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Research Article

Pattern of diabetic foot - presentation and complications in rural Indian population

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ABSTRACT

Background: Foot ulcer is one of the most common and deadest complications of diabetes mellitus. This is also a frequent cause of hospitalization and disability. Most of the patients with diabetic foot ulcers living in developing countries present to healthcare facilities fairly late with advanced foot ulcers because of poor economic status, inadequate knowledge of self-care, sociocultural reasons and poor and inadequate diabetes healthcare.
Methods: A prospective study was conducted in the department of Surgery, JNMC Sawangi (Meghe), Wardha of DMIMS (DU) with the aim to evaluate the pattern of distribution of foot ulcers in diabetic foot patients and related complications. We enrolled 30 diabetic patients in the study, of these 21 (70%) were males and 9 (30%) were females with male to female ratio 2.33.
Results: The mean age of presentation was 52.93 ± 14.10 and the mean duration of diabetes was 8.20 ± 10.06. The maximum numbers of lesion was present in the region of second to fifth metatarsal (53.33%), followed by heel (26.66%) and great toe (10%). Maximum patients 9 (30%) had grade II lesions as per Wagner's classification and 12 (40%) had II B as per University of Texas diabetic wound classification. Associated deformity was present in 36.66%, insensitivity to the 5.07 S-W monofilaments in 56.66%, impaired vibration in 43.33%, and abnormal Achilles tendon reflex in 40%. Ankle–brachial index <0.8 was present in 33.33%. Only 13.33% patients were using customized footwear whereas 46.66% were walking barefoot, the difference was statistically significant P = 0.0027.
Conclusion: The health education to promote Knowledge, Attitude, Behavior and Practice (KABP) is essential to prevent diabetes associated foot complications.

Keywords: Diabetic foot, Complications, Pattern, Wagner's classification, ABI

INTRODUCTION

According to the World Health Organization and to the international working group on the diabetic foot, diabetic foot is defined as the foot of diabetic patients with ulceration, infection and/or destruction of the deep tissues, associated with neurological abnormalities and various degrees of peripheral vascular disease in the lower limb. Foot lesion is described as any abnormality associated with the damage to the skin, nails or deeper tissues of foot. Foot deformity is defined as structural abnormalities of the foot such as hammer toes, mallet toes, claw toes, hallux valgus, prominent metatarsal heads, residuals of neuro-osteoarthropathy, amputations or other foot surgery.[1]

Diabetes mellitus, a metabolic disorder characterized by elevated blood glucose, is a serious and growing problem. More than 23 million people in the United States (U.S.) are believed to have diabetes. It is estimated that by 2025, 300 million people worldwide will have diabetes and by 2030, 360 million people. Thus, by 2030, world-wide prevalence will approach 5 percent.[2-5]

In general, the incidence of non-traumatic Lower Extremity Amputations (LEAs) has been reported to be at least 15 times greater in those with diabetes than with any other concomitant medical illness.[4,5-7] It has been reported that annually, about 1 to 4 percent of those with diabetes develop a foot ulcer; 10 to 15 percent of those with diabetes will have at least one foot ulcer during their lifetime.[8] Lower extremity amputations are less common but is an extreme complication associated with diabetes and foot ulcer. In the U.S., nearly 80000 LEAs are performed on diabetics each year.[9,10] In 2005, the overall rate of hospital discharge for new LEA was about 4.3 per 1000 people with diabetes compared with a rate of about 0.3 per 1000 in the general population.[5,9,11-14]

Prevalence of Diabetes Mellitus (DM) and impaired fasting glucose are reported to be highly variable among rural and urban population in India. A number of epidemiological studies with varying sample sizes have reported prevalence of diabetes at different geographical areas ranging from 1.6-12.4%,[15] type-2 diabetes is a global health problem.[16] According to the recent global estimates of the World Health Organization (WHO), there will be 300 million people with diabetes by the year 2025.[5,16] It is estimated that the developing countries will bear the brunt of diabetes epidemic to the extent of 77% of the global burden, in the 21st century.[17] Number of diabetics in India was 31.7 million in the year 2002 and it is estimated that number of diabetics in 2030 will be 79.4 million in India.[18,19] Epidemiologic studies have found a point prevalence of distal lower limb neuropathy ranging from 30% to 50% of the diabetic population studied[20] and Peripheral Arterial Disease (PAD) is a contributing factor to the development of foot ulcers in up to 50% of cases.[21]

Mechanical pressures on the foot during walking are elevated in patients who have diabetes and who are complicated with neuropathy and foot deformity. These elevated pressures are an important risk factor for the development of diabetic foot ulcers. For this reason, the reduction of pressure, or "offloading" has become an important component in prevention and treatment of foot ulcers in this patient group. To offload the diabetic foot, different techniques have been developed and used over the last 30 years such as total contact casts, cast shoes, prefabricated below the knee removable walkers and different types of footwear such as forefoot offloading shoes, therapeutic footwear and athletic footwear. Footwear reduces peak pressure to 20-50% of control and helps in healing planter diabetic ulcers.[22]

Recent data suggests that a structured approach to custom footwear prescription based on previous prescription algorithms can certainly reduce the risk for foot ulceration in diabetes, but more well-designed prospective trials are urgently needed to draw stronger conclusions on this aspect.[22,23] The present study was conducted with the aim to evaluate the pattern of distribution of foot ulcers in diabetic foot patients.

