

Original Research Article

Diabetic foot ulcer: a clinical study

Aymen Ahmad Khan^{1*}, Suraj Singh², Vasundhara Singh³, Shadma Khan⁴

¹Department of General Surgery, Integral Institute of Medical Sciences and Research, Lucknow, Uttar Pradesh, India

²Department of General Surgery, Dr. Hedgewar Arogya Sansthan, Karkardooma, New Delhi, India

³Department of Obstetrics and Gynecology, Kasturba Hospital, New Delhi, India

⁴Department of Obstetrics and Gynecology, Katihar Medical College, Bihar, India

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*Correspondence:

Dr. Aymen Ahmad Khan,

E-mail: aymenahmadkhan@gmail.com

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ABSTRACT

Background: Diabetic foot ulcer is one of the common presentations of diabetic foot. The diabetic foot may be defined as a group of syndromes in which neuropathy, ischemia and infection lead to tissue breakdown, resulting in morbidity and possible amputation (World Health Organization, 1995) According to the diabetes atlas 2013 published by the International Diabetes Federation, the number of people with diabetes in India currently is 65.1 million, which is expected to rise to 142.7 million by 2035. The objective of the present study was to evaluate the various presentations of diabetic foot ulcer like, resistant deep infections, ulcer with cellulitis, severe ischemia leading on to gangrene and to study percentage of surgical intervention like debridement, minor/major amputation.

Methods: 60 patients of diabetic foot ulcer admitted in the department of general surgery at Guwahati Medical College, Guwahati during the period of August 2014 to August 2015.

Results: The highest number of patients was seen in the age group of 56-65 years. The male to female ratio was approximately 1.4:1. Surgical complications are more common in men commonest presenting lesion was ulcers. Commonest site of lesion was toes. Trivial trauma is the initiating factor in about 68% of the cases. Most of the patients had history of diabetes mellitus between 6 to 10 years. Most common microorganisms grown from culture taken from the lesion was *Staphylococcus aureus*. Conservative treatment consists of control of diabetes with human insulin along with antibiotics along and simple dressing, wound debridement, slough excision, followed by dressing. Split skin grafting, disarticulation, bellow knee amputation, and above knee amputation, were the other modes of treatment. There was no mortality in present study.

Conclusions: Management of the surgical patient with diabetes should be based on knowledge of the path physiology of diabetes and on an assessment of its chronic complications.

Keywords: Diabetes mellitus, Foot ulcer, Conservative treatment

INTRODUCTION

Diabetic foot ulcer is one of the common presentations of diabetic foot. The diabetic foot may be defined as a group of syndromes in which neuropathy, ischemia and infection lead to tissue breakdown, resulting in morbidity and possible amputation (World Health Organization, 1995)

The number of people with diabetes worldwide was estimated at 131 million in 2000; it is projected to increase to 366 million by 2030.¹ Previous studies have indicated that diabetic patients have up to a 25% lifetime risk of developing a foot ulcer.² The annual incidence of diabetic foot ulcers is ~3%, and the reported incidence in U. S. and U. K. studies ranges as high as 10%.³

According to epidemiological studies, the number of patients with DM increased from about 30 million cases in 1985, 177 million in 2000, 285 million in 2010, and estimated if the situation continues, more than 360 million people by 2030 will have DM.⁴⁻⁶

According to Wilman et al, diabetic foot ulceration is a worldwide health problem approximately 15% of the 10 million diabetic patients in USA will develop foot ulcer at some time in their life time.⁷ The foot ulcer in this population is extremely debilitating and dramatically increases the risk of lower extremity amputation. According to the Diabetes Atlas 2013 published by the International Diabetes Federation, the number of people with diabetes in India currently is 65.1 million, which is expected to rise to 142.7 million by 2035.⁸

The clinical study of diabetic foot ulcer is undertaken to assess the various presentations of diabetic foot ulcer like, resistant deep infections, ulcer with cellulitis, severe ischemia leading on to gangrene and to study percentage of surgical intervention like debridement, minor/major amputation.

