Diabetes foot ulceration in a Nigerian hospital: in-hospital mortality in relation to the presenting demographic, clinical and laboratory features

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ABSTRACT

This prospective study assessed in-hospital mortality from diabetic foot ulcer in relation to the demographic, clinical and laboratory features at presentation. Forty-two patients admitted with diabetic foot ulcer were followed up from admission till discharge from hospital. Those who survived or died were compared for any differences in demographic, clinical and laboratory parameters at presentation. The mean age and duration of diabetes for the 42 patients were 56.1 ± 1.9 years and 8.3 ± 1.1 years, respectively. The in-hospital mortality rate amongst the 42 subjects was 40.5%. Ulcer grade $\geqslant$4, leucocytosis and anaemia were more prevalent in those who demised in comparison with survivors.

Key words: Diabetic foot ulceration ● In-hospital mortality

INTRODUCTION

Diabetes foot disease is a strong predictor of excess deaths (1–8). The mortality rate during

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admission of 80 patients with diabetic foot ulcer of Wagner's grade 3 in India was 2.5% (9) and 16.7% in a cohort of 12 Italian subjects admitted for diabetic foot ulcer (10). In both studies (9,10), septicaemia was the cause of all deaths. The in-hospital mortality rates from diabetic foot ulcer in recent studies (11–17) conducted in sub-Saharan Africa are high. A figure of 38.1% was reported in a cohort of 42 patients in Burkina Faso (11) and 22.2% amongst a cohort of 27 Cameroonian patients with diabetic foot ulcers (12). A report from Tanzania (13) showed a mortality rate of 29.2% amongst 92 subjects admitted with diabetic foot disease with mortality rates increasing to above 50% in patients whose foot

disease were Wagner grade ⩾4. A previous study (16) showed a mortality rate of 54% for patients admitted and treated for diabetic foot ulceration in our hospital, the Lagos University Teaching Hospital. In this study, survivors and those who demised during admission for diabetic foot ulceration were compared for any differences in demographic, clinical and laboratory parameters at presentation.

METHODS

Patients

All patients admitted to the Lagos University Teaching Hospital with diabetes-related foot ulcer from 1 May 2007 to 31 December 2007 participated in the study.

Routine practice

Diabetic patients with diabetic foot ulcer come to the attention of the authors through one of the three routes: (i) casualty, (ii) diabetes clinic and (iii) referral from other units but mainly the orthopaedics service. Diabetic foot ulceration accounted for 11.7% of 1500 diabetic admissions over the period 1998–2000 (16). The hospital has neither a dedicated foot clinic nor podiatrist in its employment. All patients with diabetes foot disease of Wagner's grade ⩾1 are offered hospital admission. At presentation, blood glucose estimation is performed with a glucometer and blood samples are taken for a full blood count, electrolytes, urea and creatinine. Dipstick urinalysis is carried out to exclude ketosis. Radiographs of both feet are performed to allow for comparisons between affected and spared feet. Radiography allows for the diagnosis of osteomyelitis and thus categorisation as Wagner's grade 3 diabetic foot if there is no foot gangrene. It also allows for the detection of radio-opaque foreign bodies and gas in the tissues. Peripheral vascular disease is diagnosed when there is reduced/absent dorsalis pedis pulsations in the affected foot or ankle-brachial index (ABI) either less than 0.8 or greater than 1. The contra-lateral foot is used if the foot with an ulcer is swollen. The diagnosis of peripheral neuropathy is made if patient has reduced/absent vibration sense assessed with a 128-Hz tuning fork. The tuning fork is placed on the medial malleoli of the affected foot but on the contra-lateral foot if the affected foot is swollen. Vibration is not assessed where sensorium is altered or the vibration perception cannot be consistently correctly perceived on the forehead. A wound swab is also requested for. Therapy consists of insulin, parenteral antibiotics, tetanus toxoid and intravenous fluids. Oral hypoglycaemic agents are stopped and patient switched to regular insulin thrice daily before meals and bedtime intermediate insulin where enteral feeding is possible but glucose-insulin-potassium infusion where patient cannot not tolerate orally. Subsequent insulin dosages are based on the results of daily fasting blood glucose levels and weekly 8-point glucose blood glucose profiles performed with a glucometer. The choice of antibiotic therapy is initially empiric and typically comprised the combination of intravenous ciprofloxacin 200 mg 12 hourly or ceftriazone 1 g 12 hourly with intravenous metronidazole 500 mg 8 hourly. Antibiotics regimen are changed when dictated by the sensitivities from wound swab cultures. Daily saline wound dressings are carried out. Packed cell volume is raised to at least 30% with packed red cells before surgery. The anaesthesia and orthopaedic units will often insist that glycaemia, septicaemia and anaemia be corrected before major surgery, usually an amputation is performed. Revascularisation procedures are currently not performed at the Lagos University Teaching Hospital. Patients are only regularly discharged from in-patient care when the ulcer is completely healed and acceptable glycaemic control has been achieved.

