ISSN: 0975-3583, 0976-2833 VOL14, ISSUE01, 2023

Medical versus Surgical Treatment for the Management of Diabetic Foot Osteomyelitis

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Conflict of Interest: none

Source of Support: Nil

Abstract

Background and Aim: Diabetic foot osteomyelitis (DFO) can be difficult to treat and securing optimal clinical outcomes requires a multidisciplinary approach involving a wide variety of medical, surgical and other health care professionals, as well as the patient. The purpose of this study is to assess the cure rates after receiving medical or surgical treatment in patients with DFO.

Material and Methods: A prospective observational study was conducted involving 116 patients with diabetic foot osteomyelitis. The patients received surgical or medical treatment based on the principles described in the literature. To register the development of a complication, both groups of treatments were followed-up 1 year after the ulcer had healed. After healing, we performed the follow-up visits over 1 year: visit 1 (ulcer healed); visit 2 (1 month after ulcer healed); visit 3 (6 months after ulcer healed); and visit 4 (12 months after ulcer healed). During follow-up visits, we registered the complications that the patients suffered.

Results: We found no association between healing time and treatment administered for the management of osteomyelitis: the surgery group healed within 15.5 ± 9.1 weeks versus 16.1 ± 12.1 weeks in the medical group ($p>0.05$). The most common complications in both groups were re-ulceration. When comparing the survival of the complication-free time between the surgical and medical treatment of osteomyelitis, we did not observe significant differences ($p > 0.05$)

Conclusion: DFO is a common and growing problem that is difficult to treat. The onset of complications after healing in patients who have suffered DFO was not associated with the treatment received. Surgical and medical approaches to the management of DFO produced similar results throughout long-term follow up.

Key Words: Antibiotics, Diabetic foot osteomyelitis, Diabetic foot, Surgery

Introduction

Diabetes mellitus is a metabolic disorder characterized by hyperglycemia due to a defect in insulin secretion, its action, or both. The long-term effects of diabetes can cause damage,

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE01, 2023

dysfunction, or even failure of various organs. The pathogenesis ranges from autoimmune destruction of the β-cells of the pancreas to insulin resistance. The microvascular complications of diabetes mellitus include retinopathy, nephropathy, and neuropathy, causing diabetic foot diseases. Myocardial infarction, transient ischemia, and stroke are macrovascular complications.

Foot infections are among the most frequent diabetes-related causes for hospitalization and the usual immediate predecessor to lower-extremity amputation in this patients.[1] Infection usually starts in ulcerated soft tissues, but can spread contiguously to underlying bone.[2] Overall, about 20% of patients with a diabetic foot infection (and over 60% of those with severe infections have underlying osteomyelitis, which dramatically increases the risk of lower-extremity amputation.[3,4] Indeed, optimally managing diabetic foot osteomyelitis is widely considered the most difficult and controversial aspect of dealing with diabetic foot infections.[5-7]

There is a growing trend for non-surgical management of Diabetic foot osteomyelitis (DFO), which has resulted in good results in remission from infection, with rates being higher than 60% in patients managed exclusively with antibiotic therapy.[8,9] The published literature is, however, limited to retrospective studies, and in certain selected cases, surgery is essential, for instance, where there is bone exposure and/or severe bone destruction, and/or patients with antibiotic resistance or medical treatment failure.[10-16] The surgical approach is based on timely containment of infection with effective debridement[17], utilizing conservative surgical techniques, which aim to avoid unnecessary minor and major amputations.[18,19] The remission rates after surgical treatment are varied, but it has been estimated as ~50%.[20,21] Several studies have concluded that a combination of conservative surgery and antibiotic therapy could be the most appropriate treatment for DFO.[22-24]

The purpose of this study is to assess the cure rates after receiving medical or surgical treatment in patients with DFO.

Material and Methods

A prospective randomized comparative trial of patients with diabetes in whom foot osteomyelitis had been diagnosed was carried out at the tertiary care institute of India. Ethical approval was taken from the institutional ethical committee and written informed consent was taken from all the participants.

We included patients with diabetes type 1 and 2, aged >18 years, having ulcers with an area between 1 and 5 cm2 , who received surgical or antibiotic treatment for the management of DFO and demonstrated healing of the ulcer and who agreed to be included in the study after providing written consent. Patients were excluded in case of extensive or necrotising soft tissue infection, critical limb ischemia (CLI), acute Charcot foot, women who were pregnant or lactating and those who refused to be included in the study. During the baseline visit, we collected the medical history and demographic characteristics of the patient; the ulcer area was evaluated by planimetry using a wound measurement system confirmed DFO diagnosis and assessed by vascular and neurological examination.

