Treatment of diabetic foot for limb salvage

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Abstract

Diabetic foot infection is a common health problem, presenting most commonly with ulcer, abscess or gangrene therefore the most common surgical treatment is debridement, incision and drainage, minor or major amputation. Care of diabetic foot includes Preventive measures like patient education of proper foot care, avoidance of localized trauma, and daily foot inspections. Wound care and aggressive debridement, good glycemic control either by insulin or oral hypoglycemic drugs, proper antibiotic according to culture and sensitivity, those measures could lead to dramatic reduction in amputations rate.

Introduction

Diabetic foot and related problems are important causes of morbidity in diabetic patients especially if they end up with amputation. They not only cause major financial burden on medical health but also cause extensive human suffering, prolong functional disability and associated mortality [1].

Uncontrolled diabetes affects infection, and infection adversely affects diabetes. The basic rules in treating any foot infection are: Absolute bed rest, regulation of diabetes, adequate culturing of wound, administration of appropriate antibiotics, adequate drainage of all infection, and appropriate wound care [1].

Only by careful examination of all parts of both feet and legs can any foot disease be fully appraised. Afoot problem may be a blister, a moist fungal infection between the toes, a callus with an underlying abscess, a painful fissure on the heel, or a frankly gangrenous toe once discovered, any infected site must be opened to provide drainage of the pus and to obtain an adequate culture of any secretions [1].

In this study we are trying to evaluate and treat patients with diabetic foot.

Patients and methods

This study was carried out on 50 patients with diabetic foot, they were 28 females and 22 males, their ages ranged from 30 years to 80 years, they were subjected to:

1- History taking which include:

- History of present illness (Diabetic foot) duration and initial cause of lesion.
- Duration of diabetes and mode of treatment oral or insulin injection.
- History of peripheral vascular disease was defined as the presence of ischemic symptoms and signs such as intermittent claudication, rest pain and / or colour changes, coldness.
- History of peripheral neuropathy is considered to be present if there is numbness in the feet, hypothesis.
- Past history of similar condition as diabetic foot lesion, previous ulcer or amputation.

2- General examination:

To detect the presence of other associated diseases

3- Local Examination:

In the form vascular examination such as loss of pulse, colour changes and coldness either in toes, foot or leg. Neurological assessment such as absence of pain in the foot or altered fine touch sensation and proprioception, presence of deformity (claw toe, hallux valgus or charcot joint), gangrene.

4- Clinical evaluation of diabetic foot

- Infection depth classification according to:
  Grade 0” At risk foot with previous, ulcer or neuropathy with deformity that may cause new ulceration
  Grade 1” Superficial ulceration not infected
  Grade 2” Deep ulceration exposing a tendon or joint with or without superficial infection
  Grade 3” Extensive ulceration with exposed bone and /or deep infection (osteomyelitis)or abscess

- Ischemia classification according to:
  Grade A” Not ischemic
  Grade B” Ischemia without gangrene
  Grade C” Partial gangrene of the foot
  Grade D” Complete foot gangrene

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Key words: diabetic foot, limb amputation

Received: March 06 2018; Accepted: March 16 2018; Published: March 19 2018
The most cases of diabetic foot had onset of diabetes between (10 – 24 y) 28 cases (56 %), and more than 20 years of diabetes in 12 patients 24% (Table 3).

The neuropathy was the most important cause of diabetic foot lesions, the most common symptoms of neuropathy was hypothesia and tingling 23 cases (46 %) (Table 4).

The number of cases associated with ischemic symptoms, claudication and rest pain was in 12 cases (24 %) (Table 5).

In Table (6), signs of ischemia were colour changes, black colour in 10 patient (20%) presented with gangrene of different parts of the foot, coldness in toes 6 patients (12%), coldness foot 4 patients (8%) coldness leg 1 patients (2%) and loss of pulse were popliteal artery 3 patients (6%), posterior tibial artery 6 patients (12%), dorsalis pedis artery 15 patients (30%).

The most common organisms identified in diabetic wound discharge as shown in table 6, were staphylococci 7 cases (14%), streptococci 7 cases (14 %), and proteus 5cases (10%), then pseudomonas 4 cases (8 %), and klebsiella 3 case (6%). Other organisms were present E-coli 5.