METHODS

A prospective study was conducted in the department of Surgery, JNMC and Acharya Vinoba Bhave rural hospital, Sawangi (Meghe), Wardha of DMIMS (DU) with the aim to evaluate the pattern of distribution of foot ulcers in diabetic foot patients and related complications. We included the patients of type I and type II DM patients having foot lesions with their consent. Prior approval from institutional ethics committee, DMIMS (DU) was obtained. We excluded the patients with foot lesions due to other causes like arterial disease, traumatic foot ulcers, immunocompromised patients, and Diabetic patients with malignancy and patients with ketoacidosi**s.**

A detailed history and examination was recorded on a predesigned proforma with sketching of foot ulcers on transparent sheets with different colors. All the foot lesions were classified as per Wagner's classification and University of Texas diabetic wound classification. Wound swab samples were obtained by rubbing the swab stick in the deepest accessible area of the lesion while ensuring aseptic techniques. The samples were then sent for bacteriological assessment to determine the presence of infective organisms. X-rays of the affected limb and color Doppler examination were done during first visit. The detailed demographic profile and other details pertaining to disease and treatment were recorded on a predesigned case record form. A total 30 patients were studied over this duration of 6 months.

Statistical analysis was done by using SPSS. Descriptive analyses of age, sex, associated complications and treatment compliance was performed. Continuous variables which are normally distributed were described using mean and standard error. The statistical significance was analyzed using student's t test and $P < 0.05$ was considered as statistically significant.

RESULTS

The total number of patients enrolled in the study 30, of these 21 (70%) were males and 9 (30%) were females; the male to female ratio was 2.33 (Table 1). The mean age of presentation was 52.93 ± 14.10 with the range of 32-78 years. The mean duration of diabetes was 8.20 ± 10.06. Seventeen (56.66%) patients were type II DM and remaining 43.34% were type I DM and on oral hypoglycemic.

Table 1: Age wise distribution of patients.

Age group (years)	No. of patients	Percentage (%)
31-40	8	26.7
41-50	6	20.0
51-60	6	20.0
61-70	6	20.0
71-80	4	13.3
Total	30	100.0
Mean age ± SD	52.93 ± 14.10	
Range	32-78 years	

The involvement of left foot was more common 50% than the right 46.7%, whereas only one patient had bilateral lesions (3.3%). The maximum numbers of lesion was present in the region of second to fifth metatarsal (53.33%), followed by heel (26.66%) and great toe (10%) with no lesion on midfoot. Three patients had multiple lesions, distributed over foot except midfoot. The classification of wounds as per Wagner's classification and University of Texas diabetic wound classification are shown in Table 2 and 3 respectively. The maximum lesions were Grade 3 - Deep ulcer with abscess or osteomyelitis and corresponding II B as per Wagner's classification and University of Texas Diabetic wound classification respectively. The other features like deformities, associated foot gangrene and features of neuropathy and vasculopathy present are described in Table 4. Associated deformity was present in 36.66% patients, insensitivity to the 5.07 S-W monofilaments in 56.66%, impaired vibration in 43.33%, and abnormal Achilles tendon reflex in 40%. Prior amputations were present in 20% patients. Posterior tibial artery was impaired in 30% and Dorsalis pedis artery was impaired in 43.33% patients, Ankle–brachial index <0.8 was present in 33.33%. Only 13.33% patients were using customized footwear whereas 46.66% were walking barefoot, the difference was statistically significant P = 0.0027.

Table 2: Distribution of patients according to Wagner's classification.

Grade	No. of patients	Percentage (%)
1	5	16.7
2	6	20.0
3	9	30.0
4	6	20.0
5	4	13.3
Total	30	100.00

Table 3: Distribution of patients according to University of Texas diabetic wound classification.

Stages & grading	No. of patients	Percentage (%)
IA	3	10.0
IB	4	13.3
IC	0	0.00
ID	0	0.00
IIA	1	3.3
IIB	12	40.0
IIC	0	0.00
IID	6	20.0
IIIA	0	0.00
IIIB	0	0.00
IIIC	0	0.00
IIID	4	13.3
Total	30	100.00

Table 4: Grade wise associated features in diabetic foot.

