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DIABETIC FOOT ULCER ASSESSMENT AND ORTHOPEDIC SURGERY MANAGEMENT IN A TERTIARY CARE HOSPITAL, SOUTH INDIA

Orthopaedics

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ABSTRACT

Diabetic foot ulcer is a foot ulcer that presents any pathology that results directly from any chronic complication of diabetes or diabetes mellitus. Objective of this present study is to organize patient's Diabetic foot ulcer assessment and orthopedic surgery management, respective role of orthopedic surgery outcomes and elucidate the potential factors that might result in failure of treatment in a tertiary care hospital, Guntur, South India. A total of 120 cases with Diabetic foot amputations from April 2015 to May 2017, aged 30 to 60 years of both the gender were considered for the present study. Of the total 4183 diabetic cases seen at the Department of Orthopedics, Government General Hospital, Guntur, during the study period, 120 (2.8%) had diabetic foot ulcers. In the present study, we noticed that a vital proportion of our diabetic patients with diabetic foot complications delayed surgical treatment, leading to re-admission incidents. These re-admission incidents pose a significant socio-economic burden on the patients. Surgical management is required to address severe diabetic foot infections because they can be life threatening.

KEYWORDS

Diabetic Foot Ulcers (DFU), DFU Assessment & Management, Orthopedic Surgery, South India.

INTRODUCTION

According to World Health Organization (2016)[1] global report on diabetes, approximately 422 million adults are living with diabetes mellitus. The number is expected to almost double by 2030[2], type 2 diabetes makes up about 85-90% of all cases[3].

India had more number of diabetics than any other country in the world, although the country has now been exceeded in the spot by China, according to the International Diabetes Foundation in 2012[4]. In India, diabetes affects more than 62 million Indians, which is more than 7.1% of the adult population[5]; Nearly one million Indian population die due to diabetes mellitus every year[6]. According to Indian Heart Association (2015)[7], India is expected to be home to 109 million people with diabetes mellitus by 2035.

Diabetes induced chronic complications related to vascular damage and secondary neuropathy, mainly affecting three locations including eyes, kidneys and feet, in addition to acute metabolic complications. Diabetic foot ulcers management has long been neglected[8].

DFUs posture is a major public health problem worldwide and contribute considerably to morbidity and mortality of patients with diabetes mellitus[9]. It is estimated that, at some point approximately 15% to 20% of diabetic patients will develop an ulcer on their foot and for many of these cases, the appropriate treatment results in some form of surgery[10].

In developing countries, Diabetic foot ulcers are the common cause of non-traumatic lower limb amputations and the risk of lower extremity amputation is 15 to 46 times higher in diabetics than in persons without diabetes[11].

Objective of the present study was to organize patient's Diabetic foot ulcer assessment and orthopedic surgery management, respective role of orthopedic surgery outcomes and elucidate the potential factors that might result in failure of treatment in a tertiary care hospital, Guntur, South India.

METHODS

Patients

A total of 120 cases with Diabetic foot from June 2015 to May 2017, aged 30 to 60 years of both the sex were considered for the present study. All patients who presented to the orthopedic surgical wards with diabetic foot ulcers were in the inclusion criteria and healed diabetic foot ulcer patients were excluded from the study. Identification of the diabetic foot patients at risk for ulceration was done in the out-patient (OP) or medical ward and diabetic patients who were found to have active diabetic foot ulceration were referred to the orthopedic surgical wards for appropriate surgical management.

DFU was defined as a hole on the normal skin occurring as a change of color on the foot for more than two weeks, induration and ulceration. A detailed patient history and physical examination was done included the following:

- Communication was maintained in the comprehensive documentation including socio-demographic and clinical characteristics including duration of diabetes, duration of diabetic foot ulcer, previous history of amputation, anatomical site, foot affected.
- Wagner' s classification (Table 1).
- Investigations (Fig. 1) including blood sugar profile, inflammatory markers (total white count, erythrocyte sedimentation rate, C-reactive protein), radiographic findings, the glycated hemoglobin (HbAlc), swabs from ulcer, X-ray of foot (Fig. 2) and renal functions were recorded. Assessment of glycemic control done by the HbAlc estimation. The results were reported in percentage, and graded as: 1. HbAlc < 7% (good metabolic control), 2. HbAlc 7-10% (fair metabolic control), 3. HbAlc ≤ 10% (poor metabolic control).
- Operative data comprised the type of surgeries performed, post-operative complications.
- Major lower limb amputation was well-defined as amputation or proximal to the ankle joint whereas amputation distal to the ankle joint was termed as minor lower limb amputation.

