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Research Article

Recurrence of Diabetic Foot Ulcer and Associated Risk Factors: A 3-Year Retrospective Study

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Abstract

The burden of diabetes foot ulcer is immense, resulting to prolonged hospital stay and high cost of care. The aim of this study is to identify the predictors of ulcer recurrence which will help mitigate this disabling, pocket-draining, but highly preventable complication of diabetes mellitus (DM).

Methodology: This was a 3-year retrospective study of patients hospitalised for diabetic foot ulcer (DFU) in Enugu State University Teaching Hospital from March 2020 to February 2023. Information on demographics, relevant diabetes history and complications, characteristics of DFU, outcome, DFU recurrence were obtained.

Results: Most of the patients (82.5%) were between 41 and 70 years of age with a mean age is 57.86 ± 12.45. There were marginally more females (52.6%) than male (47.4%). The subjects were predominantly businessmen/traders (43.9%), and 73.7% had DM duration of 1-5 years. Duration of admission was 8 weeks for 31.6% of the patients, 4 weeks for 26.3%, 3 weeks for 21.1% and 12 weeks for 12.3% of the patients. More of the patients were in Wagner grades 3 (43.9%) and 4 (31.6%). The Prevalence of (diabetic peripheral neuropathy) DPN, peripheral artery disease (PAD) and Retinopathy among the patients were 82.5%, 45.6% and 59.6% respectively. Recurrence of DFU occurred in 35% of the subjects. Occupation and wound site positively correlated with reocurrence in this study. The outcome shows that 59.6% of the patients had good healing, 21.1% had ray amputation while 14% had below knee amputation.

Keywords: Diabetic foot ulcer, recurrence, peripheral neuropathy, peripheral artery disease.

INTRODUCTION

Diabetes is a common and serious chronic disease, causing disabling and life-threatening complications[1]. It has become a significant global challenge. About 537 million adults are living with diabetes worldwide and this number is predicted to rise to 783 million by 2045[2]. About 90% of this number live in low- and middle-income countries like Nigeria.[2] In Nigeria, a prevalence of 5.77% was observed, a 2.6 fold increase over the past two and half decades[3]. This rising prevalence equally parallels a rising burden of DM complications[4]. Among these complications is Diabetes Foot Ulcer (DFU), a devastating complication with high disability and mortality rates.

Diabetic Foot Ulcer is a full thickness wound penetrating through the dermis, distal to the ankle, in a person living with DM[5]. It is a common complication of Diabetes, with a global prevalence of 6.3%[6]. In Africa, the prevalence of DFU was 13%[7]. The burden of DFU in Nigeria is enormous. It constitutes about a quarter of diabetes related complications in Nigeria, and most of those with DFU are in the active working age group[8]. Diabetic Foot Ulcer causes prolonged hospital admissions, which translates to high cost of care. It constitutes high economic burden on the patient, physical and emotional distress, and reduced quality of life[9]. Diabetes Mellitus is the commonest reason for non-traumatic amputation of the lower limb, accounting for 40-60% of all lower limb amputations globally[10]. A multicenter study in Nigeria reported 35.4% risk of lower extremity amputation following DFU[8].

Having a Diabetic foot ulcer is a risk factor for recurrent foot ulcer. Recurrent foot ulcer refers to new foot ulcer in a person with history of foot ulcer, regardless of previous foot ulcer location or time of previous foot ulceration.[11] Yearly incidence of DFU is estimated to be 2.2%[12]. Some of the risk factors for DFU include: lack of proper education on foot care and poor adherence to proper foot care practices, long duration of DM, poor glycaemic control, smoking, peripheral neuropathy, peripheral arterial disease, plantar ulcers, Diabetic retinopathy, diabetic nephropathy, co-existing hypertension. However, about 40% of persons with healed DFU will experience a recurrence within 1 year[13]. The risk increases to 60% within 3 years and 65% within 5 years[13].

Consequences of recurrent foot ulcer include: increased hospitalisation rate, reduced social and earning time, decline in functional status, risk of lower extremity amputation, and

death. The International Diabetes Federation estimates that at least one limb is lost to DFU somewhere in the world every 30 seconds[2]. Diabetes Foot Ulcer is really a serious issue and should be given serious attention. There is need to identify the risks and increase awareness of DFU recurrence in our environment; to help reduce the burden of this highly disabling, pocket draining, but highly preventable complication of DM.

