Foot ulceration in Nigerian diabetic patients: a study of risk factors

A O Ogbera

Abstract
Diabetic foot ulceration is an important cause of morbidity and mortality in Nigerian diabetic patients. Identification of the risk factors for ulceration is, therefore, of paramount significance. This study aimed to determine these risk factors. Forty-seven (47) diabetic patients with past or present foot ulceration were studied together with an equal number of controls which were diabetic subjects with no past/present history of ulceration. Risk factors strongly associated with foot ulceration included peripheral vascular disease, male sex, nephropathy, retinopathy, foot deformities, history of previous foot ulceration or amputation, cataract formation, poor glycaemic control, neuropathy, and tinea pedis. Weakly associated risk factors were walking unshod, being of low socio-educational status, and smoking. We concluded that many risk factors for foot ulceration are potentially preventable. As part of a comprehensive footcare programme, education on footcare should be directed at patients, family members, and healthcare providers.

Introduction
Of the many complications affecting the diabetic patient, foot ulceration is one of the most devastating. It has been estimated that this develops in 15% of patients
and is the single most common cause of prolonged hospitalisation amongst people with diabetes. Reports from Botswana and Nigeria have shown that foot ulceration accounts for 4% and 14%, respectively, of all diabetic hospitalisations. Although the spectrum of foot lesions varies in different regions of the world, the pathways to ulceration are probably similar in most patients, with foot lesions frequently resulting from a combination of two or more risk factors occurring together. Risk identification is fundamental for effective preventive management of the foot in people with diabetes. This has received inadequate research attention in Nigeria. Disturbingly high mortality rates associated with diabetic foot ulceration have been reported in Nigeria, and as such in-depth studies are indicated.

Patients and methods
The study was carried out in Lagos University Teaching Hospital (LUTH) over a 1-year period. Participants were recruited from the Diabetes Clinic and the medical wards of LUTH. There were 47 diabetic patients with past or present foot ulceration studied, and an equal number of controls, who were diabetic subjects with no past or present history of ulceration. Relevant medical history, general physical examination, neurological, vascular, ocular, metabolic, and other assessments were carried out in these two groups of patients. Data were analysed using the statistical package for social sciences (SPSS version 9). The statistics used included Student’s t test, Chi squared test, and logistic regression for the determination of odds ratios. The following operational definitions were used:

1. The diagnosis of diabetes was made using the 1985 WHO criteria.
2. Type 1 diabetes – diagnosed before the age of 30 years and requiring insulin from diagnosis.
3. Type 2 diabetes – treated or controlled using dietary measures and/or oral glucose-lowering agents/or though presently on insulin, were initially controlled on oral hypoglycaemic agents.
4. Glycaemic control was classified using the mean fasting plasma glucose (FPG) over a period of 3–6 months. Good control was an FPG ≤6.6 mmol/L, fair control an FPG of 6.7–7.7 mmol/L, and poor control an FPG ≥7.7 mmol/L.
5. Duration of diabetes was described as short if it was between 0 and 5 years, medium if it was 6–10 years, and of long duration if greater than 10 years.
6. Diabetic nephropathy was defined as persistent non-infective proteinuria by dipstix testing.
7. Social class was based on occupation as follows:
   I    Professional occupation
   II   Intermediate occupation
   III Non-manual skilled/manual skilled occupation
   IV  Partly skilled occupation
   V    Unskilled occupation
   High social class was I or II and low social class was class III, IV, or V.
8. Neuropathy was defined as any symptom or sign of peripheral nerve dysfunction. The absence of ankle reflex only was not diagnostic.
9. Peripheral vascular disease (PVD) was diagnosed in the presence of intermittent claudication, rest pain, impalpable pedal pulses, or an ankle brachial pressure index (ABPI) of <0.9.
Results
Of the 47 diabetic patients with past or present ulceration studied, 28 were male and 19 were female, 7 (15%) had type 1 diabetes while 40 (85%) had type 2 disease. Those that had foot ulceration when seen were 34 (72%), while those that had a past history of foot ulceration were 13 (28%) in number. For the controls, there were 4 with type 1 diabetes and 43 with type 2 diabetes. The demographic and the anthropometric indices of the patients are shown in Table 1. The cases and controls differed significantly with regards to smoking habits and glycaemic control, while no significant difference was found for such variables as age distribution, socioeconomic levels, and duration of diabetes.

Table 1  Clinical characteristics of foot ulcer patients and their controls

<table>
<thead>
<tr>
<th>Variable</th>
<th>Foot ulcer patients</th>
<th>Controls</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. (M:F)</td>
<td>47(28:19)</td>
<td>47 (23:24)</td>
<td>NS</td>
</tr>
<tr>
<td>BMI classes (&lt;25:&gt;25)</td>
<td>15:24</td>
<td>16:29</td>
<td>NS</td>
</tr>
<tr>
<td>Low social class: low social class</td>
<td>7:40</td>
<td>8:39</td>
<td>NS</td>
</tr>
<tr>
<td>Smoking No. (%)</td>
<td>11(23%)</td>
<td>4(9%)</td>
<td>0.02</td>
</tr>
<tr>
<td>Duration of diabetes(years)</td>
<td>8±7</td>
<td>8±4</td>
<td>NS</td>
</tr>
<tr>
<td>Mean FPG (mmol/L)</td>
<td>11.5±3.5</td>
<td>9.3±5.1</td>
<td>0.02</td>
</tr>
<tr>
<td>Good control</td>
<td>5(11%)</td>
<td>12(26%)</td>
<td>0.02</td>
</tr>
<tr>
<td>Fair</td>
<td>2(4%)</td>
<td>12(26%)</td>
<td>0.001</td>
</tr>
<tr>
<td>Poor</td>
<td>40(85%)</td>
<td>23(49%)</td>
<td>0.01</td>
</tr>
</tbody>
</table>

The prevalence of risk factors for foot ulceration is shown in Table 2. The known risk factors for foot ulceration were as expected more common in the group with foot ulceration. The differences were statistically significant with regards to the presence of PVD, tinea pedis, foot deformity, neuropathy, cataract, past foot amputation, and nephropathy.

