Original Research Article

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A clinicopathogical study on diabetic foot ulcer with special reference to the causative factors and its management

Sailendranath Paul¹, Dilip Kumar Das²*

Department of General Surgery, ¹KPC Medical College and Hospital, ²RG Kar Medical College and Hospital, Kolkata, West Bengal, India

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*Correspondence: Dr. Dilip Kumar Das.

E-mail: drsailen@yahoo.co.in

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ABSTRACT

Background: Diabetic ulcers are the most common foot injuries leading to lower extremity amputation. The present study was done to identify the incidence and related risk factors of diabetic foot ulcers in study participants.

Methods: This was a prospective done on 50 patients with diabetic foot ulcers. All the patients were examined thoroughly and related laboratory investigations were done. Wound culture and sensitivity was done in all cases.

Results: Mean age of onset with foot ulcers was 53.5 yrs in male and 55 yrs in females. Nephropathy was present in 12 (24%) patients. Sensorimotor neuropathy was present in 29 (58%) cases and autonomic neuropathy was present in 06 (12%) cases. Most common infection identified in diabetic foot ulcers was due to gram-negative bacteria (*E. coli* in 45 cases). Major amputation was done in 2 (4%) patients.

Conclusions: Implementation of management strategies at early stages prevents the development of complications related to diabetic foot ulcers in patients.

Keywords: Diabetic foot ulcers, Risk factors, Complications, Management

INTRODUCTION

Diabetic foot ulcer is one of the most common devastating complications of diabetes and is defined as a foot affected by ulcers associated with neuropathy or peripheral arterial disease of the lower limb in diabetic patients. The incidence of diabetic foot ulcers is more common in elder diabetic patients. About 5% of diabetic population present with a history of foot ulcers and 15% of the diabetic patients developing foot ulcers as life time risk.²⁻⁴

Majority of the foot ulcers (60-80%) will heal while 10-15% remains active and 5-24% of them finally lead to amputation within a period of 16-18 months after the first assessment.⁵ Neuropathic wounds are more likely to heal within a period of 20 weeks, while neuroischemic ulcers more often lead to limb amputation. Many studies have

reported that foot ulcers leads to amputations approximately in about 85% of diabetic cases.⁶

Diabetic neuropathy is the common presenting factor in almost 90% of diabetic foot ulcers. Peripheral arterial disease is 2-8 times more common in patients with diabetes. Other risk factors include visual impairment, diabetic nephropathy, poor glycemic control and cigarette smoking. ^{7,8}

The infections of diabetic foot are polymicrobial in nature that involves both aerobes and anaerobes. The common are *E. coli, S. aureus, P. aeruginosa, Enterococcus* species.⁹

The current study was done to identify the risk factors related to incidence of diabetic foot ulcers, associated complications, and to study the clinical course of

management of diabetic foot ulcers and their related therapeutic responses.

METHODS

The present study was a prospective study undertaken in KPC Medical College and Hospital, from December 2013 to December 2015. This study comprises of 50 diabetic foot ulcers patients presented to OPD of diabetic clinic, surgical outdoor and indoor of Medical college and Hospital, irrespective of the type of diabetes, duration of diabetes and associated complications. Each patient was examined clinically with detailed history taking and thorough physical examination. All patients underwent routine laboratory investigations and few with relevant special investigations (Doppler study) if necessary. Wound culture and sensitivity was done in all cases. All the patients were tested for neuropathy by conducting nerve conduction and velocity tests.

The data was collected and analyzed by using Microsoft Excel and presented in number and percentages.

RESULTS

The study included 50 patients with diabetic foot ulcers. Table 1 presents the demographic characteristics of study participants. Mean age of onset with foot ulcers was 53.5 yrs in male and 55 yrs in females. Mean body mass index (in kg/m²) was 21.5 an male and 27 in female. Family history of diabetes was present in 12 (24%) cases. Among them, 17 (34%) of patients were smokers. The mean fasting plasma glucose was significantly higher about 174.74 mg/dl. The prevalence of diabetic foot ulcer was more common in male (76%) in comparison to female (24%). The mean cholesterol, TG, LDL and HDL were found to be 192.3 mg/dl, 167.28 mg/dl, 111.1 mg/dl and 48.7 4 mg/dl respectively.

Table 1: Epidemiological characters of diabetic foot ulcers in study participants (n=50).

