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Original Research Article

Study of socio-demographic, behavioural and clinical risk factors of diabetic foot in a tertiary care centre

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ABSTRACT

Background: Diabetic foot is the most devastating complication of diabetes. Diabetic foot infection is a potential limb threatening condition. Several socio-demographic, behavioural and clinical factors are responsible for higher risk of diabetic foot. Hence this study was planned with the objective to assess association between socio-demographic, behavioural and clinical risk factors and diabetic foot and response of patients to various treatment modalities.
Methods: 50 patients of diabetic foot were studied over a six-month period. The diabetic foot ulcers were classified according to Wagner's classification. Data about various socio-demographic, behavioural and clinical factors was collected. Radiological investigations, neurological examination and culture and sensitivity of ulcer discharge was done. The patients were managed by conservative or surgical management.
Results: Common age group of presentation was 51-60 years. Males were more commonly affected. All participants were of low socio-economic status and majority were unskilled labourers. Tobacco (40%) and alcohol (32%) use and lack of physical activity (92%) were seen. All had diabetes of >10 years and elevated BMI. Grade 4 ulcer were the most frequent and toes were commonly involved. S. aureus was the commonest organism. Wound debridement was done in 76% patients and 34% required amputation.
Conclusions: Factors like advancing age, low socio-economic status, lack of family support, occupations involving risk of trauma to foot, tobacco use, sedentary life style, and clinical factors like longer duration of diabetes, higher BMI, uncontrolled diabetes are risk factors for diabetic foot. Hence it is essential to educate the diabetic patients about these risk factors.

Keywords: Diabetes foot, Socio-demographic factors, Wagner's classification

INTRODUCTION

Diabetes mellitus is the commonest chronic non-communicable disease in India which affects nearly 7% of adults.[1] The triad of foot ulceration, sepsis, and amputation are the most feared complications of diabetes. Chronic non-healing ulcers of the foot are known to increase the morbidity of these patients. The most significant and devastating complication of diabetes is believed to be diabetic foot and it is estimated that 15% of all diabetics have a lifetime risk of developing it.[2] The WHO definition of diabetic foot is "the foot of patients with diabetes which develops ulceration, infection and / or deep tissues destruction, accompanied by neurological abnormalities and various grades of peripheral vascular disease in the lower limb".[3] Approximately 5% of all diabetic patients have a history of foot ulceration and in about 15-20% of them their condition progresses to require an amputation. According to numerous studies, nearly 85% of all amputations in diabetic patients are preceded by foot ulcers.[4,5]

In India, approximately 45,000 lower limbs need amputation annually and it is probably preventable in

majority of them.[6] This high prevalence is a result of many contributory factors such as illiteracy, barefoot walking, late presentation, low socioeconomic status, ignorance about the basics of foot care in diabetics among primary care physicians, and belief in the alternative systems of medicine.[7] The principal underlying disorders responsible for the foot problems in diabetics are neuropathy and ischaemia.[8] While the neuropathic wounds require a period of over 20 weeks for healing, the duration is longer in neuro-ischemic ulcers and they are more likely to progress to amputation of lower limb.[9,10]

The primary exacerbating factor leading to ulcer development is loss of sensation because of peripheral neuropathy.[11] The ulcers can then be infected secondarily by gram positive organisms like *Staphylococci*, *Streptococci*, Gram negative organisms, and anaerobic bacteria. The infection can quickly evolve into cellulitis, abscess formation, and osteomyelitis.[12] Diabetic foot infection is a potential limb threatening condition since the risk of developing gangrene is higher, and the key to preventing major amputation are early arterial assessment and aggressive management.[13]

Among all the diabetic complications, diabetic foot has the highest potential of prevention by simple measures such as education and foot care. Measures like periodic comprehensive examination of foot, patient education regarding foot care involving simple hygienic practices, wearing appropriate footwear, and early management of minor injuries and a multi-disciplinary team approach can reduce the occurrence of ulcer by 50% and amputations by 85%. If ulcers do occur, most of them can be managed by early and active treatment through a multidisciplinary approach.[14,15]