5- Laboratory investigations:

In the form of fasting and postprandial blood sugar, renal and liver function tests, serum cholesterol and blood picture.

6- Bacteriologic examination:

This includes identification of the pathogenic organisms in wound discharge and detection of appropriate antibiotics suitable for eradication of such organisms through culture and sensitivity tests.

7- Duplex ultrasound: for evaluation of the arteries of lower limb.

8- Radiological examination:

All affected feet had x ray to exclude osteomyelitis and detection of deep infection in the foot which appear as subcutaneous collection of air and signs of osteomyelitis such as bony destruction and cortical erosion.

9- Angiography: is performed in diabetic patients for disabling claudication, ischemic rest pain, ischemic ulceration, and gangrene.

10- Management of diabetic foot:

1- without vascular impairment:

A) minor diabetic foot infection.

Grades 0,1 conservative treatment will be started with wound care, antibiotics therapy.

B) major diabetic foot infection.

- Infection without gangrene. grades 2,3 which treated by, surgical debridement, incision and drainage for abscess and collection, toe amputation, Trans metatarsal or forefoot amputation for exposed bone and tendon.

- Infection with gangrene. grades 2,3 below knee or above knee amputation will be done for massive infection and osteomyelitis

2- diabetic foot with vascular impairment

- with gangrene. Grades C, D partial foot amputation for partial foot gangrene and above or below knee amputation for complete foot gangrene.

- without foot gangrene. Grades A, B vascular reconstruction in the form of Bypass procedure or balloon angioplasty.

11- Follow up: For all lines of treatment to observe the result of treatment as:

- Complete healing.

- Needs skin grafts.

- Deterioration of the lesion with the need of other line of treatment.

- Reconstructive(bypass) surgery in patients with failure of healing of the foot lesion after long period due to ischemia.

Results

In Table (1), most diabetic foot cases were in age group between (51- 60 y) 21 cases (42%), and the second age group between (41-50 y)13 cases (26%).

Table 2 show diabetic foot lesions more common in females 28 cases (56 %) than in males 22 cases (44%).
cases (10%) and corynebacterium in 3 cases (6%), anaerobes were present in 13 cases (26%) in our study. Diabetic foot infections are polymicrobial in nature and showed mixed infection in most cases, staphylococci and pseudomonas in many cases and streptococci and E. coli in the other cases (Table 7).

Table 8 showed that increased number of cases of osteomyelitis of different parts of foot bones, were toes phalanges in 7 cases (14%), phalanges and metatarsal bones in 7 cases (14%) due to delayed treatment with proper antibiotics and extension of infection from soft tissue to bone (Table 9).

The number of cases examined by Doppler U.S. was 24 patients from 50 patients. We examined blood vessels of lower limb from external iliac to dorsalis pedis arteries, the flow in the popliteal artery was within normal in all cases except in 3 cases (12.5%) showing weak flow the posterior tibial artery show obstructed flow in 3 cases (12.5%). The dorsalis pedis artery was obstructed in 12 cases (50%) both posterior tibial and the dorsalis pedis arteries were obstructed in 6 cases (25%) (Table 10).

In Table 11, the most common line of treatment was debridement, 16 patients (32%), then second common line was incision and drainage 6 patients (12%) then above knee amputation 7 patients (14%), Below knee amputation was done in 6 cases (6%), then toe amputation 6 patients (12%) Trans metatarsal amputation in 2 patients (4%) and forearm amputation in one patient (2%). Reconstruction surgery in form of femoro - popliteal to distal (bypass) was done in 4 cases (8%). There are number of patients treated by more than one line of treatment, either incision and drainage with debridement or debridement with amputation.

In Table 12, clinical outcome of conservative treatment was complete healing in 24 cases (44%) and in 3 cases (10%) needs skin grafts, were conservative amputation needed in 9 cases (18%).

In Table 13, needs major amputation in 7 cases were in 2 cases (4%) below knee amputation was done and above knee amputation in 5 cases (10%).

In Table 14, needs major amputation in 3 cases were below knee amputation in 1 cases (2%) and above knee amputation in 2 cases (4%).

Table 15 shows that reconstructive surgery in 4 patients (8%) in from of femoro - popliteal and femoro - distal by pass.