METHODS

This study was conducted comprising of, 60 patients of diabetic foot ulcer admitted in the department of general surgery at Guwahati Medical College, Guwahati during the period of August 2014 to August 2015. This was a hospital based prospective observational study.

Method of collection of data

Detailed history taking, thorough physical examination, routine investigations, relevant special investigations, choosing the appropriate line of treatment.

Inclusion criteria

All patients with diabetes mellitus suffering from foot ulcers and infections of all age groups, incidental diagnosis of diabetes on admission with diabetic foot ulcer and patients with gangrenous foot, complicated by diabetes are included in the study.

Exclusion criteria

Exclusion criteria were patients with foot infections without diabetes mellitus, patients with gangrene foot of aetiology other than infection of foot complicated by diabetes, patients whose treatment could not be completed.

RESULTS

Age

Of 60 cases studied, most of the diabetic patients were in the age group of 56-65 (38.33%) followed by 46-55

(23.33%). Out of 60 patients 76.67% of the patient was above the age 45 years. The youngest patient was of 31 years and the oldest was of 91 years.

Sex distribution

In present study out of 60 patient 35 were male and 25 were females. It shows male predominance. 35 (58%) were male patient and 25 (42%) cases were female. Ratio of male: female was 1.4.

Clinical presentation

Out of 60 cases 45 (75%) patients presented with ulcer, 2 cases presented with abscess and 4 cases presented with osteomyelitis and 9 (15%) cases presented with gangrene. Ulcer was the most common presentation.

Site of lesion

The most common site of lesion was toes found in 23 patients (38.33%) followed by dorsum of foot involved in 18 patients (30%). The least was whole foot involvement found in 1 patient (1.67%)

History of trauma

In present study history of trauma (thorn prick, shoe bite, nail prick, wood piece prick etc. as a precipitating factor was present in 41 patients making a total of 68.33%.

Pathology

Out of 60 patients 43 (71.67%) patients had neuropathy, 15 (25%) had vasculopathy and in 12 (20%) both neuropathy and vasculopathy was there. In 13 patients (21.67%) pathology couldn't be identified.

Duration of diabetes mellitus

In present out of 60 patients, 4 were diagnosed on date of admission and 56 patients were known diabetic. There were 28 (46.67%) patients with duration of diabetes between 6 to 10 years. In this a patient aged 91 years has history of diabetes for last 27 years.

Incidence of different causative organisms

The most common organism grown on culture of pus was *Staphylococcus aureus* in 16 (26.66%) patients followed by enterococcus in 14 patients (23.33%), *Streptococci* in 12 (20%), *Proteus* in 9 patients, *E coli* in 8 patients, *Klebsiella* in 4 patients and *Pseudomonas* in 3 patients. In 4 patients (6.66%) there was no growth. In 10 (16.66%) patients the growth was polymicrobial.

Treatment given to patient

In the present series conservative treatment was given to 5 patients, in 46 patients debridement was done, major amputation was done in 8 patients, disarticulation was

done in 14 patients and drainage of pus was done in 2 patients. Split skin grafting was done in 13 patients as a final treatment.

Lesion outcome (prognosis)

Out of 60 patients 39 (65%) patient's lesion healed by primary healing (re-epithelialisation) by means of regular dressing, 13(21.67%) patients needed skin grafting as final treatment and 8 (13.33%) patients needed amputation.

Duration of hospital stay

The average duration of hospital stay was 41 days with minimum days of stay of 8 days and the maximum days of stay being 166 days. Maximum number of patient was in the range of 21-40 days.

DISCUSSION

Sixty cases were studied from 20th August 2014 to 20th August 2015 at Guwahati Medical College and Hospital, Guwahati. The analysis of the study is as follows. When compared with Wheel Lock et al there is not much differences in youngest and oldest group as shown in Table 1.⁹ In the study of Mummidi et al, the youngest was 31 years and the oldest was 80 years, they studied 100 patients from Jan 2013 to June 2014.¹⁰

Table 1: Comparison with age.