Several socio-demographic, behavioural and clinical factors contribute to the high prevalence of diabetic foot. Identification of these factors in diabetic patients can help in identifying the patients at high risk of developing foot problems. This data can provide the key to prevent foot problems in diabetic patients in future. The response of patients to various treatment modalities of diabetic foot will help in obtaining baseline information to initiate appropriate interventions and salvage the limb from amputation. Hence the present study was planned to assess the association between various socio-demographic, behavioural and clinical factors and diabetic foot and the response of patients to conservative and surgical treatment modalities of diabetic foot.

METHODS

A prospective study was conducted in the general surgery department of Karwar institute of medical sciences, Karwar, Karnataka for a six months period from October 2019 to March 2020. All patients who presented to surgical outpatient department or were admitted to the surgical wards with signs and symptoms of diabetic foot during the six-months period were included. The study was conducted after obtaining approval from institutional ethics committee.

Sample size

Sample size was calculated based on previous studies. With a confidence level of 95% and a precision of 9%, the estimated sample size was 50. The sampling method used in the study was purposive sampling.

Method of collection of data

Fifty patients of diabetic foot were selected randomly and studied in detail after obtaining written informed consent. Data was collected by meticulous history, clinical examination, routine investigations, appropriate radiological investigation and relevant special investigations. A predesigned proforma was used to collect socio-demographic data such as age, sex, socio-economic status, literacy, occupation behavioral factors such as tobacco and alcohol use, physical activity and clinical data such as duration and type of diabetes, body mass index, current diabetic treatment, ulcer site and discharge. Further these patients were clinically examined thoroughly and the findings were recorded. Vascular and neurological examination was performed to detect peripheral vascular disease and neuropathy. Ulcer discharge was sent for culture and sensitivity and appropriate antibiotics were selected accordingly. Radiological investigation was done to detect osteomyelitis. The details of management of each patient and the response to treatment was recorded.

Inclusion criteria

Patients with signs and symptoms of diabetic foot of all age groups and both the sexes were included in study.

Exclusion criteria

Foot ulcers, swelling and discoloration of toes due to non-diabetic causes were excluded from the study.

Categorization of diabetic foot

Diabetic foot ulcers were categorized by Wagner's classification as follows- Grade 0- No obvious ulcer, but skin changes like hyperkeratosis, Grade 1-Localized, superficial ulcer, Grade 2-Deep ulcer to bone, ligament, or joint, Grade 3-Deep abscess, osteomyelitis, Grade 4-Gangrene of toes, forefoot and Grade 5-Gangrene of entire foot.

Investigations

Routine investigations

It included-complete blood counts (CBC), blood sugar test: Fasting blood sugar and random blood sugar, HbA1c

test, Urine analysis: albumin, sugar, microscopy and renal function tests.

Radiological investigation

It included X-ray foot and arterial doppler of lower limbs.

Specific investigation

Culture and sensitivity test of the ulcer discharge.

Treatment

The participants were treated with one or more of the following modalities of treatment:

Conservative management

Insulin/oral hypoglycaemic drugs/both-depending on the blood sugar levels, appropriate antibiotics for infected ulcers and foot care.

Surgical management

Depending on the degree of foot lesions- Incision and drainage of foot abscess, wound debridement, disarticulation, Amputation-1. Ray's amputation, 2. Trans-metatarsal, 3. Below knee and 4. above knee.

Statistical analysis

Data was analysed by descriptive statistics and results presented as frequency and percentages appropriately.

RESULTS

Socio-demographic factors

The details of various socio-demographic factors are presented in Table 1.

Age

Out of 50 patients in our study, 20 (40%) were in the age group of 51-60 years followed by 14 (28%) in the age group 61-70 years. The mean age of presentation in our series was 60.08 years. The youngest patient in our study was 36 years old and oldest was 86 years old.

Gender

There was a male preponderance in our study with 36 (72%) patients out of 50 being males. The male:female ratio was 2.6:1.