This aim of this study was to determine the frequency of DFU recurrence and risks associated with its recurrence in our institution.

METHODOLOGY:

This was a 3-year retrospective study conducted in Enugu State University Teaching Hospital, a tertiary centre in South East Nigeria between March 2020 to February 2023. Approval for the study was gotten from the Heath Research and Ethical Committee of the hospital. Data for subjects were available and retrieved from the hospital records. A total of 114 subjects were recruited for the study. Cases were excluded due to missing or very poor record.

Data on demographic characteristics, duration of DM, level of glycaemia (HbA1c and presenting RBG), presence of DPN, PAD, diabetic nephropathy, visual impairment, history of previous ulcers, index ulcer and its characteristics, treatment outcome and the presence co-existing hypertension were obtained.

Peripheral artery disease was diagnosed based on Doppler ultrasound scan of lower limbs and/or surgeon's or physician's documentation of absent dorsalis pedis and/or posterior tibial artery pulsations. Peripheral neuropathy was diagnosed based on loss of pressure perception to Semmes-Weinsten 10g monofilament, diminished vibration sense to 128Hz tuning fork, and/or patients report of the typical symptoms of DPN. Wagner's classification of DFU was used to stage the ulcer, as it is what is mostly used in our centre.

We defined ulcer recurrence as healed DFU prior to index ulcer, irrespective of the site of previous ulcer. Index DFU is an ulceration (first or consequent) that was the reason for the first admission within the time frame. Satisfactory healing was taken as the surgeon's or physician's documentation of good healing and/or as reported by the patient and documented.

Data was analysed using the Statistical Package for Social Sciences (SPSS) Version 26. Categorical variables are presented as frequencies and percentages and continuous variables as means and standard deviations (SD). The chi-square test was used to test differences in categorical variables while continuous variables were compared between two or more groups of interest using student t-test.

RESULTS:

Table 1: Demographic characteristics of the patients

	Frequency	Percent
Age group		
31 – 40	6	5.3
41 – 50	26	22.8
51 – 60	40	35.1
61 – 70	28	24.6
71 – 80	8	7.0
81 – 90	2	1.8
91 – 100	4	3.5
Sex		
Male	54	47.4
Female	60	52.6
Occupation		
Civil servant	26	22.8
Business/trader	50	43.9
Farmer	14	12.3
Driver	6	5.3
Unemployed	18	15.8

Table 1 shows that most of the patients (82.5%) are between 41 and 70 years of age. Their mean age is 57.86 ± 12.45, minimum age is 31 while maximum is 96 years. There were more females (52.6%) than male patients (47.4%). The patients were predominantly business/traders (43.9%) and civil servants (22.8%).

Table 2:

	Frequency	Percent
Duration of DM (years)		
1 – 5	46	40.4
6 – 10	38	33.3
11 – 15	18	15.8
>15	12	10.5
Hypertension		
Yes	84	73.7
No	30	26.3
Duration of admission (weeks)		
2	2	1.8
3	24	21.1
4	30	26.3
8	36	31.6
12	14	12.3
16	8	7.0
Wagner		
2	20	17.5
3	50	43.9
4	36	31.6
5	8	7.0

Table 2 shows that about three quarters of the patients had DM duration of 1 to 10 years, and hypertension. Duration of admission was 8 weeks for about a third of the patients, 4 weeks for 26.3%, 3 weeks for 21.1% and 12 weeks for 12.3% of the patients. Most of the patients were in Wagner grades 3 (43.9%) and 4 (31.6%).

