

## DIABETIC FOOT ULCERS –FACTORS AND OUTCOME

Anand Babu P<sup>1</sup>, \*Ashok Swaminathan G<sup>2</sup> and Subramanian C S<sup>3</sup>

<sup>1,3</sup>Department of General Surgery, Rajah Muthiah Medical College Hospital,  
Annamalai University, Chidambaram, India

<sup>2</sup>Department of Plastic Surgery, Rajah Muthiah Medical College Hospital,  
Annamalai University, Chidambaram, India

### ARTICLE INFO

#### Article History:

Received 4<sup>th</sup> July, 2018

Received in revised form 25<sup>th</sup>

August, 2018

Accepted 18<sup>th</sup> September, 2018

Published online 28<sup>th</sup> October, 2018

#### Key words:

Diabetic foot ulcers, amputations,  
infections

### ABSTRACT

**Background:** Diabetes is a major contributing factor in up to 70% of lower limb amputations. Foot damages such as ulceration, infection, gangrene are one of the important cause of hospital admission in patients with diabetes mellitus. The burden of diabetic foot disease and ulceration is set to increase further due to the co-existence of contributory co morbidities

#### AIM:

1. To assess various prognostic factors involved in the development of foot ulcers in type 2 diabetic patients presenting in Rajah Muthiah Medical College Hospital, Chidambaram .
2. To understand the role of factors involved in the complications arising out of diabetic foot.

**Material and Methods:** In this case study 50 patients were studied. This study was conducted from October 2016 to September 2018. The study was approved by the Ethical Review Committee of Rajah Muthiah Medical College Hospital, Chidambaram.

**Results:** Findings were tabulated according to age and other clinical aspects.

#### Conclusion

1. Factors influencing the outcome and long duration of bedridden state in diabetic foot ulcer disease studied were age, male gender, duration of diabetes and tobacco smoking.
2. Amputation was done for patients having dyslipidaemia, hypertension and infection of the foot, poor glycaemic control, site and number of ulcers in foot.
3. Good prognosis can be achieved with diabetic foot lesions by optimizing glycaemic control, using combination antibiotic chemotherapy, vigorously correcting co morbid conditions.

Copyright © 2018 Anand Babu P et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

## INTRODUCTION

The theme for World Health Day  
2016 is HALT THE RISE: BEAT DIABETES,  
2018 is SAVE THE FOOT.

- Diabetic incidence and prevalence are on the rise
- Diabetic foot ulcer is a preventable complication of diabetes
- Limb Salvage

According to the World Health Organization's 'The World Health Statistics 2012' report, India has the largest number of diabetics in the world and is now being called the "Diabetic Capital of the World". It is estimated that there were 69.1 million cases of diabetes (8.7%) in India in 2015. This will mean that every fifth diabetic in the world would be an Indian. Diabetic foot is a term for foot problems in patients with diabetes mellitus (DM) because of arterial abnormalities and diabetic neuropathy, as well as a tendency toward delayed wound healing, infection, or gangrene of the foot. It occurs in

15% of all patients with diabetes and precedes 84% of all lower leg amputations. The two main types of foot ulcers are neuropathic, ischemic and mixed. In patients with diabetes, pure ischemic ulcers are less common, and the clear majority of ulcers are mixed neuro ischemic.

Prevention is the first step towards solving diabetic foot problems. It is alarming and estimated that a leg is lost to diabetes somewhere in the world every 30 seconds.

#### Aim and Objectives

1. To assess various prognostic factors involved in the development of foot ulcers in type 2 diabetic patients presenting in Rajah Muthiah Medical College Hospital, Chidambaram.
2. To understand the role of factors involved in the complications arising out of diabetic foot.

## MATERIAL AND METHODS

A total of 50 patients with diabetes mellitus from inpatients were screened by meticulous clinical examination, especially

\*Corresponding author: Ashok Swaminathan G

Department of Plastic Surgery, Rajah Muthiah Medical College Hospital, Annamalai University, Chidambaram, India

inspection and palpation for diabetic foot ulcer. Fifty of the total number screened satisfied the inclusion criteria for the study. Diabetic foot ulcers were operationally defined as a breach on the normal skin occurring as induration, ulceration or change of colour on the foot for duration equal to or more than one week. Only patients with active foot ulcerations were included in the study.

For each of the recruited subjects, a history was obtained, and it detailed the patient's demographics including the age, gender and marital status. Smoking, alcohol use, occupation, presence of trauma at onset of ulcer was noted. History regarding the diabetes including duration of disease (estimated from year of diagnosis), and the mode of treatment from either the patient or available hospital records were documented. The presence of neuropathic pain was noted.

A physical examination was then performed. Height, weight, Blood Pressured was recorded. Both feet were examined and the site, state and the stage of foot ulcers were documented. The presences of the high-risk non-ulcer lesions were also described. The lesions were staged based on the Meggitt-Wegner classification.

Peripheral neuropathy was assessed by elucidating the presence or absence of vibration sense using the 128Hz tuning fork on the medial and lateral malleoli and documented. The pressure sensation was done. Then neurological disability scoring (NDS) system was used to each foot. Range of neuropathy score: 0 – 10

Peripheral vascular disease: The dorsalis pedis and posterior tibial arterial pulses were palpated with the patient in supine position and graded as present or absent. Lower limb Arterial Doppler study had been done in the patients at time of inclusion and re-visit.

The other dermatological and/or high-risk lesions looked for were dryness, cracks, fissures, ingrown and/or improperly trimmed nails, oedema, foot deformities e.g., hammer toes, pes cavus and/or corns. X-rays were done to stage the ulcers and to identify the bone status.

Using the clinical information obtained, the type of the foot ulcer was classified as neuropathic, ischaemic or neuroischemic. Foot ulcers were categorized as ischaemic when peripheral vascular disease was present but the neurologic disability was less than or equal to 2; neuropathic when there was neurological disability more than or equal to 3 but no obvious peripheral vascular disease and neuroischemic when both neurological disability and evidence of peripheral vascular disease were present.

After the history and full clinical assessment of the patients in fasted state for about 10hours, venous blood drawn and sent for fasting blood sugars and lipid profile. Also, blood was sent for glycosylated haemoglobin (HbA1c) values. The results were then reported in percentage as per assay test recommendation as: HbA1c

- $\leq 7\%$  - good metabolic control
- $>7$  to  $<10\%$  - fair control
- $\geq 10\%$  -poor metabolic control

A pus swab was obtained from the ulcers and was delivered to the lab within half an hour The data was summarized in tabular form and is presented in the form of diagrams, tables, bar charts and histogram as appropriate. Qualitative data were

entered in form of percentages and where appropriate associations were made.

## DISCUSSION

The mean age of patients with diabetes was found to be 55 years. Peak age of incidence of diabetic ulcers was 51 – 60 years. Margueritte *et al*<sup>1</sup> in Seattle, USA, found a comparable mean of 60 years and a study done by P.N. Nyamu<sup>2</sup> *et al* in Kenyatta National Hospital, Nairobi, found a mean age of incidence as 56.9 years. This comparable mean age may suggest certain time – dependent risk factors in the evolution and course of diabetic foot ulcer disease which are common to diabetes in whatever environment. Age of onset of diabetes is also different in continents.

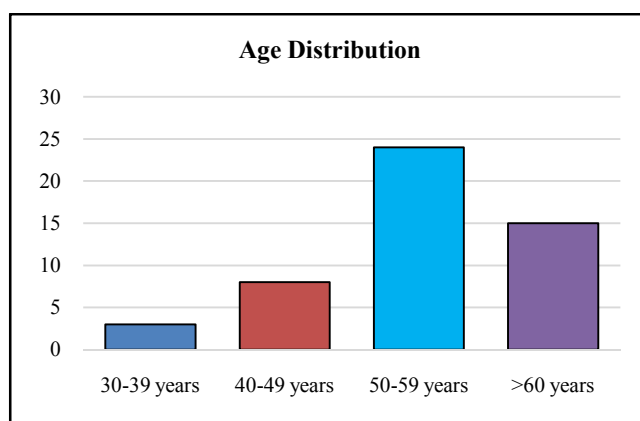


Figure 1 Age Distribution

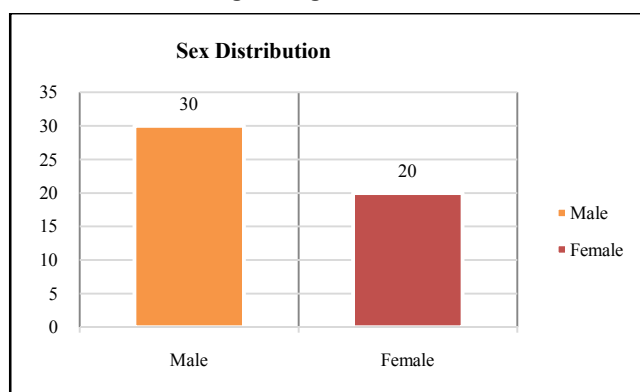


Figure 2 Sex Distribution

Men with diabetes are more likely to suffer amputation than women. According to Gayle E. Reiberet *al*<sup>3</sup> a consistently higher ulcer rate was found in males than in females. The estimated amputation rate in diabetic subjects are higher for males than for females. This is a uniform finding in most U.S. hospital discharge studies, with 1.4-2.7 times excess risk for males compared with females<sup>4,5</sup>. In 1990, the age-adjusted amputation rate for diabetes, computed from NHDS and NHIS data, was 61% higher in males than females (10.3 per 1,000 versus 6.4 per 1,000)<sup>6</sup>. This amputation risk was more pronounced in younger males. In our study, the male to female ratio is 3.1: 1 approximately and the prognosis is worse in male of age more than 50 years and in females more than 45 years.

The mean duration of diabetes in this study is 10.52 years which pointed that the longer the duration of diabetes, the higher the risk of occurrence of infection and amputation. This is in correlation with study conducted by Nelson RG, Gohdes DM<sup>7</sup>.

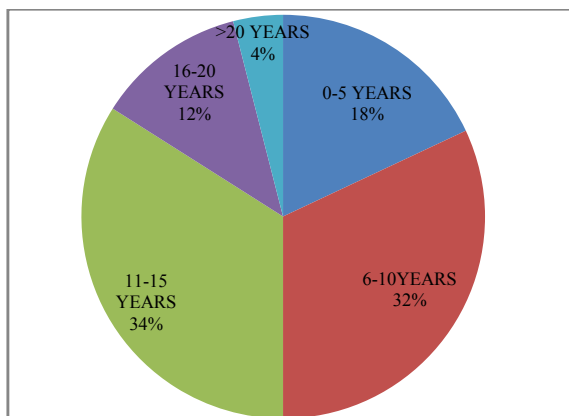


Fig. 3 Duration of Diabetes In Years

The Framingham study suggests that smoking in diabetic foot patients has the same adverse effect on macrovascular disease as they do in non-diabetics. In my study, 28 out of 50 patients gave the history of smoking in whom higher levels of amputations were attempted with poor prognosis. Smoking affects the small blood vessels and make the wounds heal slower.

In the observation of wound healing rates with high HbA1c, it was observed that patients with low HbA1c values had faster healing. My study shows 21 patients had high HbA1c of which 76.9% showed poor wound healing rates and underwent subsequent amputation. This is in correlation with Andrea L. Christman *et al*<sup>3</sup> study which showed that individuals with HbA1c of 5.6% had a wound healing rate of 0.35 cm<sup>2</sup> per day whereas those with HbA1c 11.1% had a healing rate of 0.001 cm<sup>2</sup> per day. This suggests that a relationship exists between faster wound healing rate and low HbA1c levels. Many physiological factors that are thought to contribute to poor wound healing in diabetic foot individuals include decreased or impaired keratinocyte and fibroblast migration and proliferation, cytokine and growth factor function, and angiogenic response, and response to infection<sup>7</sup>. Many of these mechanisms involve hyperglycaemia. Hyperglycaemia reduces keratinocyte migration and proliferation.<sup>11</sup> Also, it adds to the oxidative stress with the production of reactive oxygen species<sup>12</sup>. In my study, of the 23 out of 50 patients who underwent amputation, 3 cases underwent forefoot amputation, 7 underwent below knee amputation, 1 underwent above knee amputation, 12 underwent toe amputations.

In my study, dyslipidaemia in diabetic foot patients is found to be a poor prognostic factor as it delayed wound healing significantly. Dyslipidaemia directly did not influence the diabetic foot as such, but it played an important role in the development of peripheral vascular disease which in turn affected the outcome of diabetic foot. This finding is in correlation with a study done by P.J. Palumbo *et al*<sup>13</sup>, where they found that age, sex, diabetes, hyperlipidaemia, hypertension, and cigarette smoking are significant risk factors for LEAD. In patients with diabetes, vascular disease, ABI, current smoking, and arm systolic blood pressure were identified as significant independent risk factors for LEAD.

Once ulceration develops, arterial insufficiency will result in prolonged healing, imparting an elevated risk of amputation. Additionally, attempts to resolve any infection will be impaired due to lack of oxygenation and difficulty in delivering antibiotics to the infection site. Therefore, early recognition and aggressive treatment of lower extremity ischemia are vital to lower limb salvage. In my study it has

been found a major percentage of patients with associated peripheral vascular disease had underwent amputation.

Wagner's classification score may be different for a surgeon as compared to physician because the diabetic foot patients come with advanced disease to a surgeon and for this reason patient with grade 0, 1, 2 are lesser and those with grade 3, 4, 5 are more in our study. The standard treatment for diabetic foot according to Wagner's classification is prevention for grade, antibiotics and good glycaemic control for grade 1. In grade 2 patients need hospitalization, as they need surgical intervention along with antibiotics and glycaemic control. Grade 3 requires debridement and some sort of amputation. In grade 4, aggressive debridement and amputation while in grade 5 the preferred treatment is below knee amputation. Initial aggressive and radical debridement with daily surgical follow-up is the mainstay in the treatment of diabetic ulcers in nearly 90% of our patients. Patients with Grade 3, 4, 5 underwent amputation indicating grade of ulcer at presentation is a predictive factor for plan of treatment.



Fig. 4: Toe Amputation and Grafting



Fig. 5: Below Knee Amputation



Fig. 6 Above Knee Amputation

## CONCLUSION

- Factors influencing the outcome and long duration of bedridden state in diabetic foot ulcer disease studied were age, male gender, duration of diabetes and patients who smoke tobacco.
- Adverse factors which influence the prognosis drastically and where extreme sedulousness might be warranted for limb salvage were infection of the foot, poor glycaemic control, site and number of ulcers in foot.
- Good prognosis can be achieved with diabetic foot lesions by optimizing glycaemic control, using combination antibiotic chemotherapy, vigorously correcting co morbid conditions

## References

1. Margueritte J *et al*: The independent contribution of diabetic neuropathy and vasculopathy in foot ulceration. *Diabetes Care*, 1995; 2:216-219.

2. P.N. NYAMU *et al*: Risk Factors and Prevalence Of Diabetic Foot Ulcers at Kenyatta National Hospital, Nairobi: *East African Medical Journal* Vol.80 No.1 , Jan 2003
3. Gayle E. Reiber *et al*: Lower Extremity Foot Ulcers and Amputations in Diabetes; Chapter 18
4. Aetiology of Diabetic Foot Ulceration: A Role for the Microcirculation? Dr M.D. Flynn *et al*
5. Gayle, E., Pecoraro, E. and Thomas, D. Risk factors for amputation inpatients with patients with diabetes mellitus. *Ann. Intern. Med.* 1992; 97-105.
6. Peripheral Vascular Disease and Diabetes:P.J. Palumbo, MD, and L. Joseph Melton III, MD Sheehan P.Introduction to diabetes: Principles of care in the surgical patient with diabetes. In Veves A, Giurini JM, LoGerfoFW. *The Diabetic Foot*, 2<sup>nd</sup> edition USA 2006.
7. McLigeyo, S.O and Otieno, L.S. Diabetic foot ulcers, a clinical and bacteriological study 1991;3;204-209
8. Ogbuawa *et al*: Diabetic gangrene in black patients. *South Afr. Med. J.* 75:285-288
9. Nelson, R.G., Gohdes, D.M. and Everhat, J.E. Lower extremity amputation in non-insulin dependent diabetes. 12 years follow-up study in Pima indians. *Diabetes Care.* 1988; 11:8-16.
10. Feigal, D.W. and Cox, C. Risk factors for amputation in diabetic patients. A case-control study in San Fransisco, CA. UCSF Health Policy Institute. 1989; 47-56.
11. Lan *et al*, 2008. *Br J Dermatol.* 2008 Nov; 159(5):1103-15. doi:10.1111/j.1365-2133.2008.08789.
12. Guo and Dipietro, 2010. *J Dent Res.* 2010 Mar; 89(3):219-29. doi:10.1177/0022034509359125.
13. DIABETIC FOOT DISORDERS: Robert G. Frykberg *et al*, DPM, MPH, A Clinical Practice Guideline (2006 revision)
14. Armstrong DG, Nguyen HC, Lavery LA, van Schie CH, Boulton AJ, Harkless LB. Off- loading the diabetic foot wound. *Diabetes Care.* 2001; 24:1019-22.
15. Jaiswal, Mamta *et al*. "Burden of Diabetic Peripheral Neuropathy in Pima Indians with Type 2 Diabetes." *Diabetes Care* 39.4 (2016): e63-e64. *PMC.* Web. 17 Oct. 2018.

### How to cite this article:

Anand Babu P *et al* (2018) 'Diabetic Foot Ulcers-Factors and Outcome', *International Journal of Current Medical and Pharmaceutical Research*, 04(10), pp. 3719-3722.

\*\*\*\*\*