Definition of terms

Diabetic foot ulcer was defined as any breach in the skin of full thickness occurring distal to the malleoli and graded using the Wagners grading system (18). Where a patient had more than one ulcer, grading was based on the ulcer with the highest grade. Leucocytosis was defined as white blood count > 10 000 mm^3/L. Anaemia was defined as packed cell volume <30% or haemoglobin (Hb)<10 g/dL. Renal failure was defined as serum creatinine >2 mg/dL. Duration of diabetes less than 1 year or death on the same day of admission was categorised as zero.

Data capture

Data on demographic variables, type and duration of diabetes, Wagner's grade of diabetic ulcer, presence of peripheral neuropathy, peripheral vascular disease and laboratory

parameters, namely, blood glucose, white cell count, packed cell volume and serum creatinine were captured. The main outcome measure was the status at discharge from admission stratified as alive or dead.

Statistical analysis

Data were analysed using Statistical Package for Social Sciences (SPSS) version 16 for Windows (SPSS, Chicago, IL). Results are presented as mean and standard deviations for continuous variables, whereas categorical variables are expressed as percentages. Comparison of mean values was performed using the Student's t test for continuous and chi-squared test for categorical variables. Statistical significance was at $P \leqslant 0.05$.

Ethical considerations

Ethical approval was obtained from the Lagos University Hospital research and ethics committee. Informed consent was obtained from the patient or relatives if the patient was unable to give informed consent usually on the grounds of altered sensorium.

RESULTS

Demographic parameters

A total of 42 patients with diabetes-related foot ulcers were admitted during the period of the study of whom 38 (90.5%) had type 2 diabetes, whereas 4 (9.5%) had type 1 diabetes. Five of the patients, all with type 2 diabetes were only diagnosed with diabetes within 1 year of admission with foot ulcer. Twenty-eight (66.7%) of the forty-two patients were men. Two patients who died on the day of admission were included in the analysis. Eight patients who were discharged against medical advice with a median (range) hospital stay of 16 (13–61) days were categorised as discharged alive. Two patients, not among the forty-two study subjects were not included in the study as they were discharged on the same day of admission albeit against medical advice. One patient who was initially discharged against medical advice with a grade 4 ulcer but re-admitted for the same index ulcer though deteriorating to grade 5 had both admissions treated separately. The demographic characteristics at presentation of the entire study cohort are shown in Table 1. Surviving and dead subjects had similar mean ages and gender distribution.

Table 1 Demographic, clinical and laboratory parameters of all subjects

Age (years)	(42) 56.1 ± 1.9 (26–87)
Duration of diabetes (years)	(42) 8.3 ± 1.1 (0–27)
Duration of foot ulcer before admission (days)	(38) 35.9 ± 6.0 (1–150)
Duration of admission (days)	(39) 32.3 ± 5.2 (0–130)
Mortality during admission	(42) 40.5%
Peripheral neuropathy	(36) 69%
Peripheral vascular disease	(42) 31%
Blood glucose (mmol/L)	(32) 15.4 ± 1.7 (1.2–33.3)
Anaemia	(34) 61.8%
Renal failure	(25) 20%

Data are mean ± SEM, range and number of subjects or percentage and number of subjects.

