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Original Research Article

Study of below knee amputation in patients with diabetic foot ulcer in a tertiary care centre in India

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ABSTRACT

Background: This study aims to evaluate the predictive factors affecting the clinical outcome of below knee amputation performed in diabetic foot patients who had developed foot ulcers.
Methods: This is a retrospective study of 25 random patients who underwent below-knee amputation for diabetic foot ulcers. These patients were admitted in the Department of Surgery, Shri MP Shah Medical College, Jamnagar, between November 2017 and October 2019.
Results: The patient's age ranged from 30 to 80 years, with a mean age of 62.92 years. 60% were between the ages of 51 and 70. Of the total, 14 were male and 11 were female, suggesting that males due to generally more active lifestyles, may be at higher risk for foot injuries leading to diabetic ulcers. 64% were from a lower socio-economic background. All 25 patients had previous admissions, 12 had a history of previous amputation, while 13 treated conservatively. Most patients presented with infected or non-healing ulcers, cellulitis and/or gangrene. Primary healing occurred in 13 patients, 7 required refashioning for healing, 3 required transfemoral amputation and 2 patients unfortunately passed away. The mean duration of hospital stay was 49.82±28.07 days.
Conclusions: Lack of awareness, poor glycaemic control and duration of diabetes where the main factors causing diabetic foot problems. For patients with infected feet, difficulty with mobility and prolonged immobilization were common issues. Timely below-knee amputation helped restore movement and improved the ability to use prosthetic limbs, allowing for greater mobility and independence

Keywords: Below knee amputation, Diabetic ulcer, Foot ulcer

INTRODUCTION

Diabetes mellitus is heterogeneous primary disorder of carbohydrate metabolism with multiple etiological factor that generally involves absolute or relative insulin deficiency or insulin resistance or both leading to hyperglycaemia and various long-term complication.[1] India has a dubious distinction of having largest number of persons with diabetes in the world. Type-2 diabetes mellitus has become the most common metabolic disorder. Its prevalence is growing more rapidly among people in the developing world, primarily due to marked demographic and socioeconomic changes in this region. India currently leads the world with an estimated 41 million people with diabetes; this figure is predicted to increase to 66 million by 2025. The diabetes epidemic is more pronounced in urban areas in India, where prevalence rates of diabetes are roughly double than those in rural areas.[2] Following the introduction of insulin and more recently the oral hypoglycaemic agents, the control of diabetes has markedly improved, and the major problem facing diabetic patients, is the development of the long-term complications of the disease, such as neuropathy, angiopathy and ocular complications.[3] Diabetic foot is one of the serious complication of diabetes which is associated with prolonged

hospitalization and risk of lower limb amputation.[4] The increase in incidence of diabetic foot problems is due to rise in diabetic population as well as increase in lifespan of the people. In India, around 45,000 legs are estimated to be amputated every year. The significant risk factors for a patient with diabetes to require an amputation are lower extremity ischemia, neuropathy, a history of foot ulcer, elevated HbA1c and retinopathy and indicators for lower extremity amputations include septic gangrene, peripheral arterial occlusion, non-healing ulcer, severe soft tissue infection and osteomyelitis.

Amputations not only affect the physical functional status but also affect their psychosocial status and increase the financial burden by means of hospital stay and treatment and loss of employment.[5] The risk of lower extremity amputation is 18-30 times higher among those with diabetes in comparison to general population.[6] Amputation becomes inevitable when repeated treatment failure occurs. Limited amputations such as Trans metatarsal, Tarsometatarsal and chopart/lisfranc type amputation may be appropriate due to unsatisfactory vascular and neuropathic status. Stump healing is a frequent problem. Skin flap problem is common among diabetic patients and re-amputation become mandatory. Lower limb amputation is a common end result of a diabetic foot patient in India.[7,8]

METHODS

Study design

This study included 25 randomly selected cases of below-knee amputation performed among cases of lower extremity amputation done in patients with diabetic foot ulcers who were admitted and treated in the Department of Surgery at M.P. Shah Medical College, Jamnagar, between November 2017 and October 2019.

Ethical approval

This study was approved by the Institutional Ethics committee of Guru Gobind singh Hospital, Jamnagar and was prospectively registered with the office of the Drug Controller General, India (ECR/6/INST/GUJ/2013). Case records for each patient were obtained from the medical records branch and details were collected on disease onset, duration, progression, and associated symptoms.