The diagnosis of surgical site infection was based on clinical examination and identification of microorganisms in the area of operative wound suspected of being infected. The DFUs were graded according to Wagner's classification[12].

Data Collection and Statistical Analysis

Data were collected using a questionnaire. Collected data were analyzed using statistical MINI tab computer software. Data were expressed in the form of percentages and frequency tables.

RESULTS

Of the total 4183 diabetic cases seen at Department of Orthopedics,

Government General Hospital, during the study period, 120 (2.8%) had diabetic foot ulcers. Socio-demographic characteristics of cases (male and female) attended to Orthopedic Department from June 2015 to April 2017 were presented in Table 2.

Out of 120 cases, 77 (64.16%) were cases of male and 43 (35.83%) were cases of female. The data revealed that the incidence of Diabetic foot ulcer was high in males when compared with females. That the percentage of diabetic foot ulcer was higher in the age group of 45-60 years of age (i.e., 63; 52.5%) than in the 30-45 years of age (57; 47.5%). Majority of the cases (80; 66.66%) were illiterates and daily wageworkers (86; 71.66%).

Of the total 120 cases, 97 (80.83%) cases were responded that they belong to low-income group. Majority of the cases (87.5%) were reported to live in a nuclear family and 62.5% of the cases were said to be accustomed to hard work. 88.33% of the cases were said to be non-vegetarians. Smoking habit and consumption of alcohol was reported in 61.66% and 54.16% of the cases respectively. 40.83% cases had a family history of diabetes.

Majority of the cases (96; 80%) were in >5 years duration of diabetes and 75 (62.5%) cases presented 4-52 weeks of onset of diabetic foot ulcer. 111 (92.5%) cases had no previous history of amputation. The forefoot involving the toes was commonly affected in 68 (56.66%) of cases. Neuropathic ulcers (Fig. 3) were the most common type of diabetic foot ulcers. According to Wagner's classification (Table 1), Wagner's grade 4 (Fig. 4) and grade 5 (Fig. 5 a, b) ulcers were the most prevalent at 24.16% and 33.33% respectively (Table 3).

Of the 110 cases with diabetic foot ulcer, most of the cases who were treated surgically underwent lower limb amputations in 64.54% of cases, 43 (39.09%) of cases were under went Toe/Ray amputation (Minor amputation) and 47 (42.72%) of cases underwent below knee amputation (Table 4).

The HbA1c values for these cases ranged from 6.0% to 14.0%, with an average of 10.2%. Biochemical markers and haemoglobin levels of 50 cases in this study were shown in Table 5.

A total of 80 post-operative complications were recorded in 14 (17.5%) of cases of which surgical site infection, 10 (12.5%) of cases of which revision amputation was the most common complications (Table 6).

DISCUSSION

In the present study, the prevalence of diabetic foot ulcers amongst cases with diabetes at Government General Hospital, Guntur, AP, India was 2.8% which is comparable to studies in Tanzania and Kenya[13,14]. In the present study, male patients were affected more than female patients with a male to female ratio of 1.2:1, this ratio is support to other studies[13-15]. Male majority may be due to their smoking habits, which were noted in 61.66% of male cases. Smoking is a contributory factor as a result of vascular wall thickening, decrease the circulation of blood and ischemic changes in the affected neurons[16].