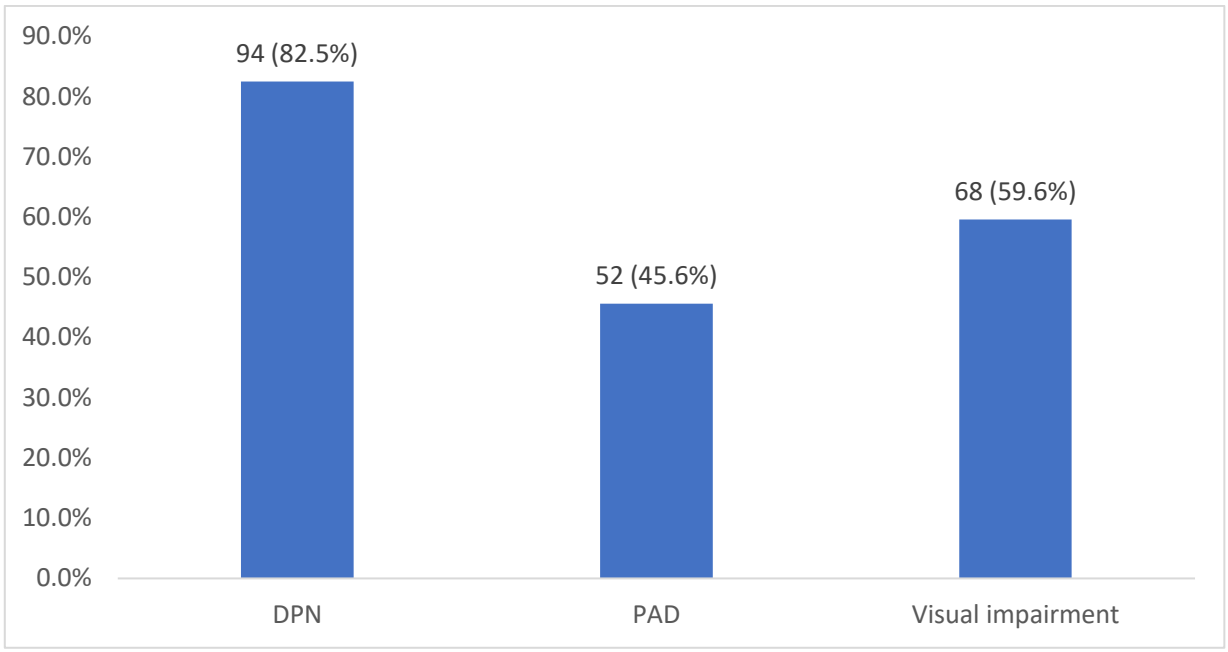

Figure 1: Prevalence of DPN, PAD and Visual impairment among the patients

The Prevalence of DPN, PAD and Retinopathy among the patients were 82.5%, 45.6% and 59.6% respectively.

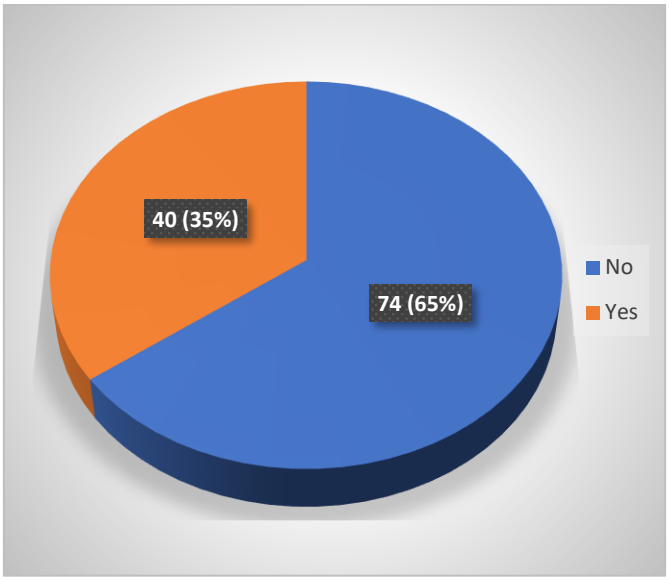

Figure 2: DFU recurrence

Figure 2 shows that 35% of the patients had a recurrence of DFU.