Aims of the study

To examine various epidemiological factors such as age, sex, socio-economic status, and co-morbid conditions. To identify and quantify the risk factors for amputation in diabetic patients with infected foot ulcers. To evaluate the healing patterns following below-knee amputation, including the rate of postoperative stump infection, reoperation rate, hospital mortality and mean duration of hospital stay. To assess the clinical outcomes of diabetic foot patients and the incidence of complications.

Inclusion criteria

This includes below-knee amputation performed for patients with diabetic foot ulcers.

Exclusion criteria

Amputations performed due to, peripheral vascular disease, gas gangrene, trauma, chronic infections, e.g., osteomyelitis, deformities, malignancies, e.g., osteosarcoma were excluded.

Statistical analysis

Data once collected was entered in Microsoft excel sheet and statistical analysis was done using SPSS v19.0 software, Categorical variables were expressed as frequency and percentage and continuous variables were expressed as mean (standard deviation) or median (inter quartile range) based on the normality of data. Information on the nature of the diabetic gangrene wound, whether further interventions such as above-knee amputation or split-skin grafting were needed, and the cause of death, if applicable, was also documented.

RESULTS

A total of 1,650 diabetic patients were admitted to the Department of Surgery at M.P. Shah Medical College, Jamnagar, during the study period, with lower extremity amputation performed on 732 patients, yielding an incidence rate of 44.36 per 100 over two years. The age of patients ranged from 30 to 80 years, with a mean age of 62.92 years (Figure 1). Out of 25 patients, 15 (60%) were within the age group of 51-70 years. All patients above 50 years underwent below-knee amputation. Of the total, 14 patients (56%) were male and 11 patients (44%) were female. A socio-economic distribution revealed that 16 patients (64%) belonged to the lower socio-economic class, while 9 patients (36%) were from the middle socio-economic class, with no patients from the higher socio-economic class.

The duration of diabetes among the 25 patients ranged from 1 to 40 years. 13 patients (52%) had diabetes for 1-10 years, 7 patients (28%) for 11-20 years, 3 patients (12%) for 21-30 years, and 2 patients (8%) for 31-40 years. (Figure 2). All patients were previously diagnosed with diabetes, with no newly diagnosed cases. The occurrence of below-knee amputation did not show a significant correlation with the duration of diabetes. Even though Neuropathy, aggravated by longer diabetes duration, is known to be a primary cause of foot sepsis. Out of 25 patients, 20 patients (80%) had associated comorbidities along with diabetes in which hypertension was the most common comorbidity, affecting 6 patients (24%), while 3 patients (12%) had both hypertension and hyperlipidaemia. 1 patient (4%) each had hypertension with ischemic heart disease (IHD) and hyperlipidaemia with IHD (Table 1).

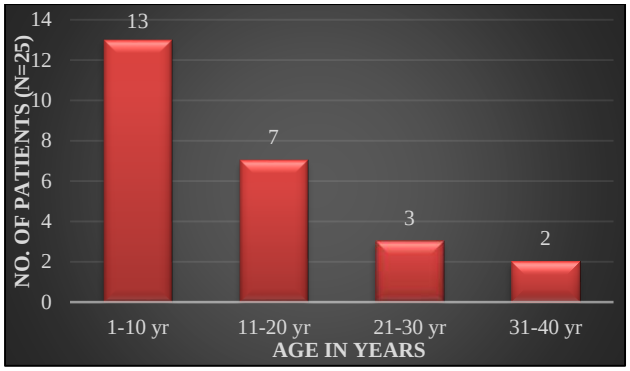

Figure 1: Age distribution.

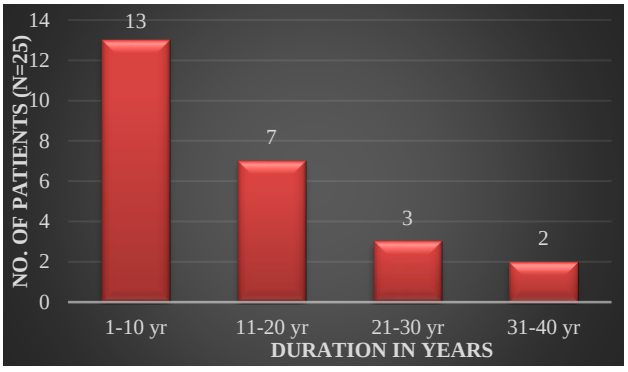

Figure 2: Duration of diabetes mellitus.