The mean age of the cases was 54.23 years which is comparable to other studies done elsewhere[10,14,15]. Morbach in 2004 [17] compared the foot disease in India, Germany and Tanzania and found that German cases were significantly older (70.5 years) compared with those from India (56.4 years) and Tanzania (51.4 years) cases. These studies were conducted in different diabetic care centers of different qualities. The comparable mean age may suggest certain time dependent risk factors in the development of diabetic foot ulcer. Age of beginning of diabetes is also different in areas.

In the present study, 62.5% of the cases have longer period (i.e., 4-52 weeks), they develop diabetic foot ulcers before they present to the physician. It is possible that better diabetes care that they receive delays the onset of foot ulcer disease. Similar observations were also reported by other studies[10,13-15].

Of the 120 diabetic foot ulcer cases of the present study, majority of them were illiterates, daily wageworkers and accustomed to hard work. Late presentation in our cases may be attributed to low socioeconomic status, poverty, lack of diabetes education, and lack of approach to medical care. Late presentation attempts at home operations, belief in faith healers and undetected diabetes are the other contributing factors.

According to Wagner's classification our DFU patients were in the severe condition as Grade 4 and 5 founded 57.8% respectively and our results supports the reported in other studies with an incidence range from 42% to 68%[10,13,18,19]. High proportions of advanced DFUs in our study may be related to the duration of diabetes, late presentations to healthcare experts and presence of co-morbidities.

DFU is one of the curable and preventable complications of diabetes mellitus[18,19]. Physicians in general medicine play an important role in the early diagnosis, assessment, management of diabetic foot complications and prevention[13,19].

The percentage of lower limb amputations in our study was 64.54%, which is higher than rates reported in other studies[10,13,18,20,21]. High amputation percentage in our study could be due to the late presentation and severity of the disease. In our study that more than half of our cases presented with high Wagner' s grade (≥ 4), and cases who had major lower limb amputation had significantly high complication rate than cases, who underwent minor lower limb amputation.

The present study demonstrated that ESR, CRP, and HbA1c are the specific markers to diabetic foot ulcers. Uzun et al (2007)[22] reported that ESR, TW and PCT had a decisive role in identifying diabetic foot wound infection, but CRP did not have a significant role, a finding inconsistent with the results of the present study. The cases with diabetic foot ulcer (No=50) had poor glycemic control with an average HbA1c reading of 10.2%. Poor glycemic control is constituting an important risk factor towards susceptibility to infection[23]. Before and after amputation it is very important to improve glycemic control in diabetic patients to reduce the risk of diabetic foot infections. In-patient management of medications and blood glucose monitoring were done under the observation of nursing staff.

The limitation of the present study was that only patients who were referred to the orthopedic surgery department from general medicine out-patient (OP) and in-patient (wards) were included in the study, which is underestimation of the frequency of Diabetic foot ulcers our hospital, as patients with diabetes are also routinely admitted in large number to other departments of the hospital.

CONCLUSION

Diabetic foot ulceration constitutes a major source of morbidity and mortality among patients with diabetes at Government General Hospital, India. In the present study, we noticed that a vital proportion of our diabetic patients with diabetic foot complications delayed surgical treatment, leading to re-admission incidents. These re-admission incidents pose a significant socio-economic burden on the patients. We feel that the availability of trained health care professionals to counsel patients in amputation surgery may help in preventing unnecessary delays in patients receiving definitive surgical treatment.

TABLE 1- WAGNER'S CLASSIFICATION OF DIABETIC FOOT ULCERS

Ulcer Grading	Description
Grade 0	No ulcer but high-risk foot
Grade 1	Superficial ulcer
Grade 2	Deep ulcer, no bony involvement or abscess
Grade 3	Abscess with bony involvement (as shown by X-ray)
Grade 4	Localized gangrene e.g. toe, heel etc
Grade 5	Extensive gangrene involving the whole foot

Note: Grade 1–3 ulcers are termed non-gangrenous ulcers and Grade 4 and 5 ulcers are termed gangrenous ulcers (Wagner. 1987).

