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Surgery

A Study of Clinical and Surgical Management of Diabetic Foot

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Original Research Article

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Abstract: A sum of 50 patients with diabetic feet was treated between 2014 and 2016. Wound progress was measured using a digital scanner. Limb salvage procedures like incision and drainage, debridement, slough excision and fasciotomy were carried out. Ten cases with gangrene of toes were treated with ray amputation. Below-knee amputation was done in four cases. A limb was considered salvaged if complete healing was achieved without any major amputations with only debridement or minor amputation through or below ankle. From this study it was concluded that in most cases of diabetic feet, limb salvage was possible if the guidelines on the management of diabetic foot are followed.
Keywords: Diabetic foot, Wagner's classifications, Infection, Limb salvage, Amputation.

INTRODUCTION

The prevalence of diabetes mellitus is growing at epidemic proportions worldwide especially in India. Most alarming is the steady increase in type 2 diabetes, especially among young and obese people [1].

Foot infections in patients with diabetes cause substantial morbidity and frequent visits to healthcare professionals and may lead to amputation of a lower extremity [2].The major predisposing factor to these infections is foot ulceration, which is usually related to peripheral neuropathy. Peripheral vascular disease and various immunological disturbances play a secondary role.

Diabetic foot infections require attention to local (foot) and systemic (metabolic) factors. Providing optimal wound care in addition to appropriate antibiotic treatment of the infection is crucial for healing. Although, many patients with severe infections are hospitalised and treated with intravenous antibiotics, the role of early surgical management is often underrated and severe diabetic foot infections can become limb- or life-threatening events. Because systemic signs of infection are frequently absent or late, all infections must be treated aggressively.

Optimal management of diabetic foot infections can potentially reduce the burdens (medical, financial and ecological) associated with inappropriate practices, including those related to antibiotic prescribing, wound care, hospitalisation decisions, diagnostic testing, surgical procedures and adjunctive treatments.

In this article, we shall analyse the usefulness of limb salvage procedures in preventing eventual limb loss, the need of a major limb amputation, decrease the total cost and may restore full ambulation earlier.

MATERIALS AND METHODS

A total of 56 patients were admitted were analysed for this prospective study conducted from 2014 to 2016. Out of 56 cases, 50 cases were taken up for surgery. The remaining 6 cases not fitting into inclusion criteria were excluded. The detailed history, clinical examination, routine blood and urinary investigations including diabetic profile, X-ray chest and foot, doppler studies, and electrocardiogram were done. Patient's blood sugar levels were maintained according to the diabetologist opinion. Patients with hypertension were controlled with antihypertensive. Patients having chest infection were treated with antibiotics. Consent for study was obtained. When perfusion is impaired as per doppler ultrasound, patients were referred to vascular surgeon to determine the extent of vascular disease and the need for vascular procedures. In present study, we had followed up all the patients after discharge for 15 days, 1 month, 3 months and few cases up to 12 months of duration.

Inclusion Criteria

- Patients with foot ulcers and diabetes mellitus.
- Patients of all ages with diabetic foot.

- Both sexes.
- Patients willing to participate in the study.

Exclusion Criteria

- Non-diabetic foot ulcers.
- Presence of Hansen's disease, neurological illness and connective tissue disorders.
- Death or absconded from ward.
- Patients not willing to participate in the study.

Several foot ulcer classification have been proposed in order to organise the proposed appropriate treatment plan, but none have been universally accepted. The Wagner-Meggitt classification is based mainly on wound depth and consists of six wound grades [3]. The University of Texas system grades the ulcers by depth, and then stages them by the presence or absence of infection and ischaemia [3]. I have used Wagner's System in this study.

Ulcer Severity Classification

Wagner's System

Grade 0: Pre-ulcerative lesion
Grade 1: Partial thickness wound up to, but not through dermis.
Grade 2: Full thickness wound extending to tendons or deeper subcutaneous tissues, but without bony involvement or osteomyelitis.
Grade 3: Full thickness wound involving bone.
Grade 4: Localised gangrene
Grade 5: Gangrene of entire foot

University of Texas System Classification: Addition to Wagner system:

Stage A: Clean wounds.
Stage B: Non-ischaemic, infected wounds.
Stage C: Ischaemic, non-infected wound.
Stage D: Ischaemic, infected wounds.

