

Original Research Article

Diabetic foot ulcer and its surgical management

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Received: 29 November 2019

Revised: 10 December 2019

Accepted: 16 December 2019

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ABSTRACT

Background: Almost 80% population of diabetic foot are from low to middle income countries like India, a country with second largest number of diabetic populations. Prevalence of diabetes mellitus in India is 9.3%. Lower extremity diseases, including peripheral neuropathy, peripheral arterial disease, and foot ulceration, is twice common in diabetic subjects. The most feared consequence of diabetic foot ulcer is limb amputation, which is seen 10 to 30 times more often in person with diabetes. The objective of this study concentrates on surgical management of diabetic foot ulcer.

Methods: This is an observational prospective study of 100 cases for evaluation of diabetic foot ulcer and its surgical management at P.D.U. Hospital, Rajkot from January 2017 to November 2018.

Results: The average age of presentation is 55.70 year. The male to female ratio was 1.27:1. Most of the patients are from lower middle class and upper lower class according to modified kuppuswamy socioeconomic classification. Most of the patients have duration of diabetes more than 5 years. Most common microorganism grown from culture was *Staphylococcus aureus*. This study has higher rate of amputations of 74% due to late presentation and neglected disease due to peripheral neuropathy causes decreased pain sensation. There was no mortality in this study.

Conclusions: Management of diabetic foot ulcer is by multimodal approach with conservative and surgical approaches. Preventive measures, early diagnosis and timely surgical intervention prevents limb amputations in diabetic foot ulcer.

Keywords: Amputations, Diabetic foot ulcer, Diabetes mellitus

INTRODUCTION

In 19th century Frederick Treves suggested a different approach for the treatment of ulcers, using sharp debridement of callus after application of linseed poultices to soften the callus. After debridement, an antiseptic cream would be applied to the thin fresh pink epidermis. Once the patient started mobilizing again, he instructed the patient to wear a thick pad of felt plaster over the healed ulcer to reduce pressure and prevent recurrence of the wound.¹

Another important achievement of the 20th century was the ability of revascularization and limb salvage. Frank

Wheellock (1919-2006) was the first American surgeon responsible for the end to side femoral popliteal bypass graft.² Emphasis on foot preservation became increasingly important and resulted in the development of distal revascularization to restore foot perfusion. Angioplasty was initially described by an interventional radiologist Charles Dotter in 1964. In January of that year, he successfully dilated a superficial femoral artery in an 82-year-old patient. Toward the end of the 20th century, the angioplasty technique was developed further, and it became possible to revascularize distal arteries down to foot arteries. It was found to be a safe and effective method for limb salvage in patients with diabetes.³

According to data almost 80% population of diabetic foot are live in low to middle income countries like India, a country with second largest number of diabetic populations after China.⁴ Prevalence of diabetes mellitus in India is 9.3% with low prevalence in Jharkhand, Tamil Nadu and Chandigarh.⁵ After this data more than half of the population remains undiagnosed. The annual incidence of diabetic foot ulcer in population-based studies is 25% in lifetime.^{6,7} Foot wounds not only add to morbidity but also to health care cost and are attributed as the most frequent cause for diabetes associated hospitalization.

The age adjusted incidence for nontraumatic lower limb amputations in person with diabetes ranges from 2.1 to 13.7 per 1000 persons. Therefore, it is believed that in every 30 seconds a lower limb is lost somewhere in the world as a consequence of diabetes.⁷

Main objective of the study was to collect data on diabetic foot ulcer and with early diagnosis and its surgical treatment to limit ulcer's progression.

METHODS

Inclusion criteria

- The study included total 100; male and female patients came to surgical outpatient department with age above 40 years. They should have only diabetes mellitus type 2 with infected lower limb disease.

Exclusion criteria

- The study doesn't include the patients with less than 40 years of age. Patients with upper limb disease with diabetes mellitus, peripheral vascular disease, associated hypertension and presented with diabetic coma are not included.

Documentation of patients, which included identification, economic status, history, clinical findings, diagnostic test, operative procedure and complications in postoperative phase and subsequent follow up period, were all recorded on a patient information sheet specially prepared. Modified Kuppaswamy classification is used to decide patients' socioeconomic class in present study. It took three parameters into account, namely; education, occupation, and income of the individual.

Study group

This study was conducted comprising of 100 patients of diabetic foot ulcer admitted in the department of general surgery, PDU Hospital, Rajkot. This was a hospital based cross sectional study from January 2017 to November 2018.

Statistical analysis

As this was an observational data collection study, with no hypothesis testing, formal calculation of sample size and statistical power was not performed.

