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CHARACTERISTICS OF PATIENTS WITH DIABETIC FOOT IN MOMBASA, KENYA

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ABSTRACT

Objective: To study the causes of perceived high mortality in patients with diabetic foot in Mombasa, Kenya.

Design: A retrospective study.

Setting: The Mombasa Hospital Private Clinics, from January 2001 to December 2005. An urban set up.

Subjects: Ninety five patients with diabetic foot disease out of 830 in-hospital patients admitted with diabetes mellitus, aged between 40 and 90 years, treated mainly at The Mombasa Hospital.

Intervention: Patients were managed conservatively and operatively. The operations were incision and drainage, debridement and amputation.

Results: The majority of the males were between 50-70 years (76%) while the majority of the females were between 60-80 years (69%), with the mean age for males of 58 years and 65 years for the females. Overall mortality was 13%. Post-amputation mortality was 28%. The mortality was found to be associated with high co-morbidity, mainly uncontrolled diabetes mellitus (100%), Sepsis (75%), ischaemic heart disease (42%), uncontrolled hypertension (25%) and renal insufficiency (25%). The measurable characteristics included high blood sugars, raised WBC count, high creatinine, high serum lipids, abnormal ECG and abnormal arterial Doppler scans.

Conclusion: The mortality associated with diabetic foot ulcer disease may be predicted by measurable characteristics. These parameters point to conditions that are themselves complications of diabetes mellitus and whose management will reduce mortality. The management of diabetic foot is therefore, multidisciplinary. Amputation appears to carry an added risk and should not be rushed until the patient is fully resuscitated.

INTRODUCTION

Diabetes Mellitus (DM) is a serious disease that develops from lack of production of insulin from the pancreas or the body's insensitivity to circulating insulin levels. This leads to elevated blood sugars. Diabetes is therefore, characterised by hyperglycaemia and subsequent development of complications.

The criteria for diagnosis of DM have been revised and published by the World Health

Organization (WHO) (1). In a symptomatic patient, a random plasma glucose concentration of ≥ 11.1 mmol/L is diagnostic. For asymptomatic patients, two diagnostic tests are required. A fasting glucose level ≥ 7 mmol/L confirms the diagnosis (providing this is supported by a second diagnostic test). The 75g oral glucose tolerance test, as recommended by the WHO, is used for diagnosis in borderline cases or for academic studies. A plasma glucose concentration ≥ 11.1 mmol/L at two hours following oral glucose confirms the diagnosis (1).

There are many complications that are associated with diabetes. These complications arise chiefly from disruption of the vascular system leading to ischaemia. The consequence is macrovascular and microvascular abnormalities that affect vital organs leading to severe morbidity even death. The common complications are retinopathy, nephropathy, neuropathy and foot gangrene. A combination of poor circulation and neuropathy makes the foot readily vulnerable to injury and infection. The result is usually a mixed blend of ulceration, infection and gangrene (Figures 1 and 2