TABLE 2- SOCIO-DEMOGRAPHIC CHARACTERISTICS OF PATIENTS (NO=120) WITH DIABETIC FOOT ULCER

Demographic Characteristics		Number with Percentage
Gender	Male	77 (64.16)
	Female	43 (35.83)
Age	30-45yrs	57 (47.5)
	46-60	63 (52.5)
Education	Illiterates	80 (66.66)
	<10th class	34 (28.33)
	>10th class to Intermediate	6 (5)

Occupation	Daily Wage workers	86 (71.66)
	Business	30 (25)
	Driver	4 (3.33)
Socioeconomic Status	Low Income	97 (80.83)
	Middle Income	23 (19.16)
Type of Family	Joint	15 (12.5)
	Nuclear	105 (87.5)
Type of Activity	Heavy Work	75 (62.5)
	Moderate Work	45 (37.5)
Type of Diet	Vegetarians	14 (11.66)
	Non-Vegetarians	106 (88.33)
Smoking habits	Yes	74 (61.66)
	No	46 (38.33)
Alcohol use	Yes	65 (54.16)
	No	55 (45.83)
Family history of DM	Yes	49 (40.83)
	No	71 (59.16)

TABLE 3- CLINICAL CHARACTERISTICS OF PATIENTS WITH DIABETIC FOOT ULCER (N=120)

Clinical Characteristics	Number with Percentage
Duration of Diabetes (in years):	
<1	0
1-5	24 (20)
>5	96 (80)
Duration of Diabetic Foot Ulcer (in weeks)	
<4	28 (23.33)
4-52	75 (62.5)
>52	17 (14.16)
Previous history of amputation	
Yes	9 (7.5)
No	111 (92.5)
Anatomical Site	
Forefoot	68 (56.66)
Midfoot	20 (16.66)
Hindfoot	24 (20)
Whole foot	8 (6.66)
Type of ulcer	
Neuropathic	72 (60)
Ischemic	15 (12.5)
Neuro-Ischemic	19 (15.83)
Unclassified	14 (11.66)
Wagner's Classification	
Grade 0	0
Grade 1	12 (10)
Grade 2	21 (17.5)
Grade 3	18 (15)
Grade 4	29 (24.16)
Grade 5	40 (33.33)

TABLE 4- TYPE OF SURGERY'S PERFORMED IN PATIENTS WITH DIABETIC FOOT ULCER (NO=110)

Type of Surgery's	Number with Percentage
Debridement	49 (44.54)
Lower limb amputation	71 (64.54)
Minor amputation:	
·Toe/Ray's amputation	43 (39.09)
Major amputation:	
·Syme's amputation	6 (5.45)
·Below knee amputation	47 (42.72)
·Above knee amputation	5 (4.54)
Skin grafting	7 (6.36)
Incision & drainage	6 (5.45)
Sequestrectomy	1 (0.90)

TABLE 5- BIOCHEMICAL MARKERS (N=50) MEASURED IN CASES WITH DIABETIC FOOT ULCER

Biochemical markers	Mean and range
ESR (mm/hr)	88.5 (7-110)
CRP (mg/l)	150.4 (2.5-350)
TW ($x10^9$/l)	14 (5.5-36.0)
HbA1c (%)	10.2 (5.9-14.0)
Haemoglobin (g/dL)	10 (9-16.0)

TABLE 6- POST-OPERATIVE COMPLICATIONS (N=80) OF DIABETIC FOOT ULCER CASES

Complications	Frequency	Percentage
Surgical site infection	14	17.5
Revision amputation	10	12.5
Stump gangrene	9	11.25
Wound dehiscence	6	7.5
Phantom pain	0	0
Diabetic coma	5	6.25
Wound hematoma	9	11.25
Skin grafting failure	8	10

Figure 1: Biochemical Analysis in the Laboratory

Figure 2: X-ray of Diabetic Foot

Figure 3: Diabetic foot affected Neuropathy leading to ulceration and infection

Figure 4: Wagner's Classification of Diabetic Foot Ulcer Grade 4

Figure 5a: Wagner's Classification of Diabetic Foot Ulcer Grade 5 before orthopedic surgery

Figure 5b: Wagner's Classification of Diabetic Foot Ulcer Grade 5 after orthopedic surgery

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