Age group	Wheel Lock et al 1969	Present Study
Youngest	32	31
Oldest	89	91

Table 2 presents the age group presented with diabetic foot ulcer was 56-65 years which is also the common period in Mayfield et al study.¹¹ This study indicates that diabetic foot ulcer usually occurs in the elderly, as 86.99% of the patient presenting with diabetic foot ulcer were above 45 years of age.

Table 2: Age wise distribution.

Age (years)	Mayfield et al	Present Study
25-35	2%	10.00%
36-45	15%	13.33%
46-55	29%	23.33%
56-65	34%	38.33%
>65	20%	15.00%

Like Mayfield et al study, the present study had more number of male patients (35) suffering from diabetic foot lesions than females (25).¹¹

The present study had ratio of male:female as 1.4 where as in Mayfield study male:female ratio was almost equal.¹¹ In Mummidi et al study the male predominance was there in there study 78% patients were male.¹⁰ Male predominance has no clear explanation but may be due their occupational and recreational activities there is more stress on the feet.

Table 3: Sex distribution.

Sex	Mayfield et al	Present Study
Male	32 53%	35 58.33%
Female	29 47%	25 41.67%

Like Apelquist et al, the most common presentation was ulcer which included 45 patients out of 60 patients.¹² The ulcer included both the superficial and deep. The commonest presentation is ulcer followed by gangrene and abscess/osteomyelitis which is comparable with the study of Apelquist et al.¹² Similarly in study conducted by Qari the most common presentation was ulcer and it was found in 59% of patients.¹³

Table 4: Mode of clinical presentation.

Presentation	Apelquist et al (n = 314)	Present study (n = 60)
Ulcer	200 63%	45 75%
Abscess/osteomyelitis	46 14.64%	6 10%
Gangrene	68 21%	9 15%

In the present study out of 60 patients the most common site of involvement was toes which were found in 23 patients and this was comparable with Apelquist et al and Reiber et al study in which the most common site was also the toes.^{12,14} But in Apelquist et al and Reiber et al , the second most common site of involvement was plantar (metatarsal heads ,mid foot and heel) where as in the present study it was the dorsum of foot.^{12,14}

Table 5: Site of lesion.

Site of lesion	Apelquist et al (n = 314)	Reiber et al (n = 302)	Present study (n = 60)
Toes	51%	52%	38.33%
Dorsum of foot	14%	11%	30%
Plantar	28%	37%	18.33%
Multiple ulcer	7%	0%	0%
Lateral aspect of foot	0%	0%	6.67%
Dorsum and toes	0%	0%	5%
Whole foot	0%	0%	1.67%

In present study out of 60 patients, 41 cases were having history of trauma, it accounts for 68.33% of the present study. This is compared with Reiber et al series in which 77% of ulcer pathways include trauma.¹⁴

Sensory neuropathy can cause loss of variety of sensations like touch, pressure, temperature, vibration, position and pain. When the sensation of pain is lost it gives rise to an insensate foot, resulting in repetitive unrecognized trauma and abnormal distribution of pressure on the feet and hence emerge as the principal factor in causing foot ulcer.

Table 6: History of trauma.

History of trauma	No. of patient (n = 60)	Percentage
Positive	41	68.33%
Negative	19	31.67%

In present study out of 60 patients 43 patients (71.67%) had neuropathy which is comparable with Reiber et al in which neuropathy was there in 78% of the patients.¹⁴ In the present study 47(78.33%) patients had either neuropathy or vasculopathy. The majority of the patients having neuropathy/vasculopathy had history of diabetes of more than 5 years.

Table 7: Pathology.

Pathology	Reiber et al	Present Study
Neuropathy	78%	71.67%
Vasculopathy	35%	25%
Both	-	20%
No neuropathy and vasculopathy	-	21.67%

In the present study the most common organism cultures is *S. aureus* followed by *Enterococcus* which is comparable with Gibbons et al and Wheta et al study.^{15,16}

Table 8: Incidence of different causative organisms.