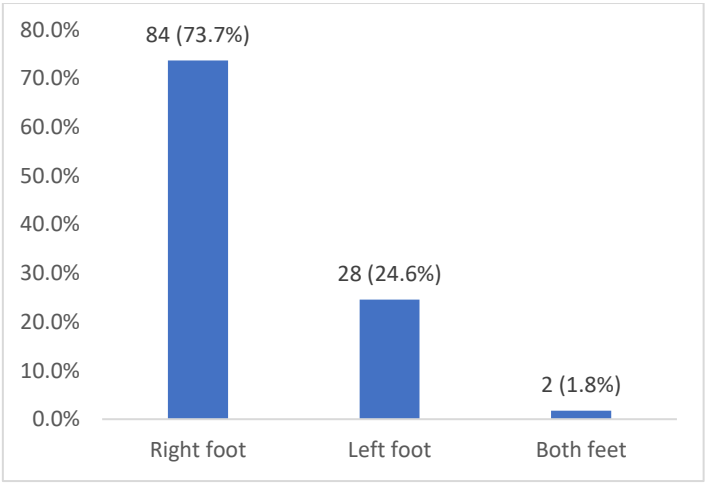

Figure 3: Site of ulcer

Table 3: Site

	Frequency	Percent
Lateral part of foot	6	5.3
Plantar surface	26	22.8
Forefoot	40	35.1
Dorsum of foot	18	15.8
Multiple site	10	8.8
Medial	8	7.0
Whole foot	6	5.3

Table 3 shows that about a third of the subjects had forefoot ulcers, followed by about one fifth with ulcers on the planter surface, before the rest

	N	Minimum	Maximum	Mean	Std. Deviation
Creatinine	110	45.90	319.30	116.22	56.52
Egfr	110	15.30	151.60	71.95	29.93
HbA1C	48	5.30	14.50	8.67	2.39
Blood glucose	108	101.00	480.00	222.88	86.14
Total WBC	82	5.64	77.00	12.81	11.30
Neutrophil	82	38.00	86.00	65.92	11.36
Absolute neutrophil count (ANC)	82	2.30	19.40	7.73	4.41

Table 3 shows that the mean ± SD of Creatinine, eGFR and HbA1C were 116.22 ± 56.52, 71.95 ± 29.93 and 8.67 ± 2.39 respectively. That of blood glucose at presentation, total WBC and Neutrophil were 222.88 ± 86.14, 12.81 ± 11.30 and 65.92 ± 11.36 respectively.

Table 4:

	Frequency	Percent
Blood glucose		
Good	36	31.6%
Poor	78	68.4%
Total WBC		
Elevated	34	41.5%
Normal	48	58.5%
Neutrophil		
Elevated	58	70.7%
Normal	24	29.3%
ANC		
Elevated	36	43.9
Normal	46	56.1
Wound Culture		
Positive	58	76.3
Negative	18	23.7

Table 4 shows that about two thirds of the subjects had poor glycaemic control and neutrophilia, while three quarters had positive wound culture.

Table 5: Factors associated with DFU Recurrence among the patients

	DFU Recurrence			
	Yes	No	χ^2	P value
	n (%)	n (%)		
Age group				
31 – 40	4 (66.7)	2 (33.3)	4.674	0.586
41 – 50	8 (30.8)	18 (69.2)		
51 – 60	14 (35.0)	26 (65.0)		
61 – 70	10 (35.7)	18 (64.3)		
71 – 80	2 (25.0)	6 (75.0)		
81 – 90	0 (0.0)	2 (100.0)		
91 – 100	2 (50.0)	2 (50.0)		
Sex				
Male	22 (40.7)	32 (59.3)	1.440	0.230
Female	18 (30.0)	42 (70.0)		
Occupation				
Civil servant	8 (30.8)	18 (69.2)	14.015	0.007
Business/trader	18 (36.0)	32 (64.0)		
Farmer	2 (14.3)	12 (85.7)		
Driver	6 (100.0)	0 (0.0)		
Unemployed	6 (33.3)	12 (66.7)		
DM duration				
1 – 5	12 (26.1)	34 (73.9)	6.632	0.085
6 – 10	18 (47.4)	20 (52.6)		
11 – 15	8 (44.4)	10 (55.6)		
>15	2 (16.7)	10 (83.3)		
Hypertension				
Yes	32 (38.1)	52 (61.9)	1.268	0.260
No	8 (26.7)	22 (73.3)		
Wagner				
2	8 (40.0)	12 (60.0)	4.929	0.177
3	22 (44.0)	28 (56.0)		
4	8 (22.2)	28 (77.8)		
5	2 (25.0)	6 (75.0)		
DPN				
Yes	32 (34.0)	62 (66.0)	0.257	0.612
No	8 (40.0)	12 (60.0)		
PAD				
Yes	20 (38.5)	32 (61.5)	0.478	0.489
No	20 (32.3)	42 (67.7)		
Visual impairment				
Yes	26 (38.2)	42 (61.8)	0.733	0.392
No	14 (30.4)	32 (69.6)		
Glycemic control				