Literacy

Majority of the study subjects were literate with overall literacy rate being 92%.

Socio economic status

The socio-economic status was assessed as per modified Udai Pareek scale and all study subjects belonged to low class.

Marital status

Among the 50 patients, 12 (24%) were unmarried showing lack of support and care and rest (76%) were married.

Occupation

Labourers accounted for 32% of study participants, fishermen constituted 28%, petty businessmen 20% and others 20% of study subjects.

Table 1: Socio-demographic factors.

Variables	Number of patients	Percentage (%)
Age (years)		
31-40	2	4
41-50	4	8
51-60	20	40
61-70	14	28
71-80	8	16
81-90	2	4
Gender		
Male	36	72
Female	14	28
Literacy		
Illiterate	4	8
Literate	46	92
Socioeconomic status		
High	0	0
Middle	0	0
Low	50	100
Marital status		
Married	38	76
Unmarried	12	24
Occupation		
Laborer	16	32
Fishermen	14	28
Petty businessmen	10	20
Others	10	20

Behavioural factors

Among the fifty study participants, 20 (40%) either smoked or chewed tobacco and 16 (32%) consumed alcohol.

Majority (92%) of the patients were sedentary, 4% performed light physical activity while the remaining 4% performed moderate physical activity as shown in the Table 2.

Table 2: Behavioral factors.

Variables	Number of patients	Percentage (%)
Smoking/tobacco chewing	20	40
Alcohol use	16	32
Physical activity		
Sedentary	46	92
Light	2	4
Moderate	2	4

Clinical parameters

The clinical parameters are presented in detail in Table 3.

Duration of diabetes

All study participants had type II diabetes for >10 years.

Family history of diabetes

84% of study participants had family history of diabetes.

Body mass index (BMI)

90% of study participants were overweight (BMI 25-29.9) and remaining 10% were obese (BMI ≥30)

Co-morbidities

Hypertension was present in 80% of study participants, ischemic heart disease in 64% and hypercholesterolemia in 72%.

Table 3: Clinical parameters.

Variables	Number of patients	Percentage (%)
Duration of diabetes (years)		
0-5	0	0
5-10	0	0
>10	50	100
Family history of diabetes		
Present	42	84
Absent	8	16
BMI (kg/m^2)		
Underweight (<18.5)	0	0
Normal (18.5-24.9)	0	0
Overweight (25-29.9)	45	90
Obese (≥30)	5	10
Co-morbidities		
Hypertension	40	80
Ischemic heart disease	32	64
Hypercholesterolemia	36	72

Clinical presentation

The clinical presentation is shown in Table 4.

Table 4: Clinical presentation.

Variable	No. of patients	Percentage (%)
Mode of presentation		
Skin changes	50	100
Gangrene	11	22
Discharge with foul smell	42	84
Ulcer	50	100
Site of lesion		
Toes	31	62
Dorsum of foot	4	8
Plantar	8	16
Multiple ulcer	3	6
Lateral aspect of foot	1	2
Dorsum and toes	2	4
Whole foot	1	2
Ulcer category (Wagner's classification)		
Grade 0	0	0
Grade 1	8	16
Grade 2	9	18
Grade 3	10	20
Grade 4	21	42
Grade 5	2	4
History of trauma		
Present	40	80
Absent	10	20
Pathology		
Neuropathy	40	80
Peripheral vascular disease (Vasculopathy)	20	40
Both	10	20

Mode of presentation

All study participants had skin changes showing discolouration on the foot and 22% of them showed gangrenous change. Ulcer was present in all study subjects and it was associated with foul smelling discharge in 84% of them.

Site of lesion

Toes were the commonest site of lesion seen in 62% of study participants followed by plantar aspect in 16%. Whole foot and lateral aspect of foot were the least involved (2% each).

Ulcer category (Wagner's classification)

Majority (42%) of study participants had Grade 4 ulcer followed by Grade 3 ulcer (20%). Grade 2 ulcer was seen in 18%, Grade 1 was seen in 16% and Grade 5 was seen in 4%.