The diagnosis of DFO was established on the basis of a combination of probingto-bone test and plain X-ray. The patients received either surgical or medical treatment, according to the

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE01, 2023

previously published recommendations[22,23]: Surgical treatment was indicated for patients with foot infection associated with substantial bone necrosis, patients with a particularly high risk for antibiotic-related problems, DFO with infecting pathogens that were resistant to available antibiotics, lower limbs suffering from untreatable ischemia that precluded systemic antibiotic delivery and when the patient had a strong preference for surgery.[18]

The surgery group underwent conservative surgery, defined as procedures in which only infected bone and non-viable soft tissue are removed, but no amputation of any part of the foot is undertaken. All surgeries were performed by the same surgeon (JLM), and bone samples were sent for microbiology and/or pathology analysis for diagnostic confirmation of DFO. During the first week after surgery, all patients received antibiotic treatment according to the results of the antibiogram; in cases of negative culture results, we prescribed empirical antibiotics according to IDSA guidelines. Medical treatment was indicated for patients too medically unstable for surgery: patients with a likely poor postsurgical foot mechanics, patients with an infection limited to small forefoot lesion, when the cost of surgery was prohibitive for the patient and when the patient had a strong preference to avoid surgical intervention. The medical group underwent medical treatment consisting of empiric antibiotic treatment at the beginning and later modified according to the results of the bone culture. Antibiotic treatment lasted 90 days.[26] Patients included in the medical group did not receive debridement of the affected bone. Once the ulcer healed, defined as complete epithelialisation without any drainage of a previous foot ulcer site after 2 weeks of the ulcer closure and according to the international recommendations, the patients wore customised insoles and therapeutic footwear, and they were monitored monthly.[27,28]

After healing, we performed the follow-up visits over 1 year: visit 1 (ulcer healed); visit 2 (1 month after ulcer healed); visit 3 (6 months after ulcer healed); and visit 4 (12 months after ulcer healed). During follow-up visits, we registered the complications that the patients suffered. All subjects were followed until the end of the follow-up time, except in cases of any adverse event that caused premature termination in the study or death. We recorded the following outcomes as a complication event: DFO recurrence, bone reinfection; new case of DFO, new bone infection; soft tissue infection; infection of the skin, which can spread to deeper structures, without affecting the bone; ulcer recurrence, new ulcer located in the same location where the ulcer under study appeared; re-ulceration, new ulcer irrespective of the location where the ulcer under study appeared; minor amputation, any resection through or distal to the ankle; major amputation, any resection proximal to the ankle; death; other complications and events related to diabetic foot syndrome.

Statistical analysis

The recorded data was compiled and entered in a spreadsheet computer program (Microsoft Excel 2007) and then exported to data editor page of SPSS version 15 (SPSS Inc., Chicago, Illinois, USA). For all tests, confidence level and level of significance were set at 95% and 5% respectively.

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE01, 2023

Results

A total of 150 patients were included in the study; 120 (80%) patients received surgical treatment and 30 (20%) medical treatment. The main baseline characteristics are summarized in Table 1 and 2.

We found no association between healing time and treatment administered for the management of osteomyelitis: the surgery group healed within 15.5 ± 9.1 weeks versus 16.1 ± 12.1 weeks in the medical group ($p>0.05$). During 1 year follow-up, 110 (73.3%) patients suffered complications. Complications during follow up were similar in both groups: 82 (68.3%) patients in the surgery group showed complications versus 26 (86.6%) patients in the medical group ($p> 0.05$). The most common complications in both groups were re-ulceration. When comparing the survival of the complication-free time between the surgical and medical treatment of osteomyelitis, we did not observe significant differences ($p > 0.05$)

Table 1: Baseline characteristics of the patients

Variable	Surgery Group n (%)	Medical Group n (%)
Gender	Male 98 (81.6) Female 22 (18.3)	Male 25 (83.3) Female 5 (1.6)
Type of DM	Type 1: 15 (12.5) Type 2: 105 (87.5)	Type 1: 28 (93.3) Type 2: 2 (6.6)
Neuropathy	120 (100)	30 (100)