Good	4 (33.3)	8 (66.7)	1.007	0.316
Poor	18 (50.0)	18 (50.0)		
Blood Glucose				
Good	8 (22.2)	28 (77.8)	3.824	0.051
Poor	32 (41.0)	46 (59.0)		
Total WBC				
Elevated	14 (41.2)	20 (58.8)	1.277	0.259
Normal	14 (29.2)	34 (70.8)		
Neutrophil				
Elevated	20 (34.5)	38 (65.5)	0.010	0.920
Normal	8 (33.3)	16 (66.7)		
ANC				
Elevated	12 (33.3)	24 (66.7)	0.019	0.891
Normal	16 (34.8)	30 (65.2)		
Site				
Lateral part of foot	6 (100.0)	0 (0.0)	17.532	0.008
Plantar surface	8 (30.8)	18 (69.2)		
Forefoot	14 (35.0)	26 (65.0)		
Dorsum of foot	6 (33.3)	12 (66.7)		
Multiple site	0 (0.0)	10 (100.0)		
Medial	4 (50.0)	4 (50.0)		
Whole foot	2 (33.3)	4 (66.7)		
Wound Culture				
Positive	20 (34.5)	38 (65.5)	0.956	0.328
Negative	4 (22.2)	14 (77.8)		

Table 5 shows that occupation was significantly associated with DFU recurrence among the patients (χ^2 = 14.015, p = 0.007). Drivers (100%) were most associated with a recurrence of DFU. Similarly, wound site was significantly associated with DFU recurrence among the patients (χ^2 = 17.532, p = 0.008). Lateral part of foot (100%) and medial (50%) were the sites more associated with DFU.

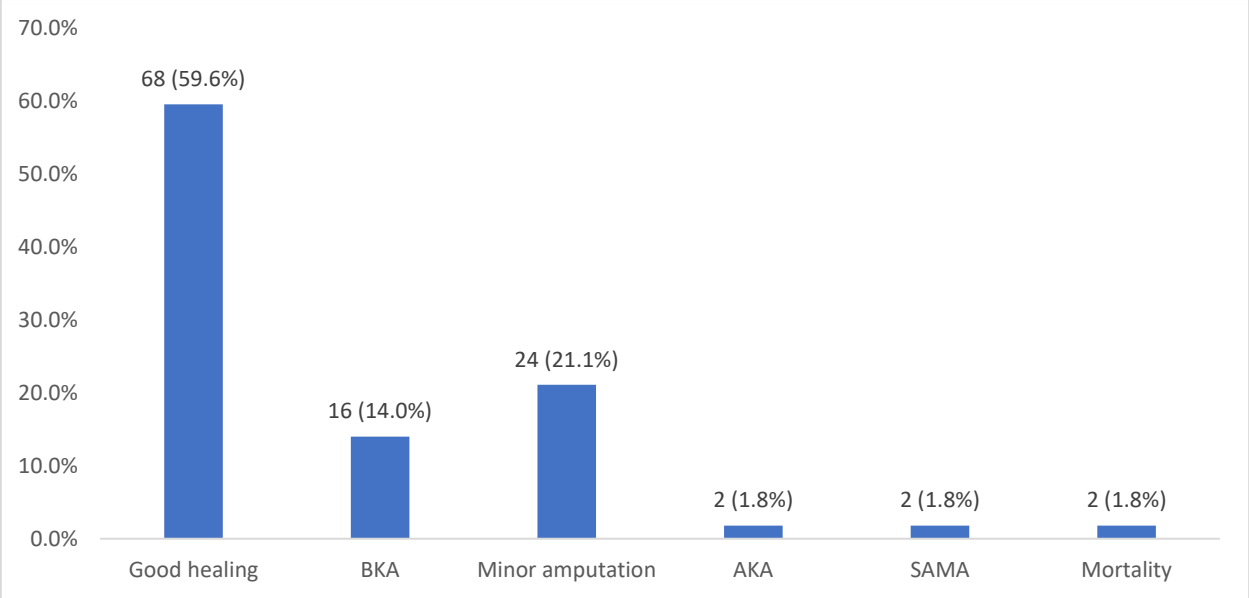

Figure 3: Outcome

Figure 3 shows that about three fifths of the patients had good healing, a fifth had ray amputation while 14% had below knee amputation.