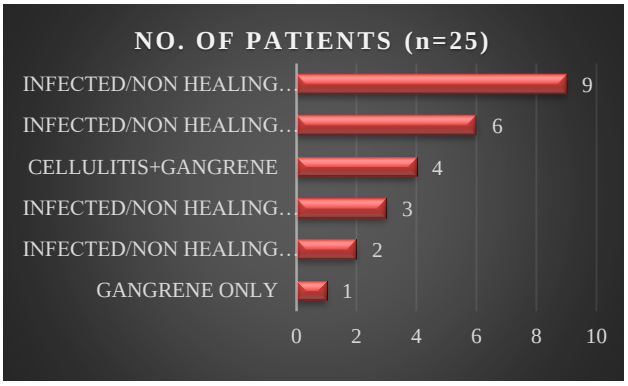

Figure 3: Clinical feature at time of presentation.

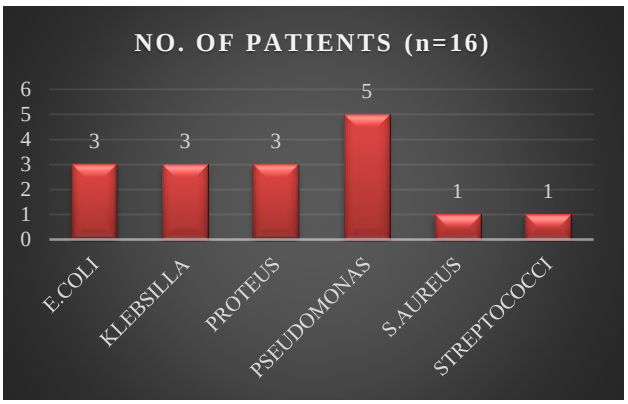

Figure 4: Preoperative microorganisms.

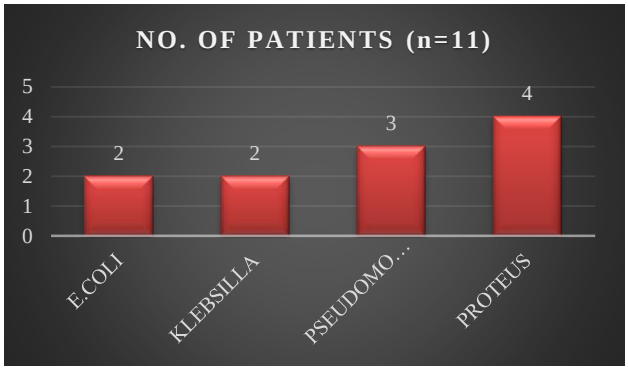

Figure 5: Postoperative infection with microorganism.

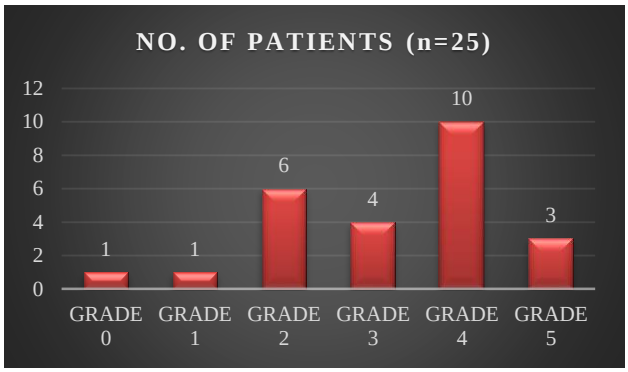

Figure 6: Postoperative wound according to southampton wound grading system.

Smoking status revealed that 11 patients (44%) were smokers and 14 patients (56%) were non-smokers, with no significant correlation found between smoking and below-knee amputation in diabetic patients. Presenting conditions among the patients varied, with 9 patients (36%) showing infected or non-healing ulcers only, 6 patients (24%) having an infected or non-healing ulcer with cellulitis, 4 patients (16%) with cellulitis and gangrene, 2 patients (8%) with an infected or non-healing ulcer accompanied by gangrene, 3 patients (12%) with an infected or non-healing ulcer with cellulitis and gangrene and 1 patient (4%) with gangrene alone (Figure 3).

