

Original Research Article

Clinicopathological study and management of diabetic foot

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ABSTRACT

Background: The main objectives were to study the bacteriology, pathophysiology of diabetic foot, various limb salvage procedures and outcome, different treatment modalities and newer techniques wherever applicable to prevent complications and to minimise the progression of occurred complication.

Methods: 50 patients admitted with diabetic foot presenting with lesions of foot were selected for the study and were managed conservatively and surgical interventions if needed.

Results: Majority of the patients in the study revealed history of trauma preceding the foot complications and the chances of injury increased in these patients because of increased incidence of ischemia, neuropathy and infection. 15 patients in this study had neuropathy, 8 patients had ischemia and all cases were culture positive. 16 cases were managed by daily dressing and wound debridement, and slough excision. 9 patients were treated with Split skin graft, 6 patients with incision and drainage (IandD) for abscess and fasciotomy, 10 cases with disarticulation, below knee amputation (BKA) was done in 4 cases and above knee amputation (AKA) in 5 cases.

Conclusions: Males are almost four times more affected than females, duration of diabetes varied from 1 year to 22 years and many patients were diagnosed post admission, trivial trauma of some kind was the initiating factor in nearly half of the cases, commonest presenting lesion was Ulcer 52%, conservative treatment consisting of control of diabetes was effective. Wound debridement, slough excision followed by dressing resulted in healing in some cases. Split skin grafts, Disarticulation, below knee amputation and above knee amputations were the other modes treatment.

Keywords: Amputation, Diabetic foot, Ulcer

INTRODUCTION

Diabetes is a worldwide problem. A majority of diabetic patients develop foot ulcers in one point of time or other during the course of their illness. A significant number of such patients will require long-term hospital treatment and amputations. The etiopathogenesis of diabetic foot lesions are multifactorial. Diabetic neuropathies, vasculopathy, poor control of diabetes and bacterial infection are some of them. The reasons for diabetic foot are

- Foot is the most vulnerable part of body for injury and infection neglected by patient.

- The site of preference for neuropathy and ischaemia is also the foot.

Recent advances in molecular biology have added substantial insight into the pathophysiology of the disease and opened new avenues for treatment.¹

The predisposing factors to pathologic changes in the foot of a diabetic are Metabolic factors like hyperglycemia and glycation of proteins, vascular changes, neuropathy, infection. Hyperglycemia is the commonest characteristic feature in the two etiologic types of diabetes.² Lower extremity arterial disease is more common among patients with diabetes than among those without diabetes.

The presence of diabetes is associated with a two- to threefold excess risk of intermittent claudication compared with its absence.³ Despite significant advances in the prevention and treatment of peripheral vascular disease, diabetes continues to be the single strongest cardiovascular risk factor for the development of critical leg ischemia and limb loss.⁴

Peripheral neuropathies are found in 55% of diabetics. Polyneuropathy is one of the commonest complications of the diabetes and the commonest form of neuropathy in the developed world. Diabetic polyneuropathy encompasses several neuropathic syndromes, the most common of which is distal symmetrical neuropathy, the main initiating factor for foot ulceration. The incidence of neuropathies increases with duration of disease and episodes of neuropathies increases with duration of disease and episodes of hyperglycemia. Peripheral neuropathy clearly renders the patient to unrecognized injury, which potentiates the risk of bacterial invasion and infection.⁵

The patients with DM are more prone to infection than normal individual. In a normal individual the flora of the lower leg and foot are restricted because skin temperature is much lower than optimum for many human pathogens and metabolic products of skin have antimicrobial chemical effect. Other reasons are acidic surface of the dorsum of and thick stratum corneum. These defences are lost in diabetics before they develop foot lesions.

The infections are poly microbial in diabetic foot. Organisms which cause foot lesions in diabetics involve both aerobes and anaerobes. Of these common are *S. aureus*, Group B. Streptococcus, Enterococcus SP, *P. Mirabilis*, *E. Coli*, *P. aeruginosa*, *E. aerogenes*, *B. Fragilis*, *B. ovatus*, *B. ureolyticus*, *P. magnus*, *P. anaerobes*, *C. bifirmentans*.

Diabetic patients also represent around 60 percent of non traumatic foot or leg amputations, the majority of which are secondary to infectious complications.⁶

Defects in immune function have been described as occurring in diabetics. White cell dysfunction in diabetes's, adherence, and chemotaxis, phagocytosis, and killing ability has been described in diabetic patients. In general, these defects are aggravated by poor glucose control. Poor granulation formation and poor healing have also been seen in diabetic mice. Salvapandian reviewed the different types of foot infections and their characteristics in 1982.⁷ These infections can occur in nondiabetic as well as diabetic persons, although the presence of the diabetic state can aggravate the risks and the morbidity associated with these infections. Foot infections can occur in the wake of acute or chronic trauma. Diabetic foot is usually dry due to autonomic neuropathy and are managed conservatively by using lubricants to keep foot moist. Lubricants should not be used in between toes. Peripheral neuropathy can rarely

cause pain and parasthesia. In such case tegritol or Dilantin sodium can be used. Vitamins including B12 are tried by some. In some patients, tricycles are used. Aldose reductase inhibitors are used by some in treating peripheral neuropathy.