### Discussion

Diabetic foot and related problems are important causes of morbidity in diabetic patients especially if they end up with amputation. Uncontrolled diabetes affects infection, and infection adversely affects diabetes. Only by careful examination of all parts of both feet and legs can any foot disease be fully appraised [1].
50 patients with diabetic foot were evaluated and treated. We found that the age of the patient ranged from 30-80 years, this age was associated with increase incidence of peripheral neuropathy as well as higher incidence of ischemia, poor controlled diabetes and more exposed to trauma. In our study of 50 patients with diabetic foot we found that 28 cases (56%) were females and 22 cases were males (44%).

Seabrook et al. [1] reported that the diabetic gangrene occurred 53 times as frequently in diabetic men and 71 times as frequently in diabetic women as in their nondiabetic. The incidence of atherosclerotic gangrene was also increased in diabetic women.

In our study loss of pulse were as follow the popliteal artery 3 patient (6%) posterior tibial artery 6 patient (12%), dorsalis pedis artery 15 patients (30%).

Miller et al. [2] reported that neuropathy and peripheral vascular disease are the most common predisposing factors for foot ulcers in patients with diabetes. Between 60% and 70% of diabetic patients with ulcers have peripheral neuropathy, 15-20% have peripheral vascular disease, and 15-20% have both.

In our study peripheral neuropathy was present in 30 patients (60%), ischemia is present in 12 patients (24%) and combination of ischemia and neuropathy in 8 patients (16%) this result more or less similar to the result reported by Miller [2] and Gavin [3].

In our study of distribution of initial causes of diabetic foot we found that the most common initial cause of diabetic foot was pinprick in neuropathic foot 9 patients (18%), trauma and cut wound in 9 patients (18%) and second common initial cause was abscess in 8 patients (16%), fungal infection in 7 patients (14%), cellulitis in 7 patients (14%), and another causes as removal of callus in 4 patients (8%), trimming nails in 4 patients (8%) and bulla in 2 patients (4%).

Fry et al. [4] stated that in the study of 20 patients with diabetic foot infection that most common organisms isolated (enterococcus faecalis (7 cases), streptococci (7 cases) and aerobic gram negative cocci were proteus species (11 cases), E. coli (6 cases), Klebsiella species (4 cases), pseudomonas (4 cases), Enterobacter (3 cases) and gram positive anaerobes were Streptococcus in (16 cases), clostridium (7 cases) and gram negative anaerobes the most frequently isolated organisms were bacteroides fragilis (9 cases).

In our study, we found that the bacteriological examination of diabetic foot cases, the most frequently isolated organisms were staph, streptococci in 14-patients, (28%), proteus, pseudomonna, E coli, were isolated in 14 patients, (28%), in 3 patients (6%) were isolated klebsiella and in 3 patients (6%) isolated neisseria, corynebacterium were isolated in 3 patients (6%), mixed infection are seen in most cases and anaerobes will be isolated in the 13 cases (26%). Thus, culture and sensitivity tests were important for proper treatment of diabetic foot associated with wound discharge, and select the proper antibiotic, better prognosis was obtained in patients treated according to culture and sensitivity than the patients use abuse antibiotics.

In our study we found the number of patients with bone affection by plain x ray 20 patient (40%) were7 patients (14%) with toes phalanges affection, 7 cases (14%) with phalanges, and metatarsal bones affection, 4 cases (8%) with metatarsal bones affection and 2 cases (4%) with calcaneus affection, bone affection due to delayed treatment with proper antibiotic and incomplete debridement of soft tissue infection.

In our study we examined 24 patients by doppler ultrasound. We found that weak flow through the popliteal artery in 3 patients (12.5%), obstructed posterior tibial artery in 3 patients (12.5%), obstructed dorsalis pedis artery in 12 patients (50%), and obstructed flow of the posterior tibial and dorsalis pedis arteries in 6 patients (25%), in our study the ischemia is the main cause of diabetic foot infection.

In our study patients on oral hypoglycemic drugs exposed to diabetic foot infection 32 patients (64%) and patients treated with insulin from the start were 18 patients (36%), which have more controlled diabetes and less exposed to diabetic foot infection and its complications.

In our study the most cases of diabetic foot have onset of diabetes between 10-20 years 28 cases (56%), the long period of diabetes increase neuropathy and atherosclerotic changes and increase diabetic foot lesion.