Organism	Gibbons et al (n=50)	Wheta et al (n=54)	Hughes et al (n=42)	Present study (n=60)
<i>S. aureus</i>	22%	20%	25%	26.66%
<i>Enterococcus</i>	16%	15%	17%	23.33%
<i>Streptococci</i>	13%	23%	20%	20.00%
<i>Proteus</i>	11%	9%	11%	15.00%
<i>E coli</i>	7%	5%	3%	13.33%
<i>Klebsiella</i>	4%	6%	7%	6.66%
<i>Pseudomonas</i>	3%	3%	0%	5%
<i>Bacteroids fragilis</i>	-	2	5%	5%

In the present series conservative treatment was given to 5 patients, in 46 patients debridement was done, major amputation was done in 8 patients, disarticulation was done in 14 patients, and drainage of pus was done in 2 patients. Split skin grafting was done in 13 patients as a final treatment.

Proper control of diabetes is very important in diabetic foot management, fasting and post prandial blood sugar estimation were well under control.

Initially the patient were started on broad spectrum antibiotic and if required it was changed depending on the culture and sensitivity report.

Table 9: Amputation.

Study	Number of cases	Amputation	Percentage
Collen et al	215	83	38.6%
Oyibo et al	194	30	15.4%
Present study	60	8	13.3%

In the present study out 60 cases studied 65% had good prognosis which healed by re-epithelialisation which is comparable with Apelquist et al and Reiber et al study.^{12,14} In the present series all the patient recovered finally there was no mortality and 13.33% underwent amputation.

Table 10: Lesion outcome (prognosis).

Lesion outcome	Apelquist et al	Reiber et al	Present study
Primary healing	63%	81%	65.00%
Amputation	24%	14%	13.33%
Skin grafting	-	-	21.67%
Death	13%	5%	0%

This study consists of 60 cases of diabetic foot ulcer patients with emphasis on various presentation and surgical intervention over a period of 12 months.. After analysis of the data the following are the conclusions.

The youngest patient in present study series of 60 patients studied was 31 years, and the oldest 91 years. The highest number of patients was seen in the age group of 56-65 years. The male to female ratio was approximately 1.4:1. Surgical complications are more common in men due to their increased susceptibility to trauma, smoking, and alcoholism. Commonest presenting lesion was ulcers, followed by gangrene and abscess/osteomyelitis. Commonest site of lesion was toes (including ventral and

Dorsal surface) followed by dorsum of foot. Trivial trauma (prior to diabetic foot ulcer) is the initiating factor in about 68% of the cases.

Out of 60 patients 4 were diagnosed of diabetes mellitus on date of admission. Most of the patients had history of diabetes mellitus between 6 to 10 years. All most all the patient had infection (only in 4 patients the culture was sterile) in addition to neuropathy and ischemia. This study shows that all three are can be there in diabetic foot ulcer. Minimum duration of stay in hospital was 8 days and maximum 166 days. Most common microorganisms grown from culture taken from the lesion was *S. aureus* followed by *Enterococcus*.

Conservative treatment consists of control of diabetes with human actrapid / human mixtard/lente/Glarginie insulin along with appropriate oral or iv antibiotics along with simple dressing was effective few cases. Wound debridement, slough excision, followed by dressing with povidine-iodine, metronidazole, collagenase, L- lysine, mupirocin, etc. dressings resulted in healing of ulcers. Split skin grafting, disarticulation, bellow knee amputation, and above knee amputation, were the other modes of treatment. There was no mortality in present study.

CONCLUSION

Diabetes is a lifelong problem, and the incidence of diabetic foot complications increases with age and duration of the disease. Diabetic patients at risk for foot lesions must be educated about risk factors and the importance of foot care, including the need for self-inspection and surveillance, monitoring foot temperatures, appropriate daily foot hygiene, use of proper footwear, good diabetes control, and prompt recognition and professional treatment of newly discovered lesions. They take a tremendous toll on the patient's physical and mental well-being as well as impose a substantial economic burden, often removing the patient from the workforce and placing a financial drain on the health care system.

The management of the surgical patient with diabetes should be based on knowledge of the path physiology of diabetes and on an assessment of its chronic complications.

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