RESULTS

Diabetic foot ulcer is more common in age group of 41-60 years of age of 68% and average age of presentation was 55.70 year. So, as the age increases in diabetic patients, they are more prone to the diabetic foot ulcer. It is due to aging (Table 1).

It is more in upper lower 79% and in lower middle class 16%. Upper middle class has 4% patients of diabetic foot ulcer. Because of lower income initial disease is neglected and lack of proper awareness of disease. (Table 2).

Among 80 patients were having duration of diabetes mellitus greater than 5 years and they were more prone to develop diabetic foot ulcers because neuropathy and microangiopathy which stay in center in development of the diabetic foot ulcer patients. 12 patients had less than 5 years of diagnosis and 8 were diagnosed on admission which is due to late diagnosis of the disease (Table 3).

Table 1: Age wise distribution.

Age (years)	No of patients(n=100)	Percentage (%)
41-50	30	30
51-60	38	38
61-70	27	27
>70	5	5
Total	100	100

Table 2: Incidence according to modified Kuppaswamy socioeconomic class.

Class	No of patients	Percentage
I (upper)	0	0%
II (upper middle)	4	4%
III (lower middle)	16	16%
IV (upper lower)	79	79%
V (lower)	1	1%

Table 3: Duration since diagnosis of diabetes on admission.

Duration since diagnosis of diabetes (in years)	No of patients	%
Undiagnosed	8	8%
<5	12	12%
5-10	41	41%
>10	39	39%
Total	100	100%

Among 15 patients had diabetes mellitus under control and 85 patients had uncontrolled diabetes. Disease progresses if the blood sugar level is not maintained and ulcer is common in uncontrolled diabetic patients (Table 4). 65 patients were having changes of osteomyelitis in local part X-ray and rest 35 patients were not having osteomyelitic changes (Table 5). 98 patients were treated with combined antibiotics therapy to cover gram negative, gram positive and anaerobic bacteria. Diabetic foot ulcer needs vigorous broad-spectrum antibiotic therapy initially and later on according to sensitivity (Table 6).

Table 4: Control of diabetes on admission.

Diabetes control status	No of patients	%
Controlled (FBS-80 to 130 mg/dl and pp ₂ bs - <180 mg/dl)	15	15%
Not in controlled (FBS - >130 mg/dl and pp ₂ bs - >180 mg/dl)	85	85%
Total	100	100%

Table 5: No of patients having associated osteomyelitis.

Osteomyelitis	No of patients	Percentage
Yes	65	65%
No	35	35%
Total	100	100%

Table 6: No of patients having mono vs combined antibiotic therapy.

Antibiotic therapy	Patients having combined antibiotic therapy	%
Mono antibiotic therapy	2	2%
Combined antibiotic therapy	98	98%
Total	100	100%

Among 23% swab cultures were positive for *Staph. Aureus* which is more common in infected diabetic foot ulcers and rest are *Klebsiella pneumoniae* 17%, *Pseudomonas aeruginosa* 13%, proteus 6% and *E. coli* 3%. Rest 31% swabs were negative for culture and sensitivity after some surgical procedures (Table 7). 76 patients were on oral hypoglycemic agents and 4 were on solely on injectable insulin therapy while 8 patients were on combine therapy of injectable insulin and oral hypoglycemic agents. Out of 100 patients 12 patients were managed by diet and exercise for diabetes. After admission all were put on injectable insulin. Patients were under stress and they should require insulin or better management of diabetes mellitus (Table 8). 74 patients were undergone some type of amputations and 19 patients required debridement and 7 patients were

managed by dressing, limb elevation and injectable insulin. Amputation is requiring as the disease spreads rapidly and (Table 9).

Table 7: Incidence of patients having positive culture media.

Bacteria	No of patients having positive culture media	%
<i>Klebsiella pneumoniae</i>	17	17%
<i>Staph. Aureus</i>	23	23%
<i>Pseudomonas aeruginosa</i>	13	13%
<i>E. Coli</i>	3	3%
<i>Proteus mirabilis</i>	6	6%
No bacteria found in te:	31	31%

Table 8: Management of diabetes mellitus at the time of admission.

Management of diabetes	No of patients	Percentage
Taking oral hypoglycemic agents	76	76%
On insulin therapy only	4	4%
Insulin therapy + oral hypoglycemic agents	8	8%
Diet and exercise	12	12%
Total	100	100%

Table 9: Surgeries performed for diabetic foot ulcer.

Management	No. of patients	Percentage
Amputation	74	74%
Debridement	19	19%
Managed with daily dressing	7	7%
Total	100	100%

Table 10: Complications of diabetic foot ulcer.