Characteristics		Number of patients N (%)	Mean value
Sex	Male	38 (76)	
	Female	12 (24)	
Family history of diabetes	-	15 (30)	
Age group (in years)	<30	02 (04)	
	30-40	05 (10)	
	41-50	09 (18)	54.1 years
	51-60	10 (20)	
	61-70	01 (02)	
	<1 month	07 (14)	
	1 month-12 months	05 (10)	
	>1 year-5 years	16 (32)	
Duration of diabetes	>5- 10 years	14 (28)	7 years
	>10-15 years	06 (12)	
	>15 years	02 (04)	
	<19	06 (12)	
Body mass index (kg/m²)	19-25	31 (62)	Male- 21.5;
	>25-30	11 (22)	Female- 27
	>30	02 (04)	
Smokers	14 (28)		
	<125	12 (24)	
	126-140	06 (12)	
Fasting blood sugar (mg/dl)	141-200	15 (30)	174.74
	201-300	14 (28)	
	>300	03 (06)	
	<200	15 (30)	_
	200-250	09 (18)	
Two hour postprandial blood	251-350	18 (36)	259.54
sugar (mg/dl)	351-450	07 (14)	20,10
	>450	01 (02)	
Serum cholesterol (mg/dl)	<200	32 (64)	
	200-250	14 (28)	192.3
	>250	04 (08)	192.3

Continued.

Characteristics		Number of patients N (%)	Mean value
Serum triglycerides	<200	37 (74)	
	200-399	12 (24)	167.28
	>400	01 (02)	
Serum LDL (mg/dl)	<100	20 (40)	
	100-300	15 (30)	111.1
	>130	15 (30)	
Serum HDL (mg/dl)	<35	02 (04)	
	35-45	15 (30)	48.74
	>45	33 (66)	

Table 2: Complication related to diabetic foot ulcers in study participants (n=50).

	No of motionts
Complications	No. of patients
Hymantanaian	N (%)
Hypertension	21 (42)
Nephropathy	12 (24)
Eye changes	
Cataract	15 (30)
Background retinopathy	12 (24)
Proliferative retinopathy	01 (02)
Hypertensive retinopathy	04 (08)
ECG	
Ischemia	06 (12)
Fixed RR	06 (12)
RBBB	05 (10)
Sick sinus	01 (02)
Neuropathy	
Sensorineural	24 (48)
Autonomic only	01 (02)
Both	05 (10)
Dyslipidemia	32 (64)
Pulmonary Kochs	03 (06)
Posterior tibial artery calcification	04 (08)
Past h/o of	
Ulceration/amputation	02 (04)
Calosity	06 (12)

Clinical characteristics of study population were presented in Table 2. Twenty one (42%) patients were hypertensives. Nephropathy was present in 12 (24%) patients. ESRD was not present even in a single case. Cataract was present in 15 (30%) of patients. Background and proliferative retinopathy was present in 12 (24%) and 1 (2%) respectively. Four (8%) patients had hypertensive retinopathy. ischemic heart disease was seen in 6 (12%) patients and 6 (12%) patients had fixed R-R interval in ECG on deep inspiration and expiration. Five patients had (10%) patient had RBBB and 1 (02%) patient had sick sinus syndrome. Dyslipidaemia was present in 32 (64%) of cases, pulmonary Koch's was present in 03 (06%) of cases. Post tibial artery calcification was present in 04 (08%) of cases. Callosity was present in 06 (12%) cases. Sensorimotor neuropathy was more common in rt.

side 36 (72%) than on the left side. Both feet ulcer was present in 5 (10%) of cases.

Table 3: Clinical characteristics of diabetic foot ulcers.

Clinical chara	cteristics	No. of patients N (%)
Foot ulcer	Right	36 (72)
	Left	09 (18)
	Both	05 (10)
Onset	Spontaneous	35 (70)
	Traumatic	15 (30)
	1 week	04 (08)
Duration	1 week -1 month	36 (72)
	>1 month	10 (20)
	Grade 0	0
Grade	Grade 1	09 (18)
	Grade 2	29 (58)
	Grade 3	07 (14)
	Grade 4	05 (10)
	Grade 5	0
	Only neuropathy	05 (10)
Cause	Only infection	17 (34)
	Both neuro and infection	21 (42)
	Ischemia and infection	03 (06)
	Neuro+infection+ischemia	04 (08)
Major	Below knee (transtibial)	02 (04)
amputation	Transfemoral	0
Minor amputation	-	07 (14)
amputation		

Most of patients had foot ulcers on right side 36 (72%) and spontaneous in nature (70%). Mean duration of onset of foot ulcer was 2.32 days. Most of the foot ulcer was infected in 45 (90%) cases. Grade-2 ulcer was the most common 29 (58%) followed by Grade-1 ulcer 09 (18%). Grade-3 and Grade-4 ulcer was present in 07 (14%) and 05 (10%) cases respectively. Both neuropathy and infection was present in most cases of the foot ulcers 24 (42%). Major amputation (below knee amputation) was done in 2 (4%) of cases and minor amputation was done in 7 (14%) of cases.