Preoperative fasting glycaemic control was assessed, with 13 patients (52%) falling into the moderate control group and 12 patients (48%) into the bad control group. None of the patients achieved good control. Post-prandial glycaemic control also followed a similar pattern, with 10 patients (40%) in moderate control and 14 patients (56%) in bad control (Table 2). Diabetes management involved oral hypoglycaemic drugs in 18 patients (72%) and insulin (Inj. Mixtard) in 7 patients (28%).

However, all patients were started on to Inj. Plain insulin before undergoing below-knee amputation. In terms of the surgical approach, 11 patients (44%) had their amputation performed on an emergency basis, while 14 patients (56%) had elective procedures. All patients had previously been admitted for diabetic foot complications.

12 patients (48%) had undergone prior amputations, such as toe or trans metatarsal amputations, while 13 patients (52%) had been treated conservatively. Three patients had multiple admissions due to diabetic foot and received antibiotic and supportive therapy along with proper foot care. Preoperative microbial cultures identified Pseudomonas in 5 patients, Klebsiella in 3 patients, *E. coli* in 3 patients, Proteus in 3 patients, and *Staphylococcus aureus* and Streptococci in one patient each (Figure 4).

Postoperative infections occurred in 11 patients (44%), with Proteus as the most frequent isolate (4 patients, 16%), followed by *E. coli* and Klebsiella (each in 2 patients, 8%), and Pseudomonas (3 patients, 12%), with all three undergoing conversions from below-knee to above-knee amputation (Figure 5).

The wound outcomes, assessed using the Southampton Wound Grading System, classified one patient (4%) as grade 0, one patient (4%) as grade 1, six patients (24%) as grade 2, four patients (16%) as grade 3, ten patients (40%) as grade 4, and three patients (12%) as grade 5 (Figure 6). Regarding hospital stay, ten patients (40%) were hospitalized for 41-70 days, with a mean stay duration of 49.82±SD 28.07 days, showing no significant difference in duration related to below-knee amputation. Wound healing outcomes showed primary healing in 13 patients (52%), healing after refashioning in 7 patients (28%), conversion to transfemoral amputation in 3 patients (12%) and 2 patients (8%) who did not survive (Table 3).

Table 1: Associated co-morbid conditions.

Comorbid factors	No of patients (n=20)
Hypertension only	6
Hypertension+hyperlipidemia	3
Hypertension+ischemic heart disease (IHD)	1
Hyperlipidemia only	2
Hyperlipidemia+IHD	4
IHD only	1
Hypertension+hyperlipidemia+IHD	3

Table 2: Preoperative blood sugar levels.

Pre-operative		No. of patients (n=25)
Fasting blood sugar level	Good control (<110)	0
	Moderate control (111-199)	13
	Bad control (>200)	12
Post prandial blood sugar level	Good control (<140)	1
	Moderate control (141-250)	10
	Bad control (>250)	14

Table 3: Final outcome.

Final outcome	No of patients (n=25)
Transtibial amputation with primary healing	13
Transtibial amputation healing after refashioning	7
Conversion to transfemoral amputation	3
Expired after transtibial amputation	2

DISCUSSION

During the study period total number of diabetic patients admitted in department of surgery, M.P. Shah medical college, Jamnagar were 1650 patients and lower extremity amputation done in 732 patients. Incidence of lower extremity amputation in diabetic patient was total 44.36/100 over two years. In our study age ranged between 30 and 80 years. Out of 25 patients, 15 patients were in the age group 51-70 years. The mean age was 62.9±16.6 years. Dr. Mohammed osman reported mean age was 61.5±11.85 year.[9] The age in years was not significantly related to level of amputation. There were 14 males (56%) and 11 females (44%). Dr. Mohammed Osman9 reported male of 60% and female of 40%. Out of 25 patients, 16 (64%) patients were coming from lower socio-economic class and 9 (36%) patients were came from middle socio-economic class.

Duration of diabetes in our patients ranged from 1 to 40 years. The mean duration of diabetes was 6.25 years. The majority of our patients (52%) had diabetes for more than 10 years. Dr. Mohammed osman reported mean duration of diabetes was 9.04 year.[9] No Any Newly Diagnosed Diabetics Were Reported In our Study There were 6 (24%) patients who had history of hypertension. Ali SM reported systemic hypertension in (18%) of patients presenting with diabetic foot sepsis.[10] 11 patients (44%) were smokers and all were males and non-smokers were 14 patients (56%). No significant correlation was encountered between smoking and level of amputation.