RESULTS

Age distribution

Age distribution of diabetic foot patients in our study is as follows-

Table-1: Age distribution

Particulars	Frequency (n=50)	Percentage (100%)
<30 yrs.	01	02
31 to 40 yrs.	06	12
41 to 50	16	32
51 to 60	20	40
61 to 70	05	10
>70	02	04

In my study, out of 50 patients, 23 patients were aged below 50 years and 27 patients were aged above 50 years (table 1).

Sex distribution

Sex distribution of diabetic foot patients in our study is as follows-

Table-2: Sex

Particulars	Frequency (n=100)	Percentage (100%)
Male	38	76.0
Female	12	24.0

In my study, out of 50 patients, 38 were males and 12 were females (table 2).

Anatomical Site

Table-3: Anatomical Site

Particulars	Frequency (n=50)	Percentage (100%)
L-foot	22	44.0
R-foot	28	56.0

In my study, out of 50 patients, 28 patients had lesion in the right leg and 22 patients had lesion in left foot (table 3).

Duration of diabetic foot

Table-4: Duration of diabetic foot

Weeks	Frequency (n=50)	Percentage (100%)
<1	06	12.0
2	12	24.0
3	08	16.0
4	06	12.0
5	03	06.0
6	03	06.0
7	05	10.0
8	04	08.0
12	02	04.0
>13	01	02.0

In my study, patients with diabetic foot presented with one week to 13 weeks duration (table 4).

Mode of Presentation in Diabetic Foot

Table-5: Mode of Presentation in Diabetic Foot

Mode of presentation	Number of Patients	Percentage
Infected ulcer	29	58
Gangrene	13	26
Deep abscess	6	12
Osteomyelitis	2	4
Total	50	100

In this series, 29 (58%) cases presented with infected ulcer, 13(26%) cases presented with gangrene of toe or foot, 6(12%) cases with a deep abscess and 2(4%) cases with osteomyelitis(table 5).

Wagner's grading.

Table-6: Wagner's grade

Wagner Grade	Frequency (n=50)	Percentage (100%)
1	10	20.0
2	20	40.0
3	06	12.0
4	10	20.0
5	04	08.0

In my study, diabetic foot patients with grade 1-5 were included and patients with grade 1 were 10 in number, with grade 2 were 20 in number, grade 3 were 06 in number, grade 4 were 10 in number and grade 5 were four in number (table 6).

Diabetes type

Table-7: DM Type

Particulars	Frequency (n=100)	Percentage (100%)
Type 2	100	100.0

In my study, all the patients were type 2 diabetics (table 7).

Diabetes Control

Table-8: Diabetes Control

Particulars	Frequency (n=50)	Percentage (100%)
Poor	35	70
Good	15	30

In my study, out of 50 patients, 15 had good control of diabetes and 35 had poor control of diabetes (table 8).

X-Ray Foot

Table-9: X-Ray Foot

Particulars	Frequency (n=50)	Percentage (100%)
Normal	46	92.0
Great toe phalanx erosion	03	06.0
2nd toe phalanx erosion	01	02.0

In my study, x-ray foot was taken for all 50 cases, bone was not involved in 46 cases, 3 cases had great toe phalanx erosion, 1 case had 2nd toe phalanx erosion (table 9).

Pus Culture Reports

Table-10: Pus Culture

Particulars	Frequency (n=50)	Percentage (100%)
Staphylococcus's	26	52.0
E. coli	06	12.0
Klebsiella Sp.	05	10.0
Proteus Sp.	04	08.0
Others	09	18.0

On pus/wound discharge culture, staphylococcus species was found in 26 patients (MRSA in 4 patients), E. coli in 6 patients, Klebsiella species in 5 patients, Proteus species in 4 patients, and in the remaining 9 cases, and various other organisms were found (table 10).

Sensitivity Reporting

Table-11: Sensitivity

Particulars	Frequency (n=50)	Percentage (100%)
Chloramphenicol	20	40.0
Vancomycin	08	16.0
Amikacin	09	18.0
Ceftriaxone	05	10.0
Others	08	16.0

In my study, organisms were sensitive to Chloramphenicol in 20 cases, Vancomycin in 8 cases, Amikacin in 9 cases, Ceftriaxone in 5 cases, and other drugs in 8 cases (table 11).