Complications	No of patients	Percentage
Recurrence	2	2%
Neuropathy	76	76%
Callus	5	5%
Deformity	2	2%
No complications	17	17%
Total	100	100%

76 patients have neuropathy, 5 had callus formation while deformity and recurrence were noted in 2 patients and among them 17 had no complications (Table 10).

DISCUSSION

Like Mayfield et al, study, the present study had a greater number of male patients (56) suffering from diabetic foot lesions than females (44). The present study had ratio of

male: female as 1.27 whereas in Mayfield study male: female ratio was almost equal and Khan AA et al, has ratio of 1.4 (Table 11).^{8,9}

Table 11: Comparison of gender distribution between studies.

Gender	May Field et al,	Khan AA et al,	This study
Male	53%	58.33%	56%
Female	47%	41.67%	44%

Table 12: Comparison of age distribution between studies.

Age (years)	Mayfield et al,	Khan AA et al,	This study
41-50	15%	13.33%	30 %
51-60	29%	23.33%	38 %
61-70	34%	38.33%	27 %
71-80	15%	10%	5 %

Most of the patients with diabetic foot ulcer were 56-65 years which is also the common period in Mayfield et al, study.⁸ Khan AA et al, also 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 while in present study most of the patients are from 41-60 years of age group (Table 12).⁹

Table 13: Comparison between studies based on socio-economic class.

Socio-economic class	Gohel Jayesh et al,	This study
I (upper)	9%	0%
II (upper middle)		4%
III (lower middle)	34%	16%
IV (upper lower)		79%
V (lower)	57%	1%

Table 14: Comparison between studies of duration since diagnosis of diabetes.

Duration since diagnosis of diabetes (Years)	Gohel Jayesh et al,	This study
Undiagnosed	13%	8%
<5	3%	12%
5-10	38%	41%
>10	46%	39%

Diabetic foot ulcers are more from lower socio-economic class rather than upper class as in present study 80% patients are from lower class and 20% are from lower middle class while in comparison to the Gohel Jayesh et al, study shows 57% are from lower socio-economic class while 34% are from middle class.¹⁰ It is due to lack of

awareness of disease, lower education and illiteracy (Table 13).

In present study, 41% have 5-10 years of duration and 39% have >10 years of duration of diabetes. In Gohel Jayesh et al, shows more patients in >10 years of duration of diagnosis of diabetes.¹⁰ Diabetic foot ulcers become more common as the duration of the disease increases and it is due to microvascular and macrovascular complications are more prone to occur as the disease duration increases (Table 14). In this study more common organism is *Staph. Aureus* and followed by *Klebsiella Pneumonia* which is comparable with Gohel Jayesh et al, and Khan AA et al, study. The percentages are higher for people who are patients in a hospital or who work there. It is easily spread by direct contact with contaminated objects.^{9,10} (Table 15).

Table 15: Organisms found in different studies.

Organism	Gohel Jayesh et al,	Khan AA et al,	This study
<i>Klebsiella Pneumoniae</i>	13%	6.66%	17%
<i>Staph. Aureus</i>	19%	26.66%	23%
<i>Pseudomonas Aeruginosa</i>	9.5%	5%	13%
<i>E. Coli</i>	3.5%	13.33%	3%
<i>Proteus Mirabilis</i>	-	15%	6%

Table 16: Management comparison between studies.

Management	Ali SM et al,	This study
Amputation	21%	74%
Debridement	46%	19%
Non-operatively managed	33%	7%

In Table 16, there is 74% of amputations were done in cases of diabetic foot ulcer and in 19% of patient's debridement is done in comparison to Ali S M et al, study shows 21% of amputations and in 46% patients underwent debridement.¹¹ Authors institute is government tertiary center so patients are from lower socioeconomic class and patients reach to the hospital at the later stage of disease. They took primary treatment at their local dispensaries and some had neglected their disease as the lack of education. 76% of patients have osteomyelitis at the time of admission that required amputations after vigorous combined antibiotic therapy which is used in 98% of the patients. So, percentage of amputations are done are higher in setup than the comparative study (Table 16).

CONCLUSION

Foot ulceration in diabetic patients is a resource consuming, disabling morbidity that often is the first step towards lower extremity amputation. Population of lower

class should be given education of diabetes mellitus and its risk factors. Prevention is the better than cure is true in this disease, too. Effective glycemic control and education are of key importance for decreasing diabetic foot disease, while early presentation and hospital admission, aggressive and appropriate medical and surgical treatment according to grade of disease can improve outcome and reduce the morbidity and mortality due to diabetes.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Lakhani DJ, Dave JP, Ramani JK, Agrawal KK, Makadiya CR, Solanki PV. Diabetic foot ulcer and its surgical management. *Int J Res Med Sci* 2020;8:25-9.