ᵔ OPEN ACCESS

Surgery

An Approach to Diagnosis and Surgical Management of Diabetic Foot in the Indian Population

Dr. Ramesh Kumar Ajai[*] M.B.B.S., M.S. (Gen Surg)

Associate Prof. Nalanda Medical College, Patna (Bihar) India

Abstract	Original Research Article

The aim of the study was to determine the various predisposing factors for diabetic foot with respect to Indian population. The diabetic foot syndrome is defined as an array of foot abnormalities, resulting from peripheral neuropathy, micro and macroangiopathy and other consequences of metabolic disturbances. The study revealed that the mean (mean ± s.d.) age of the patients was 56.51±7.14 years with range 42-75 years and the median age was 55 years. Most of the patients were with age between 50-69 years (86.3%). In this study 63.8% of the patients had habit of smoking which was significantly higher. Smoking is a strong risk factor for peripheral vascular disease, which is associated with diabetic foot ulcers. There is an association with barefoot walking and development of ulcers. In our study it was found patients had higher prevalence of neuropathy compared with peripheral vascular disease and this prevalence was lesser when compared to the Caucasians. Our study showed that more than 86% of the ulcers encountered by us were infected and cultures showed a polymicrobial growth. It was shown that patients, who followed strict control of blood sugar, i.e. lower HbA1c, developed lesser complication when compared to those with a higher HbA1c
Keywords: diabetic foot, syndrome, macroangiopathy, Indian.

INTRODUCTION

"Every other diabetic is a surgical diabetic"

– Joslin

The diabetic foot syndrome is defined as an array of foot abnormalities, resulting from peripheral neuropathy, micro and macroangiopathy and other consequences of metabolic disturbances. A clinical important manifestation of the diabetic foot syndrome is the diabetic foot ulcer. Diabetic patients are at higher risk for lower limb ulceration. Foot complications secondary to diabetes mellitus are the most common reason for hospital admission for these patients and frequently results in amputation. India with approximately 69 million cases is ranked second in the list of the nations most affected with diabetes [1]. Among diabetes mellitus related complications, foot ulceration is the most common, affecting approximately 15% of diabetic patients during their lifetime [2]. His can be attributed to several social and cultural practices such as barefoot walking, inadequate facilities for diabetes care and education, and poor socioeconomic conditions.

Aim and objectives

- To determine the various predisposing factors for diabetic foot with respect to Indian population.
- To analyze the various modes of clinical presentation of diabetic foot in our hospital
- To determine commonest microorganisms infecting the diabetic foot patients in the Indian setting.
- To evaluate the usefulness of surgical management protocols with special emphasis on strict glycemic control.

MATERIALS AND METHODS

Study area

Department of General Surgery,Nalanda Medical College, Patna, Bihar

Study population

Diabetic patients with foot ulcers admitted in this hospital, according to the WHO criteria, were selected for this study.

Inclusion criteria

All the patients with Diabetes Mellitus presenting with foot ulcers, infection of foot and gangrene of foot.

Exclusion criteria
- Patients with foot infections without Diabetes.
- Patients with ulcer and Gangrene of foot other than Diabetic etiology.
- Patients not agreeing to be part of study
- Miscellaneous - Patient on steroids

-Malignancy

- HIV

Tudy period
July2016 to July 2018

Sample size
Calculated sample was 58 patients

Study design
Institution based prospective comparative study. Medical history was taken for all subjects. Details regarding age, sex, duration of disease, patient's socioeconomic status, level of education, habit of smoking, type of footwear, and control of diabetes were noted. Age and Sex was noted for all subjects. Duration of Disease was taken as less than 10 years from first detection, to more than 20 years post detection, in 10 years intervals. History was taken about the prevalence of barefoot walking among the subjects. Blood pressure was measured in all subjects in sitting position on the right arm with a standard mercury sphygmomanometer. Culture specimens were obtained at the time of admission, after the surface of the wound had been washed vigorously by saline, and followed by debridement of superficial exudates. Specimens were obtained by scraping the ulcer base or the deep portion of the wound edge with a sterile curette. Culture and sensitivity was done to identify the correct organism and to institute the relevant antibiotic. A detailed analysis was done as to the surgical modality/modalities needed in the management of the diabetic foot ulcers. Five surgical procedures made up the majority interventions needed to treat wounds in patients with diabetes.
- Debridement
- Wound cover with skin graft
- Wound cover with flap (local/free)
- Minor amputation
- Major amputation