Surgical Procedures Performed in Diabetic Foot

Table-12: Surgical Procedures Performed in Diabetic Foot

Surgical Intervention Done	Number of Patients	Percentage
Debridement	19	38
Incision and drainage	15	30
Ray amputation	10	20
Fasciotomy	02	04
Below knee amputation	04	08
Total	50	100

Nineteen patients underwent debridement, 15 patients underwent incision and drainage, 10 patients underwent Ray amputations, two were taken up for fasciotomy and four had below knee amputations (table 12).

Comparison of major amputations

Table-13: Comparison with other studies

Study	Number of Cases	Number of Major Amputations	%
Collen's series[4]	215	83	38.6
Osaka Kosainekin Hospital[5]	210	110	52
Ozkara *et al.* [6]	84	32	38.1
Strbova *et al.* [7]	124	38	30.6
Aziz *et al.* [8]	100	28	28
Diabetes Research Centre, Chennai Study[9]	1985	377	29.1
Present study	50	04 (below knee)	08

When the present study was compared to other studies, it was found that in my series less number of cases required major amputations (table 13).

DISCUSSION

Diabetic foot ulcers represent a major clinical problem. Successful treatment requires a thorough understanding of the pathophysiology, the surgical debridement, and updating various treatment modalities. Failure to recognise the cause, pathology, and associated infectious process may lead to amputation, septicaemia, and death.

Clinical studies have reported that 25% to 50% of diabetic foot infections lead on to minor amputation and around 10% to 40% of patients go on for major amputations [10]. Of importance here is around 10% to 30% of individuals with diabetic foot ulcer will eventually progress to amputation. About 60% of amputations are preceded by infected foot ulcer. Thus, infection is often a proximate cause leading to tragic outcome [11].

The typical anatomy of foot makes foot infections potentially serious. The structure of various compartments, tendon sheaths, neurovascular bundles tend to favour proximal spread of infections. The deep space of foot is divided into medial, lateral, and central compartments. Because of the rigidity of these spaces due to tendons and bones, oedema associated with acute infection may rapidly elevate the compartmental pressure causing ischaemic necrosis of the compartmental tissues. Infections spread from one compartment to another at the proximal calcaneal convergence or by direct septal perforation. But, dorsal or lateral spread is a late sign of infection [12].

Lower limb complications are common, particularly foot ulcers and gangrene. Development of these complications is attributed to individual risk factors, poverty, racial and ethnic differences, and quality of local and national healthcare systems. The wide variations noted suggest that best practices in low incidence areas could easily be adapted in high incidence areas to reduce the burden of complications. Almost, every infection begins in a wound, often as neuropathic ulceration or a traumatic break in the skin. Infections that begin as a small problem may progress to involve soft tissue, bones, and joints [12].

In my study, out of 50 patients, 23 patients were aged below 50 years and 27 patients were aged above 50 years. 24% of the total patients were females. 29 (58%) cases presented with infected ulcer, 13(26%) cases presented with gangrene of toe or foot, 6(12%) cases with a deep abscess and 2(4%) cases with osteomyelitis. Out of 50 patients, 28 patients had lesion in the right leg and 22 patients had lesion in left foot. Patients with diabetic foot presented with one week to 13 weeks' duration. Patients with Wagner's grade 1 were 10 in number, grade 2 were 20 in number, grade 3 were 6 in number, grade 4 were 10 in number and grade 5 were four in number. In my study, all the patients were type 2 diabetics. Out of 50 patients, 15 had good control of diabetes and 35 had poor control of diabetes. X-ray foot was taken for all 50 cases, bone was not involved in 46 cases, 3 cases had great toe phalanx erosion, 1 case had 2nd toe phalanx erosion. In our study the most common organism cultured from the wound was staphylococcus. The most sensitive drug for these organisms was found to be chloramphenicol on most occasions.

CONCLUSION

Many diabetic foot complications are avoidable. Prevention of diabetic foot disease through glycaemic control, periodic foot examination, prevention of trivial trauma and patient education is the first line of defence against amputation, however, surgical intervention frequently become necessary to eradicate infection, remove necrotic tissue, close chronic wounds, eliminate structural causes of tissue breakdown and reconstruct deformities[13].

From this study it was concluded that in most cases of diabetic feet, limb salvage was possible. A comprehensive treatment approach incorporating surgical and nonsurgical therapies is required to avoid major limb amputations in severe diabetic foot infections. Limb salvage procedures may prevent eventual limb loss, the need of a major limb amputation, decrease total cost and may restore full ambulation earlier. Endovascular procedures is the future in the treatment of diabetic peripheral arterial disease and hence the diabetic foot.

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