.6)	206 (64.6)	52 (41.6)	15 (26.8)	<0.05	101 (69.7)	172 (48.5)	<0.05	130 (61.6)	105 (48.6)	38 (52.1)	<0.05
	0.8-1 *n* = 201 (40.2)	103 (32.3)	64 (51.2)	34 (60.7)	<0.05	39 (26.9)	162 (45.6)	<0.05	72 (34.1)	98 (45.4)	31 (42.5)	>0.05
	<0.8 *n* = 26 (5.2)	10 (3.1)	9 (7.2)	7 (12.5)	<0.05	5 (3.4)	21 (5.9)	<0.05	9 (4.3)	13 (6)	4 (5.4)	>0.05
Total *n* = 500		319 (63.8)	125 (25)	56 (11.2)	<0.05	145 (29)	355 (71)	<0.05	211 (42.2)	216 (43.2)	73 (14.6)	<0.05

Table 4: Relation of percutaneous oxygen saturation with duration, type, and control of diabetes

		Duration of diabetes				Type of diabetes			Control of diabetes (FBG)			
		<5 years (%) *n* = 319	5-10 years (%) *n* = 25	10 years (%) *n* = 56	*P*	1 (%)	2 (%)	*P*	<200 mg% *n* = 211	200-400 mg% *n* = 216	>400 mg% *n* = 73	*P*
Per cutaneous oxygen saturation (%)	>90	306 (95.9)	105 (84)	41 (73.2)	<0.05	136 (93.8)	316 (89)	<0.05	197 (93.4)	195 (90.3)	60 (82.2)	<0.05
	80-90	10 (3.1)	18 (14.4)	14 (25)	<0.05	7 (4.8)	35 (9.9)	<0.05	13 (6.2)	17 (7.9)	12 (16.4)	<0.05
	<80	3 (0.9)	2 (1.6)	1 (1.8)	<0.05	2 (1.4)	4 (1.1)	<0.05	1 (0.4)	4 (1.8)	1 (1.4)	<0.05

and 18.8% patients had weak or absent pulsations of the dorsalis pedis artery, which is similar to that reported by Bryfogle *et al*. (15.7%),[2] Haimovici (68.9%),[3] Helfand (40.6%),[4] Black (65%),[5] Jarrett (20.6%),[6] Frykberg *et al*. (14%),[7] and MacGregor *et al*. (20.6%).[8] The findings of the present study are comparable to that found by Helfand,[4] who reported 40.6% subjects with weak or absent pulsations of dorsalis pedis artery. The present study was done on symptomatic as well as asymptomatic diabetic patients, whereas other studies focused mainly on symptomatic patients.

On comparing impaired perception of 5.07 Semmes-Weinstein monofilament among diabetic patients with and without diabetic foot, it was found that of the 448 diabetics without diabetic foot problems 35.5% had impaired perception. Among 52 patients with diabetic foot, 69.2% had impaired perception with monofilament. Rith-Najarian *et al*.[9] reported that perception was reduced in 19% of diabetics and McNeely *et al*.[10] reported that it was impaired in 91.3% of patients with diabetic foot as compared to 51.2% of patients without any foot lesion. The finding of higher prevalence of sensory neuropathy among patients with diabetic foot is comparable to that reported by McNeely *et al*., but the number of patients affected was lower in the present study. Of the 448 diabetics without diabetic foot, 33.9%, and among 52 patients with diabetic foot, 59.6%, had sensory neuropathy (pin prick). Helfand[4] reported that among all diabetics, 2.4% had sensory neuropathy, while 34% neuropathy was reported by Harris *et al*.[11] The findings of sensory neuropathy in the present study match that of Harris *et al*. but are much higher than reported by Helfand. Such wide variation is obviously due to the type of patient population studied. Paris[12] reported that 15.6% of patients without diabetic foot and 61.5% of the patients with diabetic foot had sensory neuropathy. The prevalence of sensory neuropathy in patients with diabetic foot in the present study is in agreement with that reported by Paris, but the prevalence is higher among patients without diabetic foot in the present study.

Of the 448 diabetics without diabetic foot problems, 30.8% and among 52 patients with diabetic foot, 59.6%, had impaired vibration sensation, showing a higher prevalence of sensory neuropathy. In a study by Helfand (1974), 16.2% of diabetic patients had impaired vibration sensation. Young *et al*.[13] reported impaired sensation in 55.4% of the diabetic population. As shown in the table,

McNeely (1995), Lehto *et al*.,[14] and Lavery[15] reported that vibration sensation was more commonly reduced among patients with diabetic foot as compared to those without diabetic foot. The findings of the present study are similar to the results of the studies performed in the past.

On comparing peripheral arterial pulsation, in the present study, among 52 patients with diabetic foot, 36.5% had weak or absent dorsalis pedis artery and the posterior tibial artery was abnormal in 28.8%. Frykberg *et al*.[7] reported that pedal pulses were abnormal in 23% of the patients with diabetic foot. Ellenberg[16] reported that the dorsalis pedis was abnormal in 11% and the posterior tibial was abnormal in 5.5%. The prevalence of abnormal pedal pulses was found to be higher in our study than in previously reported studies.

In the present study, ABPI of less than 0.8 was present in 13.4% of the patients with diabetic foot. This was similar to the prevalence of 10% reported by Lavery *et al*.[15] Paris[12] reported that the ABPI was less than 0.8 in 46.1%. Reiber[17] reported that the ABPI was less than 0.8 in 35% patients in the Manchester setting and 24.1% in the Seattle setting. The prevalence of low ABPI was less in the present study, which may probably be because of the lower prevalence of smoking in the Indian population.

From the present study, it is inferred that long duration of diabetes, presence of type II diabetes, poor control of diabetes, peripheral sensory-motor neuropathy, and vasculopathy were important risk factors responsible for development of diabetic foot problems. Other contributory risk factors could be trivial trauma, ignorance on the part of the patients, and lack of knowledge and awareness about foot health care.

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