Precipitating factors

The precipitating cause of ulcer was not known in 26 (61.9%) of the 42 subjects and was regarded as 'spontaneous'. Trauma was the commonest identified precipitating factor for foot ulcer and was present in 13 (31%) patients; three following nail injury; two while walking barefoot and one with nail piercing through shoes. Ulcer resulted from bursting foot blisters at home in two patients. Four patients had trauma related to tight fitting shoes bought within 3 months of the survey. The remaining four cases of trauma consisted of the foot hitting a stone in a visually impaired male and three cases of thermal burns. One of the thermal burns was sustained by a passenger on a commercial motorcycle caused by the exhaust pipe and another by the patient resting his feet on the engine compartment within a commercial combi bus. The third case of thermal injury resulted in a patient who placed his feet on a hot surface to 'test that they were working'. The remaining three cases consisted of rat bite in one case, maceration of a callus after soaking foot with antiseptic solution and table salt in another and a decubitus ulcer from prolonged immobilisation in the third. The precipitating causes of ulcer were similar regardless of whether patient survived or died ($P > 0.05$).

Ulcer grades

Of the 42 patients studied, 7 patients had ulcer grades 1, 2 and 3 each, 13 with grade 4 ulcer and 8 with grade 5 ulcer. The grades of foot ulcers in the 17 deceased patients were two in three subjects, three in one subject, four in seven subjects and five in six subjects. The ulcer grades in the 25 surviving subjects were one

Table 2 Demographic, clinical and laboratory parameters at presentation in surviving and dead patients

	Dead	Alive	P value
Age (years)	(17) 56 ± 2.2 (42–74)	(25) 56.2 ± 2.8 (26–87)	1.0
Males (%)	(17) 64.7	(25) 68	1.0
Duration of diabetes (years)	(17) 9.1 ± 2.0 (0–27)	(25) 7.7 ± 1.4 (0–20)	0.6
Duration of foot ulcer (days)	(17) 38.8 ± 9.4 (1–150)	(21) 33.5 ± 7.9 (2–135)	0.7
Duration of admission (days)	(17) 21.2 ± 5.9 (0–78)	(22) 40.9 ± 7.7 (6–130)	0.06
Ulcer grade ⩾4	(17) 76.5%	(25) 28%	0.004
Blood glucose (mmol/L)	(11) 18.2 ± 3.6 (1.2–33.3)	(21) 13.9 ± 1.7 (1.9–31.1)	0.3
PCV (%)	(12) 23.6 ± 1.4 (16–31)	(22) 29.7 ± 1.6 (13–42)	0.02
Anaemia	(12) 83.3%	(25) 57.1%	0.08
White blood cell $\times 10^6$	(10) 27.6 ± 3.9 (10.3–54.4)	(21) 16.3 ± 3.6 (1.3–64)	0.06
Leucocytosis	(10) 100%	(21) 57.1%	0.03
Renal failure	(8) 37.5%	(17) 11.8%	0.3
PN	(13) 84.6%	(23) 78.3%	1.0
PAD	(17) 23.5%	(25) 36%	0.4

Data are mean ± SEM, range and number of subjects or percentage and number of subjects. BG, blood glucose; PAD, peripheral arterial disease; PCV, packed cell volume; PN, peripheral neuropathy.

Key Points

- this study showed the occurrence of gangrene, leucocytosis and anaemia to be associated with mortality during admission for diabetic foot ulceration
- precipitating causes of foot ulcer such as walking barefoot, soaking foot in antiseptic solutions and saltwater, 'testing' the foot by placing it on hot surface and home surgery are all indicators of inadequate foot care education
- the more frequent occurrence of leucocytosis and anaemia in those that demised is likely related to septicaemia

in seven subjects, two in four subjects, three in seven subjects, four in six subjects and five in one subject.