RESULTS
The mean (mean ± s.d.) age of the patients was 56.51±7.14 years with range 42-75 years and the median age was 55 years [Table 1].Test of proportion showed that the proportion of the patients with age between 50-69 years (86.3%) was significantly higher. Thus diabetic foot was more prevalent among the patients with age ≥50 years. The mean duration of diabetes (mean± s.d.) of the patients was 11.96±4.06 years with range 7 - 25 years and the median was 10 years. 62.1% of the patients did not use footwear which was significantly higher [Table 2]. The mean level of HbA1C (mean± s.d.) of the patients was 8.11±1.42% with range 5.80 – 11.20 % and the median was 7.95%. 72.4% of the patients had level of HbA1c>7.0% [Table 3]. Ulcers were mostly at dorsum (22.4%) (Z=1.58;p=0.11) followed by fore foot (13.8%) and great toe (13.8%)[Table 4]. Escherichia coli (62.0%) were most common among the microorganisms [Table 5]. Both debridement along with flap and debridement along with skin graft were undergone in 29.3% of the patients. In 15(25.8%) of the cases amputation was done [Table 6]. The risk of sensory abnormality was 11.00 times more among the patients with level of HbA1c >7.0% in comparison with the patients with level of HbA1c ≤7.0%. The risk of absence of peripheral pulse was 1.90 times more among the patients with habit of smoking in comparison with the patients without habit of smoking. The risk of absence of peripheral pulse was 13.50 times more among the patients with duration of diabetes >10 years in comparison with the patients with duration of diabetes foot ≤10 years.

Table-1: Age distribution

Age Group (in years)	Number	%
40-49	6	10.3%
50-59	31	53.4%
60-69	19	32.8%
≥70	2	3.4%
Total	58	100.0%

Table-2: Distribution of Footwear

Footwear	Number	%
Barefoot	36	62.1%
Normal	22	37.9%
Total	58	100.0%

Table-3: Distribution of level of HbA1c

Level of HbA1c	Number	%
>7.0	42	72.4%
≤7.0	16	27.6%
Total	58	100.0%
Mean±s.d.	8.11±1.42	
Median	7.95	
Range	5.80-11.20	

Table-4: Site of ulcer

Site	Number	%
Dorsum	13	22.4%
Fore Foot	8	13.8%
Great Toe	8	13.8%
Heel	4	6.9%
Planter Great Toe	4	6.9%
Planter Mid Foot	3	5.2%
Planter 1st MT Head	2	3.4%
Toe	2	3.4%
2nd & 5th Toe	1	1.7%
B/W 2nd & 3rd Toe	1	1.7%
Dorsum and Planter	1	1.7%
Foot Planter	1	1.7%
Great Toe & 3rd Toe	1	1.7%
Leg and Foot	1	1.7%
MT Head	1	1.7%
Planter	1	1.7%
Planter & Dorsum	1	1.7%
Planter 3rd MT Head	1	1.7%
Planter Heel	1	1.7%
Planter Mid Toe	1	1.7%
Poterior Ankle	1	1.7%
Sole Foot	1	1.7%
Total	58	100.0%

Table-5: Distribution of Microorganisms

Microorganisms	Number	%
Escherichia coli + Staphylococcus aureus	9	18.0%
Escherichia coli + Pseudomonas aerigonosa	8	16.0%
Escherichia coli	7	14.0%
Staphylococcus aureus	7	14.0%
Escherichia coli + Klebsiella pneumoniae	5	10.0%
Klebsiella pneumoniae + Pseudomonas aerigonosa	4	8.0%
Staphylococcus aureus + Streptococcus pneumoniae	3	6.0%
Escherichia coli + Proteus mirabilis	1	2.0%
Escherichia coli + Streptococcus pneumoniae	1	2.0%
Klebsiella pneumoniae	1	2.0%
Klebsiella pneumoniae + Proteus mirabilis	1	2.0%
Pseudomonas aerigonosa	1	2.0%
Staphylococcus aureus + Pseudomonas aerigonosa	1	2.0%
Pseudomonas aerigonosa + Streptococcus pneumoniae	1	2.0%
Total	50*	100.0%

Table-6: Type of surgery underwent

Operation	Number	%
Debridement and flap	17	29.3%
Debridement and skin graft	17	29.3%
Debridement and secondary intention	9	15.5%
Below knee amputation	7	12.1%
Transmetatarsal amputation	3	5.2%
Amputation of right great toe	2	3.4%
Amputation of 2nd and 5th toe	1	1.7%
Amputation of 4th toe	1	1.7%
Amputation of bilateral great toe	1	1.7%
Total	58	100.0%

DISCUSSION

The study revealed that the mean (mean ± s.d.) age of the patients was 56.51±7.14 years with range 42-75 years and the median age was 55 years. Most of the patients were with age between 50-69 years (86.3%). In a Norwegian study, Iverson et al[3] reported an average age of 67.2 ± 14 years. The mean duration of diabetes (mean± s.d.) of the patients was 11.96±4.06 years with range 7 - 25 years and the median was 10 years. Most of the patients (86.2%) had duration of diabetes≥10 years. Malrange et al[4] a study from France, found a figure of 13.0±10.4 years, as the mean duration. 63.8% of the patients had habit of smoking which was significantly higher. A. Nather *et al.* [5] did not find smoking to be a predictive factor to diabetic foot ulcers on multivariate analysis. Adler *et al.* [6] reported that individuals with co-existing hypertension had a five-fold increased risk of developing peripheral vascular disease (PVD) and thus the patients were at increased risk for amputation, compared to normotensive individuals with diabetes. Prompers L *et al.* [7] observed ischemia due to the peripheral vascular disease of the lower limbs was another contributory factor in the pathogenesis of the diabetic foot problems. Peripheral vascular disease impairs healing and increases the risk of amputation. Pendsey *et al.* [8] found in India neuropathic lesions were dominant and account for 80% of foot ulcers and the remaining 20% being neuroischaemic. Among the causative factors, extrinsic factors like injuries due to sharp objects, inappropriate footwear and thermal injuries account for 70% of neuropathic foot ulcerations. Shankar *et al.* [9] observed that the distribution of gram-negative bacteria (57.6%) is more common than that of gram-positive ones (42.3%) and it is contrary to the viewpoint that diabetic foot infections are frequently monomicrobial. Nather *et al.* [5] upon multivariate analysis found poor glycaemic control indicated by HbA1C levels higher than 7% to be a significant risk factor of developing DFU.

CONCLUSION

In our study, the mean age is comparable with the data from the rest of India, which might suggest the elderly diabetics are susceptible to diabetic foot ulcers. With the increase in the duration of disease, there is more chance to develop neuropathy. In this study 63.8% of the patients had habit of smoking which was significantly higher. Smoking is a strong risk factor for peripheral vascular disease, which is associated with diabetic foot ulcers. There is an association with barefoot walking and development of ulcers. In our study it was found patients had higher prevalence of neuropathy compared with peripheral vascular disease and this prevalence was lesser when compared to the Caucasians. Our study showed that more than 86% of the ulcers encountered by us were infected and cultures showed a polymicrobial growth. It was shown that patients, who followed strict control of blood sugar, i.e. lower HbA1c, developed lesser complication when compared to those with a higher HbA1c. The surgical treatment should be individualised as there should be an attempt to provide as much form and function as possible. Every patient needs to be assessed systematically and the ulcer characteristics should be taken into consideration before offering surgery.

REFERENCES

1. International Diabetes Federation. IDF Diabetic Atlas 7th Edition. http://www.idf.org/idf-diabetes-atlas-seventh-edition. Accessed 30 Aug 2016.
2. Shankhdhar KLK, Shankhdhar U, Shankhdhar S. Diabetic foot problems in India: An overview and potential simple approaches in a developing country. Current Diabetes Reports. 2008; 8: 452-457.
3. Iversen MM, Midthjell K, Østbye T, Tell GS, Clipp E, Sloane R, Nortvedt MW, Uhlving S, Hanestad BR. History of and factors associated with diabetic

foot ulcers in Norway: the Nord-Trøndelag Health Study. Scandinavian journal of public health. 2008 Jan; 36(1):62-8.

4. Malgrange D, Richard JL, Leymarie F, French Working Group on the Diabetic Foot. Screening diabetic patients at risk for foot ulceration. A multi-centre hospital-based study in France. Diabetes & metabolism. 2003 Jun 1;29(3):261-8.

5. Nather A, Yan L, Li X, Chionh SB, Chan YH, Wu PH. Socio-Economic factors of diabetics with and without foot problems in Singapore. InDiabetic Foot Problems 2008 (pp. 15-28).

6. Adler AI, Stratton IM, Neil HA, Yudkin JS, Matthews DR, Cull CA, Wright AD, Turner RC, Holman RR. Association of systolic blood pressure with macrovascular and microvascular complications of type 2 diabetes (UKPDS 36): prospective observational study. Bmj. 2000 Aug 12;321(7258):412-9.

7. Prompers L, Schaper N, Apelqvist J, Edmonds M, Jude E, Mauricio D, Uccioli L, Urbancic V, Bakker K, Holstein P, Jirkovska A. Prediction of outcome in individuals with diabetic foot ulcers: focus on the differences between individuals with and without peripheral arterial disease. The EURODIALE Study. Diabetologia. 2008 May 1;51(5):747-55.

8. Pendsey S, Abbas ZG. The step-by-step program for reducing diabetic foot problems: a model for the developing world. Current diabetes reports. 2007 Dec 1;7(6):425-8.

9. Shankar EM, Mohan V, Premlatha G, Srinivasan RS, Usha AR. Bacterial etiology of diabetic foot infections in South India. Eur J Intern Med. 2005 Dec;16(8):567-570.