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A study to find the causes of diabetic foot infections in a selected community

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ABSTRACT

Background: Ulcerations associated with diabetes are the most common cause of foot infections. Most of these ulcers are a direct result of loss of sensation secondary to peripheral neuropathy. The prevalence of leg ulceration is approximately 1% to 2%, and is slightly higher in the older adult population. Venous ulcers are the most common form of leg ulcers, accounting for almost 80% of all lower extremity ulcerations. Peak prevalence is between 60 and 80 years. Approximately one third of patients with chronic venous insufficiency will develop venous ulceration before the age of 40 years. In addition, venous ulcers may have a prolonged duration and are associated with a high rate of recurrence, which contributes to their prevalence. Approximately 15% of persons with diabetes will develop foot ulceration during their lifetime. Most lower extremity amputations in India are preceded by a foot ulcer. This study is done to find the commonest causes of foot infection in the background of neuropathy among the selected population. **Methods:** Total of 153 patients were included in this study. Detailed history was taken and all the wounds were

Methods: Total of 153 patients were included in this study. Detailed history was taken and all the wounds were classified according to Wagner's grades. Foot infections in the grade 3,4, 5 (which required debridement/amputations) were included in the study. Foot ulcerations without infections were excluded from the study.

Results: 142 (92%) of the patients with infection had diabetic neuropathy. All patients with diabetic neuropathy presented with sensory neuropathy. 33 (21%) patients presented with infection due to previous callus. 52 (33%) patients presented with infection due to previous non-healing ulcer. 20 (13%) patients with deformities developed callus at bony pressure areas due to neuropathy or post-surgery sequel. One patient had hot water burns injury. Five (0.03%) patients had Ingrown nails. 14 (0.09%) patients related to barefoot walking/thorn prick injuries. 6 (0.03%) patients had fungal infection. Two (0.01%) patients had itching and scratching over legs. 15 (0.09%) patients had history of previous amputation. Vigorous massage was the cause in 1 patient (0.006%). Shoe bite injury resulted in foot ulcer in 2 (0.02%) patients. Two (0.02%) patients presented with infection due to deep cracks in heels.

Conclusions: Neuropathic changes is the most common cause of diabetic foot infections among which callus, non-healing trophic ulcer and previous amputee are the predominant causes. Patient education has a crucial role in prevention of diabetic foot infections by foot care precautions.

Keywords: Diabetic foot infections, Diabetic foot ulcer, Peripheral neuropathy

INTRODUCTION

Approximately three percent of people with diabetes experience foot ulcers. And approximately 84 percent of lower limb amputations have a history of ulceration with

only approximately half of amputees surviving for more than 2 years. 56 percent of individuals with foot ulcers who do not have an amputation survive for 5 years. Foot ulcers and amputations significantly reduce the quality of life. Approximately 8.8 percent of hospital admissions of diabetic patients are for foot related problems, and such hospital admissions are about 13 days longer than for diabetics without foot related admissions. Approximately 35 to 40 percent of ulcers recur within 3 years and up to 70 percent recur within 5 years. Diabetic foot disease is the leading cause of non-traumatic lower limb amputations. 1

Risk factors implicated in the development of diabetic foot ulcers are infection, older age, diabetic neuropathy, peripheral vascular disease, cigarette smoking, poor glycemic control, previous foot ulcerations or amputations, and ischemia of small and large blood vessels.¹⁻⁴ Prior history of foot disease, foot deformities that produce abnormally high forces of pressure, renal failure, oedema, impaired ability to look after personal care (e.g. visual impairment) are further risk factors for diabetic foot ulcer.^{1,2}

People with diabetes often develop diabetic neuropathy due to several metabolic and neurovascular factors. Peripheral neuropathy causes loss of pain or feeling in the toes, feet, legs and arms due to distal nerve damage and low blood flow. Blisters and sores appear on numb areas of the feet and legs such as metatarsophalangeal joints, heel region and as a result pressure or injury goes unnoticed and eventually become portal of entry for bacteria and infection.⁵

The proportion of neuropathic, neuroischemic, and purely ischemic lesions in diabetics is 54, 34, and 10%, respectively. In India, it is estimated that approximately 40,000 legs are being amputated every year, of which 75% are neuropathic with secondary infection, which is potentially preventable. Certain factors, such as, barefoot walking, illiteracy, low socioeconomic status, late presentation by patients, ignorance about diabetic foot care among primary care physicians, and belief in the alternative systems of medicine contribute to this high prevalence.

This study is designed to identify the commonest causes for diabetic foot infection in the background of neuropathy.

METHODS

Total 153 patients were included in the study who presented in the podiatry department of Amritha institute of medical sciences between June 2008 to August 2008.

Age, sex, type/duration of diabetes, cause of ulceration, duration of ulcer, previous history of ulceration, presenting signs & symptoms of ulceration and previous treatment and socioeconomic status of the subjects were recorded. Proteinuria was detected by using the Combur 10 test strip and was confirmed by using the Micral test (for microalbuminuria) or 24 hours urinary protein estimation. Glycaemic control was assessed by measuring glycosylated haemoglobin (HbA1c) and a HbA1c<6.5%

was regarded as good glycaemic control, 6.6-7.5%, fair control and >7.5% poor. Each patient underwent assessment of the vascular status by manual palpation of femoral, popliteal, dorsalis pedis and posterior tibial arteries to define patency and grade: (a) good volume (b) diminished volume or (c) absent. Neuropathy was quantified assessing vibration sensation using a 128 Htz tuning fork and a 10g monofilament applied perpendicularly to the plantar aspect of the first toe, the first, third and fifth metatarsal heads, the plantar surface of the heel and dorsum of the foot avoiding any callus, corn or wound site and graded as normal, diminished or absent. Ankle and knee reflexes were assessed as normal reinforced or absent. Osteomyelitis was determined by probing to bone and radiological examination All the foot ulcers were classified using the Wagner's grading system for diabetic foot.

Patients presenting with grade 3, 4, 5 were included in the study.

Grade 0, 1 and 2 were excluded from the study.

Table 1: Wagner's grading of diabetic foot ulcer.

Grade	Lesion
0	Skin lesions absent, hyperkeratosis below or above bony prominences
1	Skin and immediate subcutaneous tissue are ulcerated
2	Lesions are deeper and may penetrate to tendon, bone or joint capsule
3	Deep tissues are involved, osteomyletis may be present
4	Gangrene of some portion of the toes or forefoot
5	The entire foot is gangrenous

Detailed history from each patient is taken regarding their cleanliness, type of footwear, bare foot walking, previous history of foot ulcer, frequent shoe bites, sensation over the legs and feet, itching over the legs, hot water injuries, history of any toe amputation in the past and knowledge of the foot practices that can save the foot from all such problem

RESULTS

82 (54%) patients were male, 71 (46%) patients were female.

Table 2: Gender distribution in the study.

Males	Females
82	71

Patients with age <50 years were 12 (8%) whereas patients with age >50 years were 141 (92%).

Table 3: Age distribution of patients in the study.

Age	No. of people
<50 years	12
>50 years	141

Patients below 50 years of age were both type 1 and type 2 diabetic equal in number whereas patients who were above 50 were having type 2 diabetes.

Table 4: Prevalence of type 1 and 2 diabetes in the study group.

Age	Type 1 diabetes	Type 2 diabetes
<50 years	6	6
>50 years	0	141

Table 5: Different causes of foot infections with associated neuropathy.

Causes	No. of people with neuropathy foot	No. of people with ischemia foot
Foot deformities	20	0
Previous callus	33	0
Previous non- healing ulcer	52	0
Hot burns injury	1	3
Ingrown nails	5	0
Bare foot walk	14	2
Fungal infection	6	0
Itching over legs with swelling	2	1
Previous history of amputation	15	0
Vigorous massage	1	0
Shoe bite injury	1	0
Heel cracks	3	0

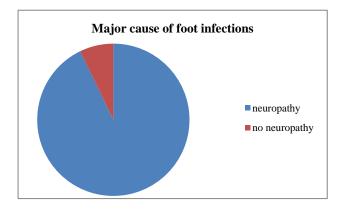


Figure 1: Neuropathy among the study group.

DISCUSSION

Infections in the foot were due to various causes and all the patients had neuropathy. 33 (21%) patients presented with infection due to previous callus. 52 (33%) patients presented with infection due to previous non-healing ulcer. 20 (13%) patients with deformities developed callus at bony pressure areas due to neuropathy or post surgery sequel. One patient had hot water burns injury. Five (0.03%) patients had Ingrown nails. 14 (0.09%) patients related to barefoot walking / thorn prick injuries. Six (0.03%) patients had fungal infection. Two (0.01%) patients had itching and scratching over legs. 15 (0.09%) patients had history of previous amputation. Vigorous massage was the cause in 1 patient (0.006%). Shoe bite injury resulted in foot ulcer in 2 (0.02%) patients. Two (0.02%) patients presented with infection due to deep cracks in heels.

Shoe bite injury, web space fungal infection, bare foot walking injury and ingrown nails are reasons of infection in peripheral vascular disease in these group. Most patients presented with infection are above 5 years history of diabetes.

142 (92%) of the patients with infection had diabetic neuropathy. All patients with diabetic neuropathy presented with sensory neuropathy. Motor neuropathy changes were seen in 83 patients. Autonomic neuropathy was seen in 112 patients. Six (0.03%) patients with infection had peripheral vascular disease. Five patients had diabetic neuropathy with peripheral vascular disease.

Among diabetic neuropathy- most infections are due to sensory loss and motor neuropathy related deformity and pressure callus and secondary infection.

Neuropathy in diabetic patients is manifested in the motor, autonomic, and sensory components of the nervous system. Bamage to the innervations of the intrinsic foot muscles leads to an imbalance between flexion and extension of the affected foot. This produces anatomic foot deformities that create abnormal bony prominences and pressure points, which gradually cause skin breakdown and ulceration.

Autonomic neuropathy leads to diminished sweating. The overlying skin becomes dry and increasingly susceptible to fissures and a subsequent development of infection.

The loss of sensation as a part of peripheral neuropathy exacerbates the development of ulcerations. As trauma occurs at the affected site, patients are unable to detect the insult to their lower extremities. As a result, many wounds go unnoticed and progressively worsen as the affected area is continuously subjected to repetitive pressure and shear forces from ambulation and weight bearing. Charcot arthropathy is a consequence of peripheral neuropathy. It is the result of a combination of motor, autonomic, and sensory neuropathies, in which there is muscle and joint laxity that leads to changes in the arches of the feet. Furthermore, the autonomic denervation leads to bone demineralization via the impairment of the vascular smooth muscle, which leads

to an increase in blood flow to the bone with consequential osteolysis.⁹

Examination of the feet is an integral part of the physical examination of every patient, more so a diabetic patient. One should look for neuropathic changes like dry skin, fissures, deformities, callus, abnormal shape of foot, ulceration, prominent veins, and nail lesions. Careful attention should be given to the interdigital spaces. Significant ischemia is characterized by loss of hair on the dorsum of the foot and a dependent rubor. One should feel the foot for warmth or coldness: examine the peripheral pulsations such as dorsalis pedis, which can be felt lateral to the extensor hallucis longus tendon and posterior tibial, which is above and behind the medial malleolus. The femoral artery should also be palpated and auscultated for the presence of bruit. The plantar aspects of the feet should be felt for the presence of any bony prominence or callus.

Sensory neuropathy can be tested by using monofilaments and biothesiometry. If these are not available, the detection of light touch by cotton wool, pinprick, and vibration sense using a 128 Hz tuning fork is sufficient. The goal is to detect whether the patient has lost protective sensations (LOPS), rendering him susceptible to foot ulceration.

A hand-held Doppler can be used to confirm the presence of pulses and to quantify the vascular supply. When used together with a sphygmomanometer, the ankle and brachial systolic pressures can be measured and the ratio then calculated. In normal subjects, the ankle systolic pressure is higher than the brachial systolic pressure. The normal ABI>1, in the presence of ischemia it is <0.9. Absent or feeble pulses, with ABI<0.9, confirm ischemia. Conversely, the presence of pulses and ABI>1 rules out significant ischemia. ¹⁰

Early detection of potential risk factors for ulceration can decrease the frequency of wound development. It is recommended that all patients with diabetes undergo a foot examination at least annually, to determine the predisposing conditions to ulceration.

Patients should be educated regarding the importance of maintaining good glycemic control, wearing appropriate footwear, avoiding trauma, and performing frequent selfexaminations.

Prevention of diabetic foot infections includes

• *Primary prevention:* Screening of high risk feet and proper advice on preventive footwear.

- Secondary prevention: Management of trivial foot lesions such as callus removal, treatment of nail pathologies, deroofing blisters, and so on.
- *Tertiary prevention:* Prompt referral to a specialist for advanced foot lesions.⁷

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REFERENCES

- 1. Turns M. The diabetic foot: an overview for community nurses. Br J Comm Nurs. 2012;17(9):422,424-7,430-3.
- 2. Turns M. Diabetic foot ulcer management: the podiatrist's perspective. Br J Comm Nurs. 2013;18(12):S16-9.
- 3. Scott G. The diabetic foot examination: A positive step in the prevention of diabetic foot ulcers and amputation. Osteopathic Fam Phys. 2013;5(2):73-8.
- 4. Wu SC, Driver VR, Wrobel JS, Armstrong DG. Foot ulcers in the diabetic patient, prevention and treatment. Vascular health and risk management. 2007;3(1):65-76.
- 5. Mekkes JR, Loots MAM, Van Der Wal AC, Bos JD. Causes, investigation and treatment of leg ulceration. Br J Dermatol. 2003;148:388-401.
- 6. Pecoraro RE, Reiber GE, Burgess EM. Pathways to diabetic limb amputation: Basis for prevention. Diabetes Care. 1990;13:513-21.
- 7. Pendsey S, Abbas ZG. The Step-by-step program for reducing diabetic foot problems: A model for the developing world. Curr Diab Rep. 2007;7:425-8.
- 8. Bowering CK. Diabetic foot ulcers: Pathophysiology, assessment, and therapy. Can Fam Phys. 2001;47:1007-16.
- 9. Clayton W, Elasy TA. A review of pathophysiology, classification and treatment of foot ulcers in diabetic patients. Clin Diabetes. 2009;27:52-8.
- 10. Pendsey S. Evaluation of neuroischemic foot. In: Contemporary management of the diabetic foot. 1st ed.New Delhi, Jaypee Brothers Medical Publishers; 2014:111.

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