Mortality rates and associated clinical and laboratory parameters

The in-hospital mortality rate amongst the cohort of 42 patients was 40.5%. The proportion of subjects with ulcer grade ⩾4 was more in those who died compared with those that survived; 76.5% versus 28%, $P = 0.004$. Leucocytosis and anaemia were more prevalent in those that demised than survived (Table 2). Admission blood glucose levels were similarly high in both groups (Table 2). The rates of peripheral neuropathy, peripheral arterial diseases (PAD) and renal failure were comparable in both groups (Table 2).

DISCUSSION

This study showed the occurrence of gangrene (Wagner's ulcer grade ⩾4), leucocytosis and anaemia to be associated with mortality during admission for diabetic foot ulceration. The in-hospital mortality rate of 40.5% for foot ulcer in this study compares with the rate of 38.1% obtained from Burkina Faso (11) but lower than 6.7% (4/64) from another Nigerian study (15). These patterns of mortality rates may be explained by the proportions of subjects with high and low-grade foot ulcers in the different studies. Similar to the Burkina Faso study (11) with 28 of 42 subjects with foot ulcer of ⩾ grade 4, our study also had a high proportion of subjects with high-grade foot ulcer, 20 of

the 42 patients. This is unlike in the Nigerian study (15) with a low mortality rate where the greater majority of patients (49/64) had foot ulcer grade <4. Although we recorded no deaths in all seven patients with grade 1 ulcer, mortality rose sharply above the entire cohort average of 40.5% to 65% in subjects with ulcer grade ⩾4. These data similar to those from a Tanzanian study (13) indicate that ulcer grade ⩾4 should be treated as medical and surgical emergencies. Precipitating causes of foot ulcer such as walking barefoot, soaking foot in antiseptic solutions and saltwater, 'testing' the foot by placing it on hot surface and home surgery are all indicators of inadequate foot care education.

The more frequent occurrence of leucocytosis and anaemia in those that demised is likely related to septicaemia. We observed no deaths in eight patients with neither of septicaemia nor ulcer grade ⩾4 and a mortality rate of 30.8% in 13 subjects with either of septicaemia (12 persons) or of ulcer grade ⩾4 (1 person). The mortality rate was, however, 66.7% in 18 subjects who had the combination of ulcer grade ⩾4 and septicaemia. This is similar to other reports (13,19–22) of increased risk for mortality with high-grade diabetic foot ulcer and septicaemia. It is possible that subjects with ulcer grade ⩾4 and septicaemia were more frequently infected with less susceptible microbial strains than those with ulcer grade <4 and septicaemia. This is suggested by a study that reported mortality related to infection with multi-drug resistant organisms (MDROs) in 2

of 80 subjects (9). In this study (9), 29 of 46 with grade 3 ulcer had MDRO, increasing to 20 of 25 in those with grade 4 ulcer, while all 9 with grade 5 ulcer were infected with MDRO. We can only speculate that our patients with high-grade diabetic foot ulcer may have demised more often from septicaemia because of MDRO.

A contributory factor to the mortality in our patients is delay in limb amputation. The reasons for delayed amputation included initial refusal by patients to consent and the current practice to have anaemia, glycaemia and septicaemia treated before amputation is performed. Prompt removal of the gangrenous foot may enhance prospects for survival as it may be easier to correct anaemia and manage hyperglycaemia once the focus of septicaemia is eliminated particularly where there is a high chance of infection with MDRO with high grade foot lesions.

This study shows a high mortality for diabetic foot ulcer in our hospital with ulcer grade ≥4, anaemia and leucocytosis at presentation to be associated with mortality. There is the need for us to study the types of organisms and the patterns of anti-microbial sensitivity in relation to the grades of foot ulceration.

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