Table 2: Mean and Standard Deviation of Various Variables

Variable	Surgery Group Mean ±SD	Medical Group Mean ±SD
Age (Years)	62.1 ± 9.2	61.5 ± 10.1
DM Duration (Years)	17.1 ± 12.1	15.4 ± 09.0
HbA1c (%)	8.1 ± 5.4	7.3 ± 1.5
Body mass index (Kg/cm2)	28.1 ± 4.2	28.6 ± 9.1
Ulcer duration (weeks)	15.2 ± 33.6	14.9 ± 13.2

Discussion

Treating diabetic foot infections is always challenging, especially with underlying osteomyelitis. Foot ulceration and infections are significant causes of high morbidity in patients. The lifetime risk of diabetic foot patients is 25%, which is one of the leading causes of lower limb amputation and prolonged hospital stay. Studies published in the past few years studies have provided much useful new evidence on optimizing DFO treatment. On the surgical side, it appears that employing more "conservative" (bone sparing) operative procedures is clinically effective and may also reduce post-operative problems.[15-18] On the antibiotic side, many patients with DFO can be treated with predominantly oral (rather than intravenous) therapy, with similar remission

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE01, 2023

rates, fewer adverse effects and lower financial costs. Furthermore, treating for more than six weeks is not necessary, and as few as 3 weeks might be sufficient.[29] Finally, in appropriately selected cases, antibiotic therapy without surgical resection can resolve forefoot DFO. Available literature suggests that primarily medical (antibiotic) treatment is most appropriate for infections confined to the forefoot in a patient with good lower extremity arterial perfusion, with no exposed bone or when surgery is not practical or seen favorably by the patient.[22,24-26] On the other hand, primarily surgical treatment (usually accompanied by antibiotic therapy) is generally best for patients in whom there is exposed bone or joint, necrotic soft tissue, a fluid collection or abscess, advanced bone destruction or who are at high risk for antibiotic resistant pathogens or antibiotic-related toxicity.

No relationship was found between healing time and the treatment administered for the management of osteomyelitis. Moreover, no differences were found between the percentages of complications that suffered from each group. Regarding the probability of suffering complications during the 1 ear follow up, we observed a clear trend in the increase in the number of complications as time progressed. In the comparison between complication-free times in patients managed with surgical versus medical treatment for osteomyelitis, we obtained similar data in terms of survival between both treatments. In a study conducted in the department of diabetes, University hospitals of Leicester, NHS Trust, UK, by Kong and Jogia,[25] patients who had diabetes with nonhealing foot ulcer and with forefoot osteomyelitis were treated with debridement and antibiotic beads (vancomycin and gentamycin) using HPS calcium sulfate. They were observed for 18 months. Osteomyelitis was confirmed in these patients with bone culture and xray foot. Calcium sulfate was mixed with 1gm vancomycin and 80mg gentamycin. All patients healed with a median time of 5 weeks and did not have a recurrence for 12 months. No adverse reactions were noted for any of these patients. [30]

The management of DFO requires an early and precise treatment after an adequate and early diagnosis, selecting appropriate antibiotic therapy and rapid determination of the patient who requires surgical treatment.[9, 22,23] Regarding the selection of the best therapy to manage patients with DFO, we acknowledge that the typical profile of those patients who received medical therapy was different from those patients who received surgical treatment in our study. Our data on the complication-free time between both treatments are consistent with the results obtained in the first published clinical trial that compared these treatments for the management of DFO.[14] We conclude that both treatments have similar results in terms of healing rates, healing times, and short-term complications and that this similarity in the results is maintained over time, thus confirming that if the treatment to be applied in patients with DFO is properly selected, both treatments are satisfactory. Thus, the most important decision in the treatment of DFO is the adequate selection of the treatment based on the patient and ulcer characteristics.

Limitation of the study is we only included patients with DFO. In future research, it would be interesting to analyze a control group of patients with diabetes but without DFO and to compare their development of complications. Moreover, in future studies, it would be interesting to report

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE01, 2023

other complications, such as episodes of hospitalization, acute kidney or liver injury, or gastrointestinal side effects related to antibiotic treatment.

Conclusion

DFO is a common and growing problem that is difficult to treat. The onset of complications after healing in patients who have suffered DFO was not associated with the treatment received. Surgical and medical approaches to the management of DFO produced similar results throughout long-term follow up. Prospective RCTs are required to develop guidelines for the appropriate management of DFO, defining the role of antibiotics and surgery in the patient work-up.

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