History of trauma

It was present in 40 (80%) of study participants.

Pathology

Neuropathy was present in 80% of study participants while peripheral vascular disease was seen in 40% and 20% had both these phenomena.

Investigations

Routine investigations

Complete blood counts elevated in 84% of study participants. Anemia was seen in 32% of participants.

Blood sugar test-fasting blood sugar was done in all patients and it was elevated in the range of 180-220 mg/dl.

HbA1c test-The mean HbA1c value in the study was 7.5.

Radiological investigation

X-ray foot showed osteomyelitis in 10 (20%) patients and arterial Doppler of lower limbs showed peripheral vascular disease in 30 (60%) patients.

Specific investigation

Culture and sensitivity test-There was a preponderance of gram-positive organisms infecting the diabetic ulcers in our study. The commonest organism was Staphylococcus aureus (24%) followed by beta hemolytic *Streptococci* (18%). *Pseudomonas* was the common gram-negative organism seen (10%). The infection was polymicrobial in 4% of patients. There was no growth in 14% of participants (Table 5).

Table 5: Causative organisms.

Causative organisms	Number of patients	Percentage (%)
S. aureus	12	24
Enterococci	7	14
Streptococci	9	18
Proteus	2	4
E. coli	4	8
Klebsiella	2	4
Pseudomonas	5	10
Bacteroids fragilis	0	0
Polymicrobial	2	4

Treatment

Conservative management involving insulin or oral hypoglycemics or both for diabetic control, antibiotic cover and foot care was given to 1 (2%) patient. Remaining patients were managed surgically. Incision and drainage were done in 4 (8%) patients, wound debridement in 38 (76%) patients and disarticulation in 2 (4%) patients. 17 (34%) patients required amputation, out of which Ray's amputation was done in 12 (24%) patients, trans-metatarsal amputation in 1 (2%) patient, below knee amputation in 3 (6%) patients and above knee amputation in 1 (2%) patient (Table 6).

Table 6: Modalities of treatment.

Modalities of treatment	Number of patients	Percentage (%)
Conservative management	1	2
Surgical management		
Incision and drainage	4	8
Wound debridement	38	76
Disarticulation	2	4
Amputation		
Ray's	12	24
Trans metatarsal	1	2
Below knee	3	6
Above knee	1	2

Response to treatment/prognosis

Out of 50 patients, lesion healed by primary healing (re-epithelialisation) in 30 (60%) patients, 2 (4%) patients needed skin grafting as final treatment and 17 (34%) patients needed amputation.

DISCUSSION

The current study was a hospital based prospective study conducted on a total of 50 diabetic foot patients who presented to the surgical outpatient department or admitted to surgical wards of Karwar institute of medical sciences, Karwar, Karnataka between October 2019 to March 2020.

In our study, majority (40%) of participants were in the age group of 51-60 years. This observation is similar to the findings of study by Al-Mahroos et al.[16] The mean age of presentation was 60.08 years. Similar findings were reported by Vibha et al.[17] The youngest patient in our study was 36 years old and oldest was 86 years old, which is similar to findings reported by Khan et al.[18] Advancing age was significantly associated with diabetic foot in various studies.[19,20]

There was a male preponderance in our study with 72% patients being males. The male: female ratio was 2.6:1. This is similar to the observation in a study done by Navarro-peternella et al.[20] Female preponderance among diabetic patients was reported by Vibha et al.

In the present study, 92% of the study subjects were literate. All the study participants had low socio-economic status. This is in accordance with the study done by Vibha et al. This association between low socio-economic class and diabetic foot may be due to lack of awareness about diabetic complications and foot care,

lack of prompt treatment of foot injuries and non-affordability for treatment.

24% of study participants were unmarried and exhibited lack of support and care. Diabetic foot was common among the unskilled workers in our study which could be due to risk of occupational trauma among them.