Table 4: Details of wound culture and their sensitivity.

Wound culture	No (%)	Sensitivity
E. coli	45 (90)	4-quinolones, amikacin
S. aureus	11 (24.4)	4-quinolones, 3 rd generation cephalosporins
P. aeruginosa	07 (15.5)	4-quinolones, cetazidime, amikacin
Klebsiella	01 (2.2)	4-quinolones, azithromycin, amikacin
Both E. coli+ Pseudomonas	03 (6.6)	4-quinolones, amikacin
Proteus	02 (4.44)	Metronidazole, clindamycin
Candida	01 (2.22)	Clotrimazole

Most of the infected ulcers were due to gram-negative bacteria. Twenty cases were (44%) due to *E. coli*, 03 (6.66%) due to mixed *E. coli* and *Pseudomonas* infection, 07 (15%) due to *Pseudomonas*, *Klebsiella* 01 (2.2%), 11 (24.4%) of ulcers was due to *Staph aureus*. Most of the gram-negative bacteria were sensitive to 4- quinolones especially to ofloxacin.

DISCUSSION

The total number of diabetic patients recruited during this study was eleven hundred out these total numbe of patients having diabetic foot ulcer was 50. So, the estimated prevalence of diabetic foot ulcer is 4.54%. The prevalence rate of diabetic foot ulcer varied from study to study. ^{10,11} In a study done by Yazdanpanah et al the rate of incidence of diabetic foot ulcer was 2.8%. ¹²

The relative preponderance of diabetic foot ulcer in male was 3.16:1 which was consistent with other studies The increased incidence rates in males may be due to more outdoor activity and increased chance of trivial trauma due to bare footedness. ^{13,14}

The mean age of patients was 54.1 years (53.2 yrs in males and 55 yrs in females). This was similar to the findings of Yazdanpanah et al.¹² Early incidence of diabetic foot ulcer may be due to early age of onset of diabetes, poor glycaemic control, and poor foot care leading to complication in our country. Family h/o diabetes was present in 30% cases.

The sensorimotor neuropathy was present in 29 (58%) cases and autonomic neuropathy was present in 06 (12%) cases. The prevalence of neuropathy was 41.6% in a study done by Young et al. 15 lt may be due to early age of onset of diabetes and poor glycaemic control in our country.

Hypertension was present in 21 (42%) cases and ischemic heart disease was present in 06 (12%) cases, eye disease in 30% cases. In a study conducted by Ramsey et al hypertension was present in 56.4% cases, ischemic heart disease was present in 07% cases and eye diseases in 23% cases. ¹⁶ This establishes association or aetiological relationship of diabetic foot with macrovascular complication and eye changes. In our study nephropathy was present in 12 (24%) cases. This was a well-known risk factor reported in earlier studies. ¹⁷

Both infection and neuropathy was present in 21 (42%) cases. Only infection was present in 17 (34%) cases and neuropathic ulcer was present in 05 (10%) cases. Similar incidence of neuropathic ulcers was seen in 51 cases in a study done by Fernando et al.¹⁸

Most of the foot ulcer 45 (90%) was infected and most common infection was due to gram-negative bacteria. Among gram-negative bacteria *E. coli* was most common 23 (51%) and among Gram positive infection *S. aureus* was common and present in 11(25%) cases. In a study done by Chetan et al the most common pathogenic organism identifies *S. aureus* in 18 (36%) cases. ¹⁹

Most of the grade 1 and grade 2 foot ulcers responded to conservative management, glycemic control, wound debridement and antibiotics and most of the grade 3 and grade 4 ulcer required minor or major amputation. In our study grade 2 ulcers was more common (58%). In our study major amputation was done in 4% cases and minor amputation in 14% cases. The rate of amputation was lesser compare to the study of Chetan et al. ¹⁹ The mean age at amputation was 50 years. It was 61.2 years in a study by Pendsey et al. ²⁰

CONCLUSION

The management of diabetic foot ulcers at early stages advantages in preventing the development of related chronic complications and amputations. To prevent amputations, accurate diagnosis of neuropathic and neuroischemic syndrome of diabetic foot, rapid and appropriate treatment of foot lesions including sepsis and glycaemic control, intensive follow up of patients and prevention of foot lesions were to be done. The only way to reduce this devastating complication even in this millennium is strict control of blood sugar right from the beginning, optimum care of foot by chiropodist, orthotist, nursing staff and shoe fitter supported by thorough education of the patients.

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Institutional Ethics Committee

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