One of the primary goals of treating diabetes is to save the diabetic foot. This can be achieved by correction of vascular risk factors, improved circulation to foot, proper treatment of diabetic foot ulcers, team work, patient education in foot care.

The key to the successful treatment of osteomyelitis (OM) in the diabetic foot is a combination of antibiotic therapy and surgical procedures. The latter may include surgical debridement with excision of the osteomyelitic bone and/or minor amputations. The ultimate goal of treatment is to achieve limb salvage wherever possible in the diabetic patient. However, in some cases major amputation such as below the knee amputation, above knee amputation is required.

Total contact cast is the most extensively studied technique; it offers total unloading of the ulcer as well as the rapid mobilization of the patient who may resume normal activities immediately. Scotch cast, a sort of removable boot made of stiff, light material padded with wadding in order to reduce pressure.

Foot problems such as ulceration, infection, gangrene is quite common in diabetic patients. These account for frequent and prolonged hospitalizations, significant morbidity and even mortality and a rough estimate yields that 25% of all admissions of diabetics are due to foot problems and nearly 5-10% needs foot or leg amputation. Over the all non traumatic amputations 50% are related to diabetes. However, with proper foot care this would be prevented or minimised. So, the study has been taken up to identify the complications using newer techniques wherever possible and to study pathogenesis of disease.

METHODS

The patients were admitted with diabetic foot in the Department of Surgery, K. R. Hospital attached to MMC and RI, Mysore.

Inclusion criteria

Patients with Diabetes Mellitus presenting with lesions of foot i.e. ulcer, blister, abscess, gangrene admitted in the department of Surgery, K R Hospital, Mysore.

Exclusion criteria

- Patients with chronic foot leg ulcers due to cause other than diabetes such as traumatic, arterial, venous, trophic, TB, Syphilitic, malignant ulcer are excluded from study.

- Blister, cellulitis, abscess, gangrene of foot due to causes other than Diabetes is excluded from the study.
- Patients with severe medical illness, too old and patients unfit for surgery are excluded from the study.

All the patients underwent routine laboratory investigations and few with relevant special investigations. In the present study, patients were tested for peripheral neuropathy with tuning fork, monofilament and few patients with biothesiometer. The vascularity of lower limb was investigated with Audio Doppler, Colour Doppler and one patient with angiography.

RESULTS

Age distribution

In 50 cases we studied, the youngest patient was 35 years and oldest was 79 years of age. Highest number of cases were found in 51-60 years of age (34%) followed by 61-70 years of age (26%).

Gender distribution

Of the 50 cases studied in this series, 39 (78%) cases were male and 11(22%) cases were female.

History of trauma

31 cases in this series revealed a history of some kind of injury (trauma) before the onset of lesion.

Mode of presentation

Out of the 50 cases, 26 cases presented with ulcer, 14 cases with gangrene of toe or foot, 8 cases with cellulitis and 2 with abscess.

Duration of diabetes

Duration was not accurately known, as few patients were unaware of being diabetics and were diagnosed on admission with complaints of non-healing ulcers.

Table 1: Profession (occupation).

Profession of patient	No. of cases	Percentage
Agriculture	28	56
Business	5	10
Coolie	5	10
Driver	1	2
House wife	8	16
Teacher	2	4
Dhobi	1	2

In present study 20% were diagnosed to have diabetes on admission. Only two patients had diabetes of more than

20 years of duration. Maximum patients in present study were diabetics of 6 – 10 years duration (30%). As per the literatures, it is said that the disease is more common in the people who perform sedentary work, but this series depicts that the complications are more common among those professionals, who are exposed to risk of trauma and injury during their work. Foot complications are more in urban peoples as Diabetes is common in urban people. But the present study shows foot complications commonly in rural and agriculture background, it may be because of common rural patient's admission in our hospital.

Table 2: Culture and sensitivity.

Bacteria	No. of cases	Percentage
<i>Staphylococcus aureus</i>	18	36
<i>Pseudomonas</i>	10	20
<i>Klebsiella</i>	8	16
<i>E. coli.</i>	6	12
<i>Proteus</i>	5	10
Non-haemolytic streptococcus	3	6

Majority of the septic lesions yielded *Staphylococcus aureus* on culture of pus. Other organisms that were isolated are, *Pseudomonas*, *Klebsiella*, *E. coli*, *Proteus* etc. Most of them were sensitive to Ampicillin, Ceftriaxone, Gentamycin, Imipenem, Meropenem and Amikacin. Most of the cultures yielded polymicrobial growth.

Neuropathic lesions

In the present study 15 cases were found to have neuropathy with the above investigations. Patients with neuropathy varied from 50-80 years.