The behavioural factors associated with diabetic foot in the present study were tobacco use (40%), alcohol consumption (32%) and lack of physical activity (92%). Similar findings were observed by Navarro-peternella et al.[20] Tobacco use and sedentary life style have been identified as a risk factor for diabetic foot in various studies.[20,21]

All study participants had long duration of type II diabetes (>10 years) and family history of diabetes was present in 84%. Longer duration of diabetes was reported as a risk factor for diabetic foot by Shahi et al.[21] Majority of participants were overweight (90%) and rest were obese in our study. Elevated BMI was associated with higher risk of developing diabetic foot in studies by Zantour et al and Sohn et al.[22,23] However, Malgrange et al did not found this association.[24]

The participants in our study had comorbidities like hypertension (80%), ischemic heart disease (64%) and hypercholesterolemia (72%).

The commonest presentation of diabetic foot in the present study was skin changes showing discolouration on the foot and ulcer which was seen in all participants (100%). Gangrenous change was seen in 42% and foul-smelling discharge from ulcer was seen in 84% of them. This is similar to the study of Apelquist et al.[25]

In the present study, the commonest site of lesion were toes involved in 62% of study participants followed by plantar aspect in 16%. The least involved sites were whole foot and lateral aspect of foot (2% each) similar to study of Apelquist et al.[25]

Ulcer categorisation was done by Wagner's classification. Grade 4 ulcer was the commonly observed ulcer in our study seen in 42% of participants and grade 5 ulcer was the least common (4%) which was similar to the study by Mehraj et al.[26] History of trauma was present in 80% of study participants which is comparable to the findings of study by Reiber et al.[27]

In this study, neuropathy was seen in 80% of study participants, peripheral vascular disease in 40% while 20% had both these phenomena. Similar findings were reported by Khan et al.[18]

All participants in the present study had moderate control of diabetes as observed by elevated fasting blood sugar and mean HbA1c value. Osteomyelitis was seen on X-ray foot in 20% patients. Arterial Doppler of lower limbs showed vasculopathy in 60% patients.

There was a preponderance of gram-positive organisms infecting the diabetic ulcers in the present study. Staphylococcus aureus (24%) was the most common organism followed by beta hemolytic *Streptococci* (18%). The common Gram-negative organism was *Pseudomonas* (10%). The infection was polymicrobial in 4% of patients while there was no growth in 14%. Similar findings were reported by Wheat et al.[28]

In our study, conservative management which included insulin or oral hypoglycemics or both for diabetic control, appropriate antibiotic cover for infected ulcers and good foot care was given to 2% patient. Remaining patients required surgical treatment in the form of incision and drainage (8%), wound debridement (76%) and disarticulation (4%). Amputation was required in 34% patients. Among them, 24% underwent Ray's amputation, 2% trans-metatarsal amputation, 6% below knee amputation and 2% above knee amputation. This is similar to the series reported by Mehraj et al. In the present study, most lesions healed by primary healing (60%), while skin grafting was required in 4% and 34% patients needed amputation.

The limitation of the present study was short duration of the study because of which long term benefits of treatment and chronic complications of diabetic foot could not be assessed.

CONCLUSION

Diabetic foot is a common complication of long-standing diabetes. Several socio-demographic factors like advancing age, low socio-economic status, lack of family support, occupations involving risk of trauma to foot contribute to the risk of developing diabetic foot in diabetics. Tobacco use, sedentary life style, longer duration of diabetes, family history of diabetes, higher body mass index and uncontrolled diabetes are the behavioural and clinical risk factors for diabetic foot. Peripheral neuropathy is also an important factor in the development of foot lesions. Hence it is essential to educate all the diabetic patients at risk about good glycemic control, risk factors, proper foot care, periodic foot examination and neurological examination of lower limbs, prompt treatment of foot lesions and regular follow-up. It is also imperative to screen all diabetic patients for foot lesions at the time of diagnosis. An aggressive and multidisciplinary approach should be employed in diabetic foot cases to salvage the limb from amputation.

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