

STUDIES ON DIABETIC FOOT ULCERS IN PATIENTS AT JOS UNIVERSITY TEACHING HOSPITAL, NIGERIA

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An epidemiological and microbiological studies of diabetic foot ulcers were carried out in our hospital, with a view to reducing the amputation and mortality rate associated with the disease. Wound swabs from 38 Diabetes Mellitus (DM) foot ulcer patients were investigated using culture methods for both strict aerobes and anaerobes. The bacterial isolates were subjected to antibiotic susceptibility tests using the disc diffusion method. Baseline biochemical and haematological analysis were also carried out. The prevalence of the disease was stratified in relation to some clinical and laboratory parameters, gender, age, educational and occupational status of the patients. The prevalence of the disease was 24.7%, with an amputation and mortality rates of 18.4% and 15.8% respectively. Only 13% had DM for less than 1 year, while 53% for more than 10 years. 28.9% have regular shoe-wearing habits. Duration of healing ranged from 2 weeks to 24 weeks (mean = 2.7 months). 31% of the patients with marked periosteal reaction had lower extremity amputation or died before amputation could be done. *Staphylococcus aureus* (31%), *Proteus spp* (16%), *Pseudomonas aeruginosa* (10%), *Klebsiella spp* (6%), *Peptococcus spp* (6%), *Bacteroides fragilis* (3%), *Streptococcus pyogenes* (3%), *Escherichia coli* (3%), *Candida albicans* (3%), *Streptococcus viridans* (1%), *Flavobacterium spp* (1.5%) and *Bacteroides melaninogenicus* (1%) were isolated. Most of the bacteria isolates were sensitive to pefloxacin. Our results demonstrate a very high rate of diabetic foot ulcer with the corresponding high rate of amputation and mortality. A multi-disciplinary approach to the management of DM foot ulcers is advocated.

Efforts should be made to carry out cultures of samples from refractory ulcers to rule out yeast colonization which if not treated will delay wound healing.

Key words: Diabetic foot ulcers, Microbial and antimicrobial surveillance, Refractory ulcers.

INTRODUCTION

Diabetes Mellitus is increasingly being recognized as a major medical problem in our environment, and the threat of lower extremity amputation (LEA) casts an ominous shadow over the lives of diabetic patients. Diabetic ulcers are the most common foot lesions leading to lower extremity amputation (1). Management of the diabetic foot requires a thorough knowledge of the major risk factors for amputation, frequent routine evaluation and meticulous preventive

maintenance (2). The etiology of lower extremity diabetic ulcer includes injury complicated by underlying neuropathy, ischaemia or both. The use of recombinant growth factor is becoming more widespread as more is learnt about their essential role in wound healing (3).

According to a study by Bild (4), more than 50,000 amputations were performed on diabetic patients each year in the United States of America. Reported prevalence rates of diabetic foot ulcers in different

groups of Nigeria diabetics range from 0.9% to 8.3% (5-8). This complication led to limb amputation in 40% of cases (8). Foot infections caused a third of all skin infections in 1,050 Nigeria diabetics (9), and accounted for 25% of deaths in ketocidosis (8). In a study by Walters *et al* (10) in the United Kingdom, the prevalence of diabetic foot ulceration was 7.4%.

Psychosocial problems from limb amputation persistently retard rapid rehabilitation. In Nigeria with inadequate health care facilities and uniform lack of comprehensive rehabilitation programmes, it is important to recognize foot lesions early and thereby offer early and effective treatment. Amputation is expensive (about \$500 per case, not including the costs of rehabilitation) and there is **difficulty in psychological readjustment.**

When managing diabetic foot ulcers, one is faced with the dilemma of whether to opt for radical surgery or to continue with conservative measures. We therefore, decided to carry out a prospective study to see how we can effectively reduce the amputation rate and the mortality associated with diabetic ulcers in our environment.

PATIENTS AND METHODS

Patients

One hundred and fifty four diabetics were admitted from January 1998 to December 1999 for various reasons ranging from poor control of diabetes to septicaemia. All were prospectively studied. Each of the patients with diabetic foot ulcer(s) was interviewed using the close ended questionnaire and then examined clinically. For example, with respect to shoe wearing habit, patients were asked whether it is regular or none. In this study, diabetic is defined according to WHO guidelines of glucose more than 7.0 mmol/L (>126 mg/dl) for fasting blood sugar or more than 11.1 mmol/L (>200 mg/dl) 2 hours postprandial (11).