Ischemia

These investigations showed atherosclerotic changes with low volume flow in the anterior and posterior tibial arteries in nine patients and few patients had thrombosis in the blood vessel.

Duration of hospitalization

In this study minimum stay in hospital was 6 days and maximum were 66 days. The average stay of hospitalization is around 32 days.

In this series 16 cases were managed by daily dressing and wound debridement, and slough excision. 9 patients were treated with Split skin graft, 6 patients underwent incision and drainage for abscess and some of them fasciotomy, also 10 cases who presented with Gangrene of toes and phalanges, were treated with disarticulation. Below knee amputation was done in 4 cases and above knee amputation in 5 cases.

Table 3: Treatment.

Treatment	No. of cases	Percentage
Slough excision and regular dressing	16	32
I and D and Fasciotomy	6	12
Split Skin Graft	9	18
Disarticulation	10	20
Below knee amputation (BKA)	4	8
Above knee amputation (AKA)	5	10

Antibiotics were administered after culture and sensitivity. Blood glucose level was controlled with insulin and oral hypoglycaemic agents. Neuropathy treated with methyl cobalamine and in some cases with pregabalin. General nutrition was maintained. Offloading done in Neuropathic ulcers (total contact cast). In most of the cases, limb was salvaged by conservative treatment and minor amputations.

DISCUSSION

During the past 3 decades, the incidence of colorectal. The diabetic foot is one of the most common and devastating complications of diabetes mellitus. These ulcers account for most of the hospital admissions for patients with diabetes, and they represent a common precursor for amputation. When a diabetic foot ulcer becomes infected, gangrene and amputation can follow in rapid succession.⁸

Diabetic foot ulcer causes more amputations than any other lower limb disease. Management of the diabetic foot requires a thorough knowledge of the risk factors for ulceration and amputation, the most common of which are neuropathy, ischemia and infection. Amputations are not inevitable, however; early detection and appropriate treatment of ulcers can prevent up to 85% of amputations.⁹

Approximately 40-60% of all amputations of the lower extremity are performed in patients with diabetes. More than 85% of these amputations are precipitated by a foot ulcer deteriorating to deep infection or gangrene. The prevalence of diabetic foot ulcers has been estimated to be 3-8%. The complexity of these ulcers necessitates a multifactorial approach in which aggressive management of infection and ischemia is of major importance. For the same reason, a process-oriented approach in the evaluation of prevention and management of the diabetic foot is essential. This management is complicated, and typically requires radical debridement, appropriate antibiotics and local wound care with daily dressing with appropriate dressing solutions.¹⁰ Selective debridement also includes the removal of specific, targeted areas of unidentifiable devitalized tissue along the wound margin.¹¹ However, as patients with diabetes are typically immunocompromised and often fail to mount a

physiologic response to infection, clinicians should look for secondary signs of infection including exudates, delayed healing, friable granulation tissue, discoloured granulation tissue, foul odour, pocketing.¹²

When compared with Wheel, Lock and Root series, there is not much difference in youngest and oldest age group.¹³

In the present study 39 were males and 11 female cases. The male to female ratio 3.5:1. The incidence is more among males probably as they are the peoples of the family who mostly working out door, which makes them more vulnerable for trauma and sequelae.

The commonest pathophysiological changes that lead to diabetic foot are neuropathy, ischemia and infection. Most of the patients had diabetes of 6-10 years duration, accounting for 30%, 20% were newly diagnosed as diabetics following admission followed by patients having diabetes of 2-5 year, accounting 16% of study neuropathy changes seen in 15 cases, ischemic complication was noted in 9 cases and infective complication of foot noted in all cases.

The commonest organism cultured was *Staphylococcus aureus* 18 (36%) cases, followed by *Pseudomonas* 10 (20%). Most of the organisms were sensitive to ampicillin, cloxacillin, gentamycin, amikacin, ciproflaxacin and cephalosporin etc

The amputation rate is much lower (18%) compared to Collen's series (38.6%) in 1962.¹⁴ This could be due to, better education of the patient, better glycaemic control, proper care of foot, proper use of antibiotics, extensive debridement and regular dressing. After amputation, wound healed well. The patients were referred to Rehabilitation center for prosthesis.

CONCLUSION

The youngest patient was 35 years old and the oldest 79 years. The highest number of patients was seen in the age group of 51-60 years (34%). Males are almost four times more affected than females. (Males are more vulnerable to trauma). Trivial trauma of some kind was the initiating factor in nearly half of the cases. Minimum stay in hospital was 6 days and maximum 66 days. Commonest presenting lesion was Ulcer 52%, followed by gangrene (28%), and cellulitis (16%).

Conservative treatment consisting of control of diabetes with Plain/Lente insulin, long acting insulin (insulin glargine) along with appropriate oral / IV antibiotics was effective in some cases. Neuropathy treated with methyl Cobalamine and few with pregabalin.

Neuropathic foot was offloaded. Split skin grafts, Disarticulation, below knee amputation and above knee amputations were the other modes treatment.

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

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