Stokes [5] stated that the degree of atherosclerotic occlusive disease is related to the duration of diabetes (15%) have involvement at 10 years after initial diagnosis and (45%) at 20 years.

In our study the lines of treatment for 50 patients with diabetic foot were antibiotic only in 5 patients (cellulites and superficial infection), incision and drainage in 6 patient (12%), debridement in 16 patients (32%) alone or with other lines of treatment, toe amputation in 6 patients and trans metatarsal amputation in 2 patients (4%) and foot forefoot amputation in one patient, below knee amputation in 3 patients (6%) and above knee amputation in 7 patients (14%) and reconstructive surgery (bypass) in 4 patients (8%), and Balloon angioplasty in 2 patients (4%), the most patients treated by more than one line of treatment as incision drainage and debridement, debridement and amputation.

Cook et al. [5] reported that in the study of 22 patients with diabetic foot, were debridement alone in 6 patients (24%) debridement with amputation of toes in 8 patients (32%) toe amputation only in one patient (4%) metatarsal amputation in one patient (4%), while below knee amputation in 3 cases (12%).

Our study, showed that the healing time was increased with increasing severity of diabetic foot infection according to the graded classification, healing time ranged from 2 weeks to 10 weeks or more.

In our study the clinical outcome of conservative treatment were complete healing occur in 22 cases (44%) with debridement and minor amputation, and 5 cases (10%) are need skin grafts, were conservative amputation needed in 9 cases (18%), in 3 cases (6%) below knee amputation and above knee amputation in7 cases (14%), reconstructive surgery in 4 patient 8% in from of femoro-popliteal and femoro-distal By pass.

**Conclusion**

Diabetic foot infection is a common health problem, presenting most commonly with ulcer, abscess or gangrene therefore the most common surgical treatment is debridement, incision and drainage, minor or major amputation.

Care of diabetic foot includes. Preventive measures like patient education of proper foot care, avoidance of localized trauma, and daily foot inspections. Wound care and aggressive debridement, good glycemic control either by insulin or oral hypoglycemic drugs, proper antibiotic according to culture and sensitivity, those measures could lead to dramatic reduction in amputations rate. The patient should be informed by the following instructions:

1. Inspect your feet twice daily. Look all over the feet for cracks, blisters, reddened spots, cuts, and ulcers or for excessively moist skin between the toes.
2. Bath your feet daily with warm water and mild soap. Dry gently and carefully between the toes. Blot do not rub.

3. Never use heating pads, hot water bottles, or any other heat source to warm your feet, irreparable damage can be done in a minute. Wear socks in bed if your feet are cold at night.

4. Skin calluses and corns. Do not use chemical agents or medicated pads, these can cause burns, do not perform bathroom surgery with a razor blade, use a pumice stone or foot file to reduce calluses gently at bath time, keep the skin moist regularly to prevent cracking and infection by using a gentle skin lotion, a very thin layer of petroleum jelly can also be used to seal in moisture after the bath and do not put creams, lotions, or ointments between the toes.

5. Trimming nails straight, do not attempt to dig out the corners.

6. Make sure shoes are long and wide enough and have enough room for the toes, especially if they are clawed. Avoid synthetic material that do not breathe. Leather is still generally the best material because it shapes and stretches. Avoid shoes made of hard materials eg. Plastic or patent leather.

7. Avoid stockings elastic tope or garters. Wash and change stocking daily. Stockings made of absorbent, natural materials such as cotton and wool are best.

8. Be sure that your physician examines your feet periodically.

   Better results of treatment can be obtained if the following instruction are carried out:

   - Aggressive debridement of infected and necrotic wounds is essential to achieving the quickest and the most dependable healing.

   - Adequate control of blood sugar.

   - Evaluation of the vascularity of the foot and early management.

   - Hospitalization and bed rest during the period of treatment and administration of appropriate antibiotics. Treatment of all patients according to depth – ischemic classification of diabetic foot, helps in proper management and give a good prognosis.

   - Strict medical control of the diabetic process, with prompt wound care management along with preventive measures, lowers morbidity associated with lower extremity diabetic ulcers.

   The assessment of the patient's vascular state with clinical evaluation and duplex ultrasound as well as angiography if needed plus proper control of diabetes, good antibiotic therapy, wound care, can avoid unnecessary amputation or at least to do lower or conservation amputation instead of higher above knee amputations.

References