Bacteriology

The wound swabs were collected as much as possible before any antibiotic therapy and inoculated immediately onto freshly prepared Blood Agar (BA), Chocolate Agar (Choc.) and MaConkey (McC) Agar plates. Pre-heated Robertson's Cooked Meat medium (RCM) was also inoculated and incubated aerobically at 35°C. One set of BA, Choc and McC agar plates was incubated aerobically at 35°C for 18-24 hours. The other set was incubated anaerobically at 35°C for 48 to 72 hours. The RCM broth cultures were subcultured after 48 hours and 72 hours onto the solid media and incubated

appropriately. The identifications of the isolates were done using the standard methods (12). Antibiotic susceptibility tests were carried out on the pathogenic isolates using the NCCLS techniques (13).

Haematology

Full blood count and Erythrocyte Sedimentation Rate (ESR) values were carried out on the patients' blood samples collected on admission (14).

Chemical pathology

Short-term glycaemic control was assessed by fasting glycosuria, acetonuria and fasting blood glucose levels. Urinalysis of the patients' samples were carried out using the MediTest strips and proteinuria was defined as the presence of greater than 50 mg/dl of protein.

Plain foot radiographs

Serial plain radiographs on the affected limbs were carried out on 32 of the 38 patients with diabetic foot ulcers. Two of the six patients that did not do X-ray could not afford the cost and their ulcers healed within six weeks, while the remaining four had above knee amputation immediately they were brought to the hospital so as to save their lives.

Surgery

Prophylactic surgery was done when necessary by serial debridement and large lesions were skin-grafted. In a few cases, where the life of the patients was in danger, amputation (especially

above the knee) was inevitably carried out.

Antibiotic therapy

The patients were treated based on the *in vitro* susceptibility pattern of the isolates, in addition to Metronidazole, Vitamin C, Vitamin B-complex and Insulin therapy. This was in addition to the scrupulous twice-daily dressing of the ulcers with hydrogen peroxide and eusol after warm hypertonic saline immersion of the affected whole foot for 30 minutes

RESULTS

Table 1 shows the duration of diabetes mellitus at the time of presentation to the hospital with diabetic foot ulcers. Only 5 (13%) of the 38 patients studied had duration of diabetes mellitus for less than one year. All the ulcers were located on the hind limbs and 7 (18%) had bilateral ulcers on both hind limbs while 31 (82%) had unilateral ulcers. The duration of healing ranged from 0.5 month to 6 months with a mean of 2.73 months. None of the patients was hospitalised for the entire duration of the healing. As soon as the blood glucose level is stabilised, they were discharged and then followed up in an ambulatory setting. The fasting blood glucose at the time of admission ranged from 6.0 mmol/L to 28 mmol/L. The packed cell volume (PCV) ranged from 18% to 45%; white blood cell (WBC) count ranged from 3,500/mm³ to 15,700/mm³; differential neutrophil

counts ranged from 48% to 78%; lymphocyte counts from 19% to 50% and the erythrocyte sedimentation rate (ESR) ranged from 6 mm/hour to 150 mm/hour. All these were the baseline data at the time of admission.

The plain foot x-rays showed periosteal reaction, osteomyelitis and soft tissue swelling. A few of the x-rays were normal while 31% of the patients who had marked periosteal reaction had their limbs amputated or died before amputation could be done

The sex distribution of the diabetes patients that attended the hospital for the 2 year period is shown in Table 2. There is no significant difference in the prevalence of diabetic foot ulcers in relation to gender ($p>0.05$). For the 2-year period, the prevalence of the diabetic foot ulcers in our hospital was 24.7%. Table 3 shows the prevalence of some important clinical and laboratory parameters in the patients with diabetes foot ulcers while Table 4 shows the prevalence in relation to the ages of the patients. No ulcer was seen in patients of less than 20 years and more than 80 years of age while the 51-60 years group had the highest with 44.7%.

The prevalence of diabetes foot ulcers in relation to educational status of the patients is shown on Table 5. Patients with no formal education recorded the highest with 36.8% ($P<0.05$). Table

6 shows the prevalence of the diseases in relation to the occupational status of the patients. Civil servants recorded the highest with 39.2%, but there is no statistical difference ($P>0.05$).

The microorganisms isolated from the diabetic foot ulcers are shown on Table 7. Twenty-two (58%) of the patients had poly-microbial flora, while 4(6%) showed no growth and strict anaerobes, aerobes and yeasts were encountered. Table 8 summarizes the percentage susceptibility patterns of the bacterial isolates to some of the commonly prescribed antibiotics in our hospital. Most of the isolates were sensitive to pefloxacin, except for *Klebsiella spp* that recorded only 25% sensitivity.

