



RESEARCH ARTICLE

DIABETIC FOOT: A CLINICOEPIDEMIOLOGICAL AND INVESTIGATIVE STUDY IN
A TERTIARY CARE HOSPITAL

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ARTICLE INFO

Article History:

Received 25th March, 2018

Received in revised form

04th April, 2018

Accepted 19th May, 2018

Published online 30th June, 2018

Key words:

Dental Implants,
Immediate Implants,
Provisionalisation,
Esthetics.

ABSTRACT

Background: Diabetic foot ulcer is one of the common and dreaded long term complication of diabetes mellitus especially in developing countries. This study attempted to determine the disease burden in terms of epidemiology and clinical profile of diabetic foot ulcer (DFU) at a tertiary care hospital in North India. **Methods:** In this descriptive study, the patients with known diabetes presenting with foot ulceration were enrolled over a one year period. The demographic profile, duration of diabetes, clinical presentation, type of ulcer, isolated microorganism and treatment taken were studied. **Results:** A total of 50 patients were included in the study. The average age of patients was 55.7 year (with range from 44 to 80 years). Majority of patients were males. 68% patients belonged to low socioeconomic status. History of smoking was seen in 44% of the cases. All patients had type 2 diabetes mellitus. The average duration of diabetes was 7.1 years. Foot ulcers in 26 patients were pure neuropathic, 4 patients had ischemic-type, while 10 had neuro-ischemic origin. 67.4% positive culture were obtained and gram negative organisms were most commonly isolated. **Conclusions:** Diabetic foot is a dreaded disability with long stretches of hospitalization and with the ever dangling end result of an amputated limb. It is, no wonder, one of the most feared complications of diabetes. Preventing the diabetic foot should be the first priority and it can be achieved by identifying the high-risk individuals, proper glycemic control, wound care, microbiological control and patient education.

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Citation: Dr. Nitish Sharma, Dr. Nidhi Sharma. 2018. "Diabetic foot: a clinicoepidemiological and investigative study in a tertiary care hospital", *International Journal of Current Research*, 10, (06), 70696-70699.

INTRODUCTION

Diabetes is one of the most prevalent chronic diseases worldwide. In a study it was reported that 285 million adults worldwide had diabetes in 2010 and this figure is projected to rise to 439 million by the year 2030 (Shaw *et al.*, 2010). Such a profound demographic shift is likely to yield a corresponding increase in the prevalence of diabetes chronic complications, including those in the lower extremity, the diabetic foot (van Dieren *et al.*, 2010). It is estimated that the annual population-based incidence of a diabetic foot ulcer (DFU) ranges from 1.0% to 4.1%. The lifetime incidence may be as high as 25% (Reiber, 2001). Despite the efforts of conservative therapy, there will always be a percentage of ulcers that necessitate hospitalization. These cases require strict glycemic control, appropriate dressings, microbiological control and may need surgical debridement or endovascular intervention (Adam *et al.*, 2006).

Foot problems in diabetics can frequently be life or limb threatening, yet have not received the same level of attention as other diabetes complications (Waspadji *et al.*, 1996). Until today, descriptive data regarding demographical and clinical factors in foot ulcers among diabetic patients in India are relatively few. In the current study, we attempt to study epidemiological profile and clinical presentation of diabetic foot ulcers.

MATERIALS AND METHODS

This study was a prospective study in which known diabetic patients presenting with foot ulcers to the Department of Orthopedics in a tertiary care hospital in North India were included over a period of one year from January 2017 to January 2018. After taking informed consent, demographic profile of the patient e.g age, occupation, socioeconomic status, etc. was noted. History regarding duration of diabetes, type of diabetes, history of smoking, family history of diabetes, history of foot ulceration in past and treatment taken was inquired and recorded in a predesigned proforma and entered on excel sheet. Clinical evaluation of the patient involved general physical examination. Neurological assessment and

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DOI: <https://doi.org/10.24941/ijcr.31136.06.2018>

palpation of peripheral pulses were done. Peripheral arterial disease was diagnosed as ankle brachial index (ABI) < 0.9 in either leg. Patients were subjected to ophthalmologic examination to rule out diabetic retinopathy. Assessment of glycemic control was done by measuring mean HbA1c value, fasting and random blood glucose levels. The results of HbA1c was stratified in percentage graded as: HbA1c < 7%, good glycemic control; HbA1c 7-7.9%, fair control; HbA1c 8-9.9%, poor control; HbA1c ≥ 10%, very poor control. Specimens of the foot lesions, after decontamination and debridement followed by curettage, were collected for gram stain, aerobic and anaerobic culture, and for antimicrobial susceptibility testing. Radiographs were taken from the affected foot(s) to discover bone abnormalities. Osteomyelitis was determined by radiological examination. Specialized investigations such as Colour Doppler, were done if it was presumed to be of importance to quantitatively assess the blood flow. Using the clinical information obtained, the type of foot lesion was determined and classified as neuropathic, ischemic, neuroischemic, or unclassified.