Table 2  Comparison of risk factors in diabetic patients with and without foot ulceration

<table>
<thead>
<tr>
<th>Variable</th>
<th>Foot ulcer patients</th>
<th>Controls</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>*PVD</td>
<td>11(29%)</td>
<td>3 (14%)</td>
<td>0.005</td>
</tr>
<tr>
<td>Tinea pedis</td>
<td>11(40%)</td>
<td>3 (7%)</td>
<td>0.0003</td>
</tr>
<tr>
<td>Foot deformity</td>
<td>17(36%)</td>
<td>8(18%)</td>
<td>0.04</td>
</tr>
<tr>
<td>Neuropathy</td>
<td>39(83%)</td>
<td>23(49%)</td>
<td>0.02</td>
</tr>
<tr>
<td>Cataract</td>
<td>11(23%)</td>
<td>4(9%)</td>
<td>0.04</td>
</tr>
<tr>
<td>Past foot ulceration</td>
<td>14(30%)</td>
<td>7(14%)</td>
<td>NS</td>
</tr>
<tr>
<td>Past foot amputation</td>
<td>9(19%)</td>
<td>2(4%)</td>
<td>0.02</td>
</tr>
<tr>
<td>Nephropathy</td>
<td>24(52%)</td>
<td>6(21%)</td>
<td>0.02</td>
</tr>
<tr>
<td>Retinopathy</td>
<td>20(46%)</td>
<td>6(27%)</td>
<td>NS</td>
</tr>
</tbody>
</table>

Odds ratio estimation for risk factors for foot ulceration
Predictive factors for foot ulceration based on the variables measured are presented in Table 3. Stepwise logistic regression was done for the variables in order to calculate the odds ratio, giving an approximation of the relative risk of these variables. The risk of developing foot ulceration was increased in males, diabetic patients aged over 61 years, and in the presence of tinea pedis, poor glycaemic control, neuropathy, nephropathy, retinopathy, cataract, PVD, foot deformity, past foot ulceration and amputation. In comparison to those in whom these characteristics were absent, belonging to a low social and educational class, a history of significant smoking, long duration of diabetes, and walking unshod were not associated with an increased risk of developing foot ulceration.

Discussion
The risk factors for foot ulceration found in this study were mainly those that have been documented previously.\(^5,12\) The most common risk factors, among a host other factors identified in this study, were neuropathy, poor glycaemic control, structural foot deformity and PVD. These lend support for a multi-factorial aetiology of diabetic foot ulceration.

In this study, those of male sex and greater than 61 years of age were found to have an increased risk for foot ulceration – the odds ratio estimate of these factors being high. Similar findings have been documented by others.\(^5,12\) This finding in elderly people with diabetes is expected, given the fact that at least 90% of all people living with diabetes have type 2 disease, which is known to be prevalent in middle-aged and elderly people. Moreover, at diagnosis, long-term complications of diabetes may have already developed.\(^9\)

The universal observation that neuropathy is the commonest long-term complication of diabetes\(^5,11-13\) was supported in this study by its presence in 87% of the subjects with past or present foot ulceration. Mechanical factors that have not hitherto been widely reported in Nigerian series\(^12,14\) play an important role in the initiation of foot ulcers with injury typically occurring in the setting of a foot deformity.\(^5\) The commonest observed foot deformity was the presence of prominent metatarsals.

PVD is said to be less common among African diabetic patients\(^12,14\) compared to their Western counterparts; it was found in 36% of those with diabetic foot ulceration. There might possibly have been an underestimation of PVD in this study because of the presence of arterial calcification, which is common in diabetes.\(^5\) Nigerian studies have reported the presence of arterial calcification seen radiologically in 24%\(^14\) and 21%\(^15\) of diabetic patients. Previous ulceration and amputation – seen in 30% of the subjects with past or present foot ulcers – often lead to reoccurrence of ulceration and re-amputation.\(^5\)
The figures for co-morbidities such as nephropathy (often found in association with foot ulceration) in this report are comparable to those reported in some Nigerian studies. The increased risk for foot ulceration in the presence of retinopathy – seen in 59% of our foot ulcer patients – is confirmed in this study and elsewhere. Next to PVD, retinopathy had the highest odds ratio estimate.

The role of poor glycaemic control in the genesis of diabetic complications cannot be over emphasised as the mean FPG was noted to be considerably higher in patients with foot ulceration than in the control group. Various studies have shown similar findings. Tinea pedis, an often overlooked risk factor for foot ulceration, was seen in 40% of foot ulcer patients and may provide a portal of entry for more serious infections in the diabetic foot. Gupta and colleagues have reported on the association between tinea pedis and foot ulceration in diabetics.

Long duration of diabetes, which has been inconsistently reported as a risk factor for diabetic foot ulcers, was not found to be a significant risk factor in our study. Twenty-six per cent (26%) of foot ulcer patients in this study had diabetes diagnosed only when presenting with foot lesions. These corroborate the general observation that the diagnosis of diabetes is sometimes made with accompanying complications. Other factors that were poorly related to foot ulcer risk from our study were smoking, low socio-educational status, and walking unshod.

In view of the multifactorial pathogenesis of diabetic foot ulceration, a multidisciplinary footcare team with emphasis on preventative care should be set up in facilities providing care for people with diabetes.

References