The summary of the laboratory data comparing patients whose ulcers healed and those who went home for amputation or died is shown in Table 9. There were no significant differences in the haematocrit values, white blood cell counts, erythrocyte sedimentation rates, differential neutrophil counts, fasting blood sugar and fasting glycosuria on first visits. Only 8(21.1%) of the patients had acetonuria on their first visit; out of which 7(87.5%) underwent amputation or died.

Table 1: Duration of Diabetes Mellitus at the time of presentation with ulcer.

Duration (years)	No of Patients	% of Total
<1	5	13
1-5	7	18
6-10	6	16
>10	20	53

Table 2: Sex Distribution of Diabetic Foot Ulcers in JUTH (January 1998-December 1999).

Admission	Males	Females	Total
Total DM	96	58	154
Total DM Foot	24	14	38
Relative frequency of DM Foot	25%	24.1%	24.7%

Table 3: Prevalence of some Important Clinical and Laboratory Parameters in the Patients.

Parameter	Number Examined	Number positive	%Positive
Positive knowledge of foot care.	38	11	28.9
Regular shoe wearing habit	38	30	78.9
Presence of previous foot ulcer	38	12	31.6
Presence of unilateral lesion	38	31	81.6
Spontaneous initiating factor	38	30	78.9
Presence of foot pain	38	26	68.4
Presence of shooting or lancinating pain	38	27	71.1
Presence of pain at rest	38	24	63.2
Presence of intermittent claudication	38	11	28.9
Presence of intermittent claudication	37	14	36.8
Presence or nocturnal diarrhoea	38	15	39.5
Presence of postural dizziness	24	21	87.5
Presence of impotence	38	22	57.9
Presence of fever	38	8	21.1
Presence of acetonuria	38	24	63.2
Presence of albuminuria	38	7	18.4
Amputation	38	6	15.8
Mortality			

Table 4: Prevalence of Diabetes Foot ulcers in relation to Age at JUTH, Nigeria

Age Group (years)	Number with Ulcer	% with Ulcer
21-30	2	5.3
31-40	4	10.5
41-50	9	23.7
51-60	17	44.7
61-70	4	10.5
71-80	2	5.3

Tables 5: Prevalence of Diabetes Foot in Relation to Educational Status

Educational Level	No. of Ulcer	% with Ulcer
None	14	36.8
Primary School	10	26.3
Secondary school	6	15.8
Tertiary Institution	8	21.1

Table 6: Prevalence of Diabetes Foot Ulcers in Relation to Occupational Status of the Patients

Occupational Status	No with Ulcer	% with Ulcer
Farmers	5	13.2
Traders	8	21.1
Civil servants	13	39.2
House-wives	7	18.4
Others (like Butchers, motor mechanics, applicants)	5	13.2

Table 7: Microbial Isolates from Diabetic Foot Ulcers at JUTH, Nigeria

Microorganism	No of Isolates	% of Isolates
<i>S. aureus</i>	21	31
<i>S. pyogenes</i>	2	3
<i>S. viridans</i>	1	1
<i>Cl. perfringens</i>	4	6
<i>Peptococcus spp</i>	4	6
<i>Klebsiella spp</i>	4	6
<i>Proteus spp</i>	11	16
<i>B. fragilis</i>	2	3
<i>B. metaninogenicus</i>	1	1
<i>Flavobacterium spp</i>	1	1
<i>P. aeruginosa</i>	7	10
<i>Candida albican</i>	2	3
<i>Acinetobacter spp</i>	1	1
<i>Esherichia coli</i>	2	3
No growth	4	6

Table 8: Percentage Susceptibility Patterns of the Bacterial Isolates to Clindamycin (CLN), Augmentin (AMC), Ampicillin (PN), Cotrimoxazole (SXT), Tetracycline (Te) and Pefloxacin (Pef).

	Antibiotics					
	CLN	AMC	PN	SXT	Te	Pef
Bacteria						
<i>S. aureus</i>	29*	48	0	10	48	90
<i>S. pyogenes</i>	100	100	100	0	0	100
<i>S. viridans</i>	100	100	100	0	0	100
<i>CL. Perfringens</i>	75	100	50	0	75	100
<i>Peptococcus sp.</i>	100	75	25	0	25	100
<i>Klebsiella sp.</i>	NA+	25	0	25	0	25
<i>Proteus sp</i>	NA	36	0	0	9	73
<i>B. fragilis</i>	50	50	50	50	50	100
<i>B. melaninogenicus</i>	0	0	0	0	0	100
<i>Flavobacterium sp.</i>	0	0	0	0	100	100
<i>P. aeruginosa</i>	NA	NA	NA	NA	NA	86
<i>Acinetobacter sp.</i>	NA	0	0	0	0	100
<i>E. coli</i>	NA	100	0	0	0	100

* % susceptible
+ Not applicable.

Table 9: Laboratory Parameters of Patients with healed Diabetic Ulcers Amputated/Dead Patients.

	PCV (Mean + SE)	WBC (Mean + SE)	ESR (Mean + SE)	Neutrophils (Mean + SE)	FBS (Mean + SE)	Aceton uria Num- ber	FG Number
Healed Ulcers	37.88+1.165	6816+558.62	41.167+6.574	57.12+1.365	12.748+0.832	01	21
Limb/death	30.538+1.96	1111+1086.623	81.154+10.837	67.846+2.412	19.269+1.45	07	13
P-Value (using kruskal- Wallis ANOVA	P > 0.05	P > 0.05	P > 0.05	P > 0.05	P > 0.05	P>0.05	P > 0.05

DISCUSSION

This study has shown a relatively high prevalence rate of diabetic foot ulcers (24.7%) among the DM patients in our hospital with 18.4% and 15.8% amputation and mortality rates. The population was limited to patients who attended the hospital during the study period either as in patients or ambulatory patients. It is very likely that the burden of diabetic foot ulcers may be more

in the general population (15years and above) within the metropolis with a DM prevalence of 3.1% (16). We believe that a combination of conservative approach and aggressive prophylactic surgery in high-risk patients, if started very early in the course of the disease will reduce the amputation and mortality rates in our environment, which hitherto was high. Previously many limbs that should have been

saved were amputated without trying the combination of conservative approach and aggressive prophylactic surgery. Also some DM foot ulcers patients shy away from attending the hospital for fear of amputation and eventually some of them die due to infections. We believe that with adequate health education, which should be given to the DM patients particularly on their clinic days, they will be willing to report any ulcers to the physician no matter how trivial. Proper management of the ulcers includes the use of proper footwear, non-weight-bearing limb support, use of appropriate antibiotics, debridement, aggressive revascularization, control of serum glucose levels and careful monitoring of the ulcers. Empirical antibiotic selection was replaced by culture-guided definitive therapy as soon as possible and this greatly improved the condition of the patients. It was discovered in the study, that the prevalence of diabetic ulcers was low in those with positive knowledge of foot care and this confirms the advantage of regular health education for the diabetics. The prevalence of the disease in relation to age is in agreement with the known knowledge that diabetes mellitus is highest in the 51-60 year age group. A few

diabetic with no formal education had the highest prevalence of ulcers due mostly to ignorance.

Some of the important parameters which are relevant to development of foot ulcers in diabetic patients such as peripheral neuropathy, peripheral pulses, presence of calluses, blisters, corns and trophic changes are being prepared for publication. Although new therapies, such as the use of exogenous recombinant growth factors are being developed for refractory ulcers (17), care must be taken to isolate and identify all the microbial flora of the ulcers.

The bacterial isolates showed a high rate of multiple resistance to commonly used antibiotics. This is mainly due to the ready availability and the easy access to those antibiotic by the general population without medical prescription. It is most likely that majority of the *Staphylococcus aureus* strains isolated in this study are MRSA as earlier reported by Ikeh (18), who got a prevalence of 43% out of the 180 consecutive isolate of *S. aureus* in our hospital. In this study, we encountered few isolates of *Candida albicans* as part of the mixed microbial flora and the patients responded very well on the inclusion of ketoconazole to the treatment regimen. Diabetic ulcers should be thoroughly evaluated and appropriately treated through established protocols utilizing all members of the team. This certainly

reduces the duration of hospital admission, morbidity and loss of limbs. Although foot problems in diabetics cannot be eradicated completely, it is always better to diagnose and manage diabetic ulcers effectively, educate and motivate patients to care for their feet so as to minimize complications and decrease health care costs. In the absence of facilities for culture and antibiotic susceptibility tests, pefloxacin may be useful as a monotherapy in diabetic foot ulcers due to the marked clinical and laboratory response in our study.

Except for acetonuria, none of the conducted laboratory parameters determined the outcome of the diabetic foot ulcers disease. This shows that with proper management of the patients, the morbidity, amputation and the mortality rate can be drastically reduced if the management is started early. The study population was limited to patients who attended the hospital either as inpatients or ambulatory patients, and it is very likely that the burden of diabetic foot ulcers is more in the general population.

ACKNOWLEDGEMENTS

The authors wish to thank the nursing staff of the affected wards for their cooperation. This study was supported in part by the senate Research grant (RGC/1997-98/010) of University of Jos, Nigeria.

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