Observations	Wagner's classification of diabetic foot					Total N=30 (%)
	Grade 1 N=5	Grade 2 N=6	Grade 3 N=9	Grade 4 N=6	Grade 5 N=4	
Ulcer tenderness	3	3	6	2	1	15 (50%)
Foot gangrene	-	-	-	1	2	3 (10%)
Deformity	2	3	3	1	2	11 (36.66%)
Altered Skin temperature	2	3	3	4	3	15 (50%)
S-W monofilament	3	3	5	4	2	17 (56.66%)
Impaired vibration	2	4	4	2	1	13 (43.33%)
Abnormal Achilles tendon reflex	-	2	4	3	3	12 (40%)
IPTA	-	1	4	2	2	9 (30%)
IDPA	-	2	4	4	3	13 (43.33%)
AB I (<0.8)	-	-	3	4	3	10 (33.33%)
Amputations	1	-	2	1	2	6 (20%)
Bare foot walking	2	3	3	4	2	14 (46.66%)
Use of customized footwear	1	-	-	2	1	4 (13.33%)

IPTA = Impaired posterior tibial artery, IDPA = Impaired dorsalis pedis artery, ABI = Ankle-brachial index

DISCUSSION

Foot disease is a common complication of diabetes that can have tragic consequences. Wagner's classification of the diabetic foot provided an objective grading for elucidation of association and comparison of risk factors including patient awareness for the prevention of diabetic foot disease. A high proportion of foot complications in diabetes are due to factors such as diabetic peripheral neuropathy, angiopathy, hyperglycaemia and infection working alone or together.

Prevalence of Diabetes Mellitus (DM) and impaired fasting glucose are reported to be highly variable among rural and urban population in India. A number of epidemiological studies with varying sample sizes have reported prevalence of diabetes at different geographical areas ranging from 1.6-12.4%.[24] Management of diabetes and its complications in a rural setting poses a formidable challenge. It has been reported that diabetic patients who wore footwear both inside and outside their homes developed lesser foot problems than those patients who wore footwear only when they went outside their homes[25] In India, patients with diabetic neuropathy who live in rural areas are more prone to foot ulcers than those who live in urban areas for various reasons. The main common predisposing factor is barefoot walking, which can result in injury to the feet. Secondly, individuals in rural areas often sleep in huts or farmhouses where rodents are common; rodent bites to the feet of the patients with diabetes can lead to chronic ulcers.[26] Such injuries result in frequent and long-term admission to the hospital and cause much morbidity.

The mean age of presentation was 52.93 ± 14.10 with the range of 32-78 years. The mean duration of diabetes was 8.20 ± 10.06. The numbers of type I DM were more as compared to type II DM. The blood sugar was controlled in type II DM as compared to type I DM. The frequency of follow up for type II DM patients were more as that is the reason for better blood glucose control. The maximum lesions were Grade 3; Deep ulcer with abscess or osteomyelitis as per Wagner's classification.

The site of ulcer or lesion depends on cyclic tissue hypoxia during ambulation and direct trauma. It becomes even more important in the presence of peripheral sensory neuropathy. The maximum numbers of lesion was present in the region of second to fifth metatarsal (53.33%), followed by heel (26.66%) and great toe (10%) with no lesion on midfoot. Various studies have evaluated the role of obesity,[27] different load carrying conditions,[28] simulated changes in body mass,[29] or body mass as a correlate to peak plantar pressure[30-33] but showed no consensus in the regional areas affected by body mass when peak plantar pressure has been measured. However there is direct relationship between increasing body mass and dynamic peak plantar pressure in different regions.

The prevalence of ABI <0.8, swelling of the foot, foot pain, foot deformity, previous amputation, insensitivity to the 5.07 S-W monofilaments, vibration sensation and abnormal Achilles tendon reflex were comparable to other studies.[34-38]

Epidemiologic studies have found a point prevalence of distal lower limb neuropathy ranging from 30% to 50% of the diabetic population studied[39] and Peripheral Arterial Disease (PAD) is a contributing factor to the development of foot ulcers in up to 50% of cases.[40] Both type 1 and type 2 diabetic patients are similarly affected. With such frequent occurrence of neuropathy, it is no surprise that more than 60% of diabetic patients' foot ulcers are primarily due to underlying neuropathy. Distal neuropathy affects all the three components - sensory, motor and autonomic.[39] In our study, neuropathy was the cause for ulcerations in 56.66% and rest 43.34% were as a result of vasculopathy. PAD commonly affects the tibial and peroneal arteries of the calf. Endothelial cell dysfunction and smooth cell abnormalities develop in peripheral arteries as a consequence of the persistent hyperglycemic state. There is a resultant decrease in endothelium-derived vasodilators leading to constriction. Further, the hyperglycemia in diabetes is associated with an increase in thromboxane A2, a vasoconstrictor and platelet aggregation agonist, which leads to an increased risk for plasma hypercoagulability. There is also the potential for alterations in the vascular extracellular matrix leading to stenosis of the arterial lumen. Moreover, smoking, hypertension, and hyperlipidemia are other factors that are common in diabetic patients and contribute to the development of PAD.[40]

It is concluded from the study that the barefoot walking is quite common in rural population; hence the health education to reinforce the necessity of change in the health education to promote Knowledge, Attitude, Behavior and Practice (KABP) is essential to prevent diabetes associated foot complications. Further larger randomized controlled trials are required to confirm the results of use of specialized foot wears and diabetes related foot complications.

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