El thair et al, reported 12 % patients were smokers.[10] Patients were presented with infecting/non healing ulcer in 11 patients (44%) and gangrene in 10 patients (40%). Morris AD et al, reported in their series of 258 patients non traumatic major LEAs in diabetic patients, infected non healing ulcer (31%) and gangrene (29%) as the two main indications for amputation.[11] Preoperative glycaemic control was graded as good, moderate and bad according to the blood sugar level. Two indices were considered, FBS and PP2BS. Our study shows that in fasting blood sugar level monitoring, 13 patients (52%) were fall into moderate control group and 12 patients (48%) were fall into bad control group and in post prandial blood sugar level monitoring, 10 patients (40%) were fall into moderate control group and 14 patients

(56%) were fall into bad control group. This clearly depicts that patient who were with moderate glycaemic control underwent below knee amputation than with good glycaemic control.

Diabetes was controlled by oral hypoglycaemic drugs in 18 patients (72%) and by inj. Insulin (Inj. Mixtard) in 7 patients (28%). However, all patients were shifted to inj. Plain insulin after admission. Osman et al reported diabetes was controlled by oral hypoglycemic drugs in 64 patients (92%) and by inj. Insulin in 3 patients (4%) and by diet in 3 patients (4%).[9] In our study 12 patients (48%) reported history of previous admission for amputation and 13 patients (52%) treated conservatively. Dr. Mohammed osman reported 40% history of previous admission for amputation.[9] Out of 25 patients who were underwent below knee amputation 11 patients (44%) operated as in emergency and 14 patients (56%) operated as elective. 11 patients (44%) operated in emergency had wet gangrene associated with infected ulcer/ non healing ulcer/cellulitis and among 3 patients (12%) of 11 had gas gangrene.

Preoperative microorganism was isolated which was pseudomonas in 5 patients (20%) followed by klebsiella in 3 patients (12%), *E. coli* in 3 patients (12%), staphylococcus aureus and streptococci in 1 patient (4%) respectively. Suliman et al reported Preoperative microorganism isolated in which Staphylococcus aureus was isolated in (50%) of patients.[3] It was followed in frequency by coliforms (38.63%), streptococci in (4.55%) and no growth was obtained in 3 cases (6.8%). Postoperative infection was present in 11 (44%) compared with Toursarkissian et al, had 58%.[12] The requirement of reoperation was in 10 (40%) patients. The most frequent type of reoperation was refashioning in 7 (28%), followed by above knee amputation in 3 (12%). In this study we found that after amputation patients were provided with crutches and artificial limbs.

All the patients were feeling comfortable with crutches and artificial limb. Out of 25 patients, 10 patients (40%) were stayed in hospital for 41-70 days. Mean duration of hospital stay was 49.82±SD 16.48 days. Dr. Mohammed osman reported mean duration of hospital stay was 30.14±SD 21.87 days.[9] The overall in hospital mortality in our study was 2 (8%). Dr. Mohammed osman reported hospital mortality was 20%.[9] In our study 25 patients underwent below knee amputation primary healing occur in 13 patients (52%), ended with Transfemoral amputation in 3 patients (12%) and 2 patients (8%) expired.

There are limitations in this study. First, the study had a retrospective design and was conducted at a single center. The determination of the level of amputation was based on the clinical experience of the surgeon, along with a second opinion from another surgeon, rather than on objective imaging techniques such as magnetic resonance (MR) angiography, computed tomography (CT) angiography, or Doppler ultrasound. Additionally, in more than 50% of the patients with diabetes, the exact cause of amputation could not be conclusively attributed solely to diabetes, as the presence of peripheral vascular disease in these patients was not evaluated.

CONCLUSION

In conclusion, this study underscores the multifaceted challenges faced by diabetic patients with infected ulcers, particularly those requiring amputation, and highlights the critical importance of timely intervention, comprehensive management, and patient education. By emphasizing the significance of early diagnosis, blood sugar control, and appropriate treatment strategies-including infection control, anemia correction, and revascularization-this research contributes to a deeper understanding of how these factors can improve outcomes, reduce the risk of further amputations, and enhance patient quality of life.

Furthermore, the study calls for increased public awareness and the integration of rehabilitation programs that provide necessary resources, such as prosthetics and mobility aids, to support patients in their recovery. Overall, it advances knowledge in the field by identifying key areas for improving care, reducing psychological burden, and promoting better long-term outcomes for diabetic patients facing the risk of amputation.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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