DISCUSSION:

There was high prevalence of DPN (82.5%), PAD (45.6%) and visual impairment (59.6%) among the subjects in this study. This is similar to the findings in other studies which also noted these conditions as the major risk factors for foot ulceration in DM subjects [8, 14, 15]. In this study, 35% of the studied subjects had recurrent DFU. This high prevalence of reoccurrence of DFU was also found by other researchers. A meta-analysis of 1426 patients found that the DFU reoccurred in 37% of cases [16], while multi-centre studies in Germany (GER) and Czech Republic (CZ) found that 69% of patients in GER and 70% in CZ experienced at least one DFU recurrence [17]. Armstrong et al found that roughly 40% of patients had recurrence within 1 year after ulcer healing, almost 60% within 3 years, and 65% within 5 years [18]. Furthermore, even in specialty foot clinics, recurrence of DFU is often very high, generally ranging from 25 to 80% per annum [19, 20]. Established risk factors for reoccurrence of DFU include plantar ulcer location, presence of osteomyelitis, poor glycaemic control, peripheral neuropathy, deformities of the feet, peripheral vascular disease, loss of foot protection sensitivity, C-reactive protein > 5 mg/l, diabetes duration, vascular intervention, presence of callus and previous amputation [16, 21, 22, 23].

This study found that occupation significantly associated with DFU recurrence among the patients (χ^2 = 14.015, p = 0.007). Drivers (100%) were mostly associated with this recurrence, followed by business men/traders (36%) and civil servants (30.8%). This very high prevalence of reoccurrence in drivers could have been as a result of the fact that drivers sit for a long period of time, possibly wearing shoes, with their feet pressed on a hard surface (the pedal or the floor of the vehicle). This would further predispose them to foot ulceration considering the high prevalence of DPN among the study subjects.

In this study, wound site significantly associated with DFU recurrence among the patients (χ^2 = 17.532, p = 0.008). Lateral (100%) and medial (50%) parts of the foot were the sites most associated with recurrent DFU. Few studies have characterized the location of DFU reoccurence relative to the location of previous wounds. Orneholm et al found that of the 34% of patients who developed reocurrence of foot ulceration, 18% was on the same foot, 15% was on the contralateral foot and 8% occurred on the same site and foot [24]. Another study conducted at a foot clinic in Malta found that reulceration occurred on the same foot in 84.4% of participants, and that the majority of these ulcers (43.8%) were on the plantar aspect of the foot, 31.3% were on the apex of the toes, 15.6% were located dorsally, and 9.4% on the lateral aspect of the heel. The authors also found that of the 27 ulcers that recurred on the same foot, only 34.4% recurred at the same site, on the same foot [25]. A similar study done at a University Medical Centre in Netherlands found that patients with a plantar hallux ulceration were most likely to get another ulceration at the same location as the index ulcer compared with the other groups, and that reulceration at the same location was more likely in the group of patients with a plantar hallux or submetatarsal ulcer at enrollment compared with ulcers at any other location [26]. Another study conducted at a tertiary referral hospital in Egypt found that 61.3% of patients had reoccurrence of foot ulceration particularly in the forefoot (33.3%) and 24.6% in the big toe [27]. Further studies are needed to elucidate the relationship between the location of previous foot ulcers and reulceration especially as it concerns the site in both cases.

CONCLUSION

There is high prevalence of DFU reoccurrence in patients admitted with this condition in our centre. Subjects' occupation and location of the ulcer positively correlated with this reoccurrence.

RECOMMENDATIONS

1. Sensitization and education of DM subjects on measures to prevent the development of DFU in the first place. This would involve all health care providers (HCP) who are involved in the management of DM and its complications.
2. Aggressive and multidisciplinary approach in the management of DFU to ensure better outcome. Established risk factors of DFU and its recurrence should be comprehensibly dealt with.
3. Diabetic subjects should be discouraged from engaging in activities and occupations that would place them in harm's way especially as it concerns foot ulceration.

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