The staging of the ulcers was done using the Wagner system (Wagner, 2002) as under

Wagner grade	Signs
0	No ulcer in a high-risk foot
1	Superficial ulcer involving the full skin thickness
2	Deep ulcer penetrating to ligaments/muscle, but no bone involvement or abscess formation
3	Deep ulcer with cellulitis or abscess formation, often with osteomyelitis
4	Localized gangrene
5	Extensive gangrene involving the whole foot

RESULTS

Demographic profile: A total of 50 patients were studied. The average age of patients was 55.7 year (with range from 44 to 80 years). Male patients (84%) outnumbered females (16%). 68% patients belonged to low socioeconomic status. History of smoking was seen in 44% of the cases.

Clinical characteristics of patients: The studied patients had type 2 diabetes mellitus. The average duration of diabetes was 7.1 years (with range of 5 to 17 years). None of these patients was classified as having type 1 diabetes. The mean HbA1c at the time of admission was $11.6 \pm 2.6\%$. 34% patients were taking insulin, 16% were on oral hypoglycemic agents, rest of the patients were on irregular treatment. Out of 50 patients, 26% of patients developed recurrence of foot ulcers either at the same site or at a different site and had to be hospitalized again. Common precipitating events of ulceration included minor trauma, walking barefoot, spontaneous blistering, ill-fitting shoes, self treatment and reporting late to tertiary care centre. 40% of patients could not remember the initiating events of the wound. In this study, 40 patients (80%) were in high grade Wagner, i.e. Wagner grade ≥ 3. 10 patients had grade 2 disease, 31 patients had grade 3 disease, 8 patients had grade 4 disease, one patient had grade 5 disease. Foot ulcers in 26 patients were pure neuropathic, 4 patients had ischemic-type, while 10 had neuro-ischemic origin. Infection was present invariably in nearly all patients, except two cases with dry gangrene. In radiographic studies of the affected foot, 6 (12%) had osteomyelitis. One patient presented with septicemia. 22% patients had associated diabetic retinopathy on ophthalmologic examination.

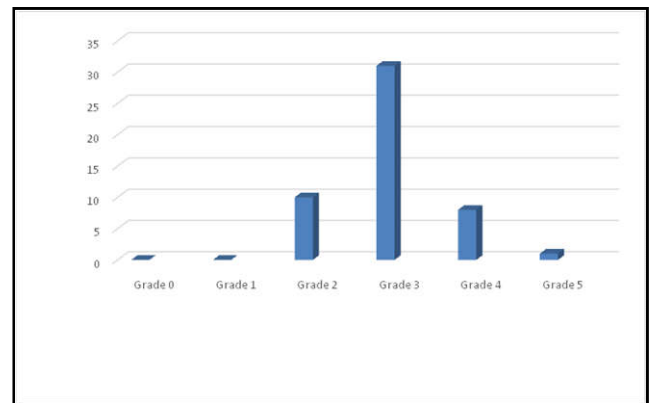


Figure 1. Distribution of cases according to grade of ulceration

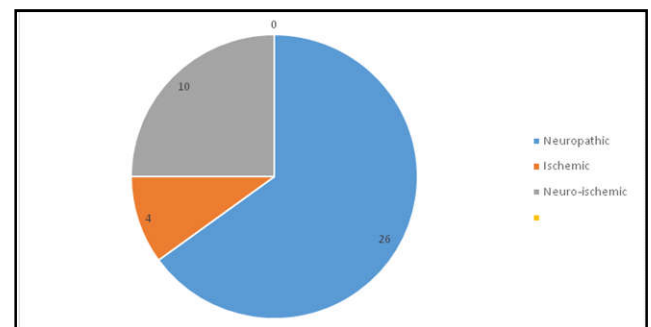


Figure 2. Distribution of diabetic foot ulcers according to underlying pathogenetic mechanism

Microbiologic pattern: A total of 43 specimens were cultured which yielded 29 positive cultures (67.4%). Among the positive-cultured specimen, Gram-negative bacilli constituted the majority (85%) and *Escherichia coli* was found to be the most common isolates. Eight samples were polymicrobial infection. Anaerobic microorganisms constituted to 2.2% of the total isolates. The most commonly isolated anaerobe was *Peptostreptococcus spp.*

DISCUSSION

Abbott *et al.* (2002) reported that more than 2% of diabetic patients will develop new foot ulcers annually. The prevalence of DFU varied between 4% and 20.4% among hospital-based studies in individuals with diabetes (Bouter *et al.*, 1993; Benotmane *et al.*, 2000). According to some authorities (Smith *et al.*, 1987; Waugh, 1988), diabetic foot problems are responsible for 23–50% of the hospital bed occupancies by diabetic patients. The mean age of patients in our study was 55.7 year (with range from 44 to 80 years) which correlates with a study performed by Bansal *et al.* (2008). Male patients (84%) are commonly involved which has been shown in previous studies as well (Oyibo, 2001; Viswanathan, 2006; Morbach, 2004). Males are more commonly involved in outdoor activities making them more prone to trauma. Impaired sensations due to peripheral neuropathy adds to it. 68% patients belonged to low socioeconomic status which is a well known risk factor in previous studies as well (Boulton, 2006; Khanolkar, 2008). History of smoking was seen in 44% of the cases which is similar to a study by Parisi MC *et al.* (2008). In our report, infection was present invariably in nearly all patients and Gram-negative bacteria were the most commonly isolated. *Peptostreptococcus spp.* was the most predominant anaerobic isolates, which is in accordance to the

previous bacteriologic study from Singapore (Ng, 2008) or other tertiary care hospital in India (Chopdekar, 2011). Boyko *et al.* (1999) in the Seattle Diabetic Foot Study found the mean duration of diabetes to be 13.2 years compared to 7.1 years in this study. With regards to diabetes control, 80% of patients had poor glycemic control, i.e. HbA1c > 8%. Poor drug compliance, lack of financial resources, lack of education and poor access to medical facilities may all lead to poor glycemic control. Overall mean HbA1c in this study was higher than what Hartemann-Heutier *et al.* (2002) and Ozkara *et al.* (22) have shown (mean HbA1c 8.7% and 10.3%, respectively). Thewjitcharoen *et al.* (23) found that approximately 56.8% of DFU patients had neuropathy only and another 29.3% had neuroischemic ulcers (52% and 20%, respectively, in our study). Of note, pure ischemic ulcers usually present in lower percentage (8% in our study). Autonomic neuropathy results in loss of sweating and dryness of skin leading to formation of cracks. This coupled with motor neuropathy leads to atrophic changes in foot musculature leading to arch collapse and foot deformity. Decreased sensations make individual unaware of minor trauma, further adding to the insult. 40% of our patients were unaware of the cause of the ulcers. Perhaps the co-existence of neuropathy, lack of foot care is the main cause of the tendency for progression of their lesions before presentation. Other studies quote inadequate footwear (Abbott *et al.*, 2002; Benotmane, 2000) or spontaneous blisters (Thewjitcharoen *et al.*, 2014; Ogbera *et al.*, 2008) as the most common cause of foot ulceration. It is well known that a previous DFU history increases the risk of further lesions (Abbott *et al.*, 2002; Larsson *et al.*, 1998). Recurrence of foot ulceration in 26% of patients showed that they require more personal education regarding foot care. This finding is very important as foot ulceration is a preventable entity in many cases with adequate education, routine foot care and attention to foot wear (Abbas, 2015; Van Netten *et al.*, 2016). The famous maxim told that prevention is better than cure can be applicable: identification of high risk foot with simple equipment and management at early stage of ulcer is the most efficient and cost-effective solution, rather than managing them in the hospital and increasing the financial burden.

Conclusion

Diabetic foot ulcers cause significant morbidity and pose sizeable economic burden on developing countries. Lack of proper education, little awareness about foot care, financial barriers and delay in seeking medical advice further adds to this complication of long standing diabetes. The present study highlights that effective glycemic control, optimal wound care, aggressive medical management and timely surgical intervention may decrease disabling morbidity with better outcome of this disastrous complication.

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