

Original Research Article

A multi centric study of diabetic foot ulcer: causes and complications

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ABSTRACT

Background: Diabetes mellitus is a metabolic disorder and has become an epidemic. 73 million people in India have diabetes mellitus. Presently India has ranked the second highest country with diabetics in the world. Diabetic foot ulcer is a result of one or both of the complications of diabetes such as neuropathy and ischemia. The objective of the study was to study the causes for the ulcer formation on the toes.

Methods: A prospective study was carried out from January 2016 to August 2018 from multiple diabetic clinics in Hyderabad, India. All the patients had undergone the following tests. 1) X-ray foot, 2) ABI (ankle brachial index) test, 3) Neuropathy test by VPT (vibration perception test) and monofilament.

Results: The age of the patients mostly ranged from 50 to 70 years. 61% of the patients had neuropathic ulcer, 20% had ischemic ulcer, 19% had neuro-ischemic ulcer. 69% of these patients had osteomyelitis. 52% had ulcer on the right foot and 48% on the left. 15% had dry gangrene with ulcer where as 85% had infected ulcers. 60% of the ulcers were only on the plantar aspect and 24% had ulcers all around the toe. ABI (ankle brachial index) was normal 0.9 to 1.2 in 80% of patients whereas 20% had abnormal (<0.9). 60% of patients had ulcers involving the 1st and 2nd toes and both feet were almost equally affected.

Conclusions: Neuropathy is the leading cause for ulcers on the toes followed by ischemia and then infection. Treating the neuropathic ulcer early can bring down the amputation rate of the toes by 50%.

Keywords: Diabetic foot, Neuropathy, Ischemia, Infection, Ulcers, Amputation

INTRODUCTION

It has been estimated that diabetes affects around 20% of the population and thus is the most common disorder of metabolism. The new cases occurring annually are on increase and it has been estimated that the total number of persons living with diabetes can rise to a whopping of 366 million by 2030. This increased number of estimated persons living with diabetes has been attributed to improved diagnostic methods, increased expectancy of the life, changes in the lifestyle and diet of the populations with modern era.¹

Diabetes affects almost all body parts, important being brain, heart, kidney, foot etc. over a long term it affects many other systems. Diabetics are more prone to hypoglycemia and infections. But when the foot is affected, then it affects the quality of life of the persons drastically. Its treatment and management is long term and thus puts burden not only on the patient but also on his family.²

Diabetic patients developing ulcer of the foot are at increased risk of developing the more amounts of morbidity and mortality. There is always a risk of foot or

limb getting amputated during its long term management as its end point of the management.³

Complication occurring in the foot of a diabetic person puts a heavy economic burden on the patients. If clinical examination has been carried out properly we can easily identify those with at risk of developing the diabetic foot. This can be done by regular screening of the newly detected diabetes mellitus.⁴

Diabetic foot complication is a major cause of burden in terms of finances, emotional well being in the developing world. There is increased, morbidity, disability and even mortality due to the presence of diabetic foot ulcers. The incidence of ulcer over foot in diabetics has been estimated at 15% of all the diabetes mellitus patients.⁵

Among all the complication of the diabetes, diabetic neuropathy and ulcer over the foot are the very important one. It ranges from very simple to very complex variety and may lead to amputation of the limb and can be cause of infections that may be threatening the life of the patient of the diabetes mellitus.⁶

The most common risk factor leading to amputation of the foot in patients with diabetes mellitus is the severe ulcer over the foot. It has been said that among every six patients with diabetes mellitus, one has the ulcer over the foot and this situation is prevalent in developed countries, and it may more worse in developing countries.⁷

There are certain risk factors of the ulcer over foot in patients with diabetes mellitus. They are like presence of neuropathy, trauma to the foot etc. it also depends upon the characteristics like biologic or metabolic of the patients with diabetes mellitus.⁸

Ulcer over the foot in patients with diabetes mellitus is a long term complication. But there is possibility of prevention. It's a challenge to the existing health system. Age of the patient, awareness level of the patient, type of the diabetes, habits of the patients, practices of the patient related to self care, presence of neuropathy all these factors affect the occurrence of the ulcer over the foot in the patients with diabetes mellitus.⁹

Present study has been carried out to study the causes for the ulcer formation on the toes.

METHODS

Study design: Hospital based multi centric cross sectional study.

Study duration: From January 2016 to August 2018.

Sample size

A total of 100 patients of diabetic foot ulcer have been studied from various hospitals in Hyderabad.

Settings

Present study was carried out from multiple diabetic clinics in Hyderabad, India

Ethical issues

Institutional Ethics Committee permission was obtained. Informed consent was taken from the patients having ulcer over the foot and who are diabetics

Inclusion criteria

Inclusion criteria were known cases of diabetes mellitus with ulcer over the foot; willing to participate in the present study.

Exclusion criteria

Exclusion criteria were known cases of diabetes mellitus not having ulcer over the foot; not willing to participate in the present study

After selecting the patient with diabetes mellitus, detailed clinical examination of the foot was carried out to ascertain the presence of ulcer over toe of the patient. Once confirmed, the patient was asked the informed consent to be included in the present study. Like this, 100 patients with diabetes mellitus having ulcer over the foot from different diabetic clinics of Hyderabad, India have been included in the present study.

Causes leading to the presence of ulcer over the foot like neuropathy, ischemia, and neuro ischemia were seen and recorded. Incidence of osteomyelitis was also seen and recorded. Side of the limb affected and the toes affected in terms of side, number and type was noted and recorded. Wound was examined for presence of type of gangrene like whether it is a wet gangrene or dry gangrene. Location of the ulcer was ascertained like whether it was present on plantar side or complete or plantar plus lateral or lateral only or lateral plus dorsal location or dorsal only

X-ray foot was done in all the patients. ABI (Ankle Brachial Index) test was done in all the patients. Neuropathy test by VPT (vibration perception test) and Monofilament was done in all the patients.

Statistical analysis

The data was noted and recorded in the pre tested, pre designed, semi structured study questionnaire, and then it was entered in the Microsoft Excel worksheet. Finally it was analyzed using proportions.

RESULTS

Table 1 shows causes that led for the development of ulcers in the diabetic patients. The most common cause that led for the development of ulcers in the diabetic

patients was neuropathy in 61% of the cases followed by ischemia in 20% of the cases and neuro ischemia in 19% of the cases. Thus neuropathy has been found to be the most common cause for the development of the ulcers in the patients with diabetes.

Table 1: Causes that led for the development of ulcers in the diabetic patients.

Causes	Number	%
Neuropathy	61	61
Ischemia	20	20
Neuro-ischemia	19	19
Total	100	10

Table 2 shows incidence of osteomyelitis in these patients. It was found that most of the patients i.e. 69% had osteomyelitis. While in 31 patients, there was no osteomyelitis. Thus it has been found that the incidence of the osteomyelitis was very high that is it is found to cover almost two third of the cases of diabetic foot ulcer. But even in the absence of osteomyelitis also, one third of the patients can develop diabetic foot ulcer.

Table 3 shows distribution of study subjects as per ankle brachial index (ABI). It has been seen that the ankle

brachial index was normal in majority i.e. 80% of the cases while in 20% of the cases it was abnormal. Thus it has been found and can be stated from the observation of this table that the only 20% of the patients with diabetic foot ulcer had abnormal ankle brachial index which was taken as less than 0.9. Almost 80% of the patients with diabetic foot ulcer had normal ankle brachial index which was taken as ranging from 0.9 to 21.2.

Table 2: Incidence of osteomyelitis in these patients.

Incidence of osteomyelitis	Number	%
With osteomyelitis	69	69
Without osteomyelitis	31	31
Total	100	100

Table 3: Distribution of study subjects as per Ankle Brachial Index (ABI).

ABI	Number	%
Normal (0.9 – 1.2)	80	80
Abnormal (< 0.9)	20	20
Total	100	100



Figure 1: Images showing different types of lesions. (A) Plantar neuropathic ulcer; (B) vascular ulcer; (C) infected neurovascular ulcer; (D) x ray showing osteomyelitis secondary to neuropathic ulcer.

Figure 1 shows images showing different types of lesions. Figure 1A shows the picture of the patient who had neuropathic type of diabetic ulcer where the plantar side was found to be affected. Figure 1B shows the picture of the patient who had vascular type of diabetic foot ulcer. In this the areas appears black and the great toe is seen to be affected. Figure 1C shows the picture of the patient who was having neurovascular type of diabetic foot ulcer and it was infected as well as neglected by the patient and hence it shows erosion. Figure 1D shows the X ray of the patient who had osteomyelitis secondary to neuropathic ulcer.

Table 4: Comparing ulcers on the left and right feet

Toe	Left	Right	Total
1 st	17	18	35
2 nd	13	12	25
3 rd	5	10	15
4 th	4	3	7
5 th	9	9	18
Total	48	52	100

Table 4 shows comparing ulcers on the left and right feet. Left side was found to be affected in 48 cases while the right side was found to be affected in 52 cases. Overall the first toe was found to be the most commonly affected in 35 cases followed by second toe in 25 cases. Third toe was affected in 15 cases and fifth toe was found to be affected in 18 cases. Similar trend was seen when the sides were compared. On left side, 17 had first toe affected, 13 had second toe affected, 5 had third toe affected, 4 had fourth toe affected and 9 had fifth toe affected. On right side, 18 had first toe affected, 12 had second toe affected, 10 had third toe affected, 3 had fourth toe affected and nine had fifth toe affected.

Table 5: Presentation of the wound.

Presentation	Number	%
Wet infected wound	85	85
Dry gangrene with ulcer	15	15
Total	100	100

Table 5 shows presentation of the wound. It was observed that majority i.e. 85% had the wet infected wound type presentation at the diabetic clinics. Dry gangrene with ulcer was seen in only 15% of the cases. Thus from the results of the present study we can say that wet infected wound is commonly found in the patients with diabetic foot ulcer. We can also say that the dry gangrene with ulcer is less common in patients with diabetic foot ulcer.

Table 6 shows location of the ulcers on the involved toes. Majority i.e. 60% had the ulcer which was located on the plantar side followed by location completely in 24% of the cases. Two cases had plantar plus lateral location, four cases had later location, four cases had dorsal plus lateral location, and six cases had dorsal location. Thus

from the findings of the present study we can say that generally and most commonly 60% of the cases of the diabetic foot ulcer present with plantar side affected followed by complete affection.

Table 6: Location of the ulcers on the involved toes.

Location	Number	%
Plantar	60	60
Complete	24	24
Plantar+lateral	2	2
Lateral	4	4
Dorsal+lateral	4	4
Dorsal	6	6
Total	100	100

DISCUSSION

Mariam et al selected 279 patients by systematic random sampling.¹⁰ They found that rural dwellers had a 2.57 times more risk of developing ulcer over foot compared to their urban counterparts. Having type 2 diabetes was associated with 2.58 times more risk of developing ulcer over foot compared to patients with type 1 diabetes mellitus. Being overweight was associated with 2.12 times more risk of developing ulcer over foot compared to normal weight. Being obese was associated with 2.65 times more risk of developing ulcer over foot compared to normal weight. Inappropriate self-care practices was found to be associated with 2.52 times more risk of developing ulcer over foot compared to those who have good self-care practices. Having neuropathy was found to be associated with 21.76 times more risk of developing ulcer over foot compared to not having the neuropathy.¹⁰

Younis et al found that 7.02% was the prevalence of ulcer over foot in diabetics.¹¹ Out of that, 4.5% had ulcer on the planter side while in our study it was in 60% of the cases. Presence of ulcer on dorsal side was seen in 2.6% of the cases while we found it in 6% of the cases. They noticed that bilaterality was present in 8.5% of the cases. They found that increasing age, more duration of diabetes, were some of the important risk factors. They observed that 74% had neuropathic ulcers while this proportion was 61% in the present study. They noticed that 19% of the cases had neuro-ischemic ulcers which is exactly the same found in the present study.¹¹

Assaad-Khalil et al found in their study that the prevalence of type 2 diabetes mellitus was 96.75%.¹² They found that as the duration of diabetes increased, the risk of diabetic foot increased significantly. It was also associated with presence of coronary heart disease. Foot fissures were also found to be associated with the risk of developing the diabetic foot.

Nather et al studied 192 cases of diabetes of type 2.¹³ They noted that the Indians had a high incidence of

diabetic foot. They observed that elderly above the age of 60 years had a greater risk of amputation due to diabetic foot. Stroke also had a greater risk of amputation due to diabetic foot. They discussed about the ankle brachial index which was also studied in the present study and they stated that if it is less than 0.8 then had a greater risk of amputation due to diabetic foot. In the present study we found that it was abnormal in 20% of the cases.¹³

Bajaj et al observed that the incidence of neuro ischemic ulcer was 30% while it was less in the present study (19%).¹⁴ Neuropathic ulcer incidence in their study was 70% while it was 61% in the present study. The authors found that the neuro ischemic ulcer was more common in males compared to females. They concluded that neuropathic ulcer was double than that of neuro ischemic ulcer. This is in accordance with the findings of the present study.¹⁴

CONCLUSION

Neuropathic diabetic ulcer was the most common. Mostly it was associated with osteomyelitis. But the ankle brachial index was normal in majority. First toe was the most commonly affected. Wet wound was the most common than the dry gangrene. Plantar aspect was most common presentation. These findings help physicians understand the nature of the diabetic foot ulcer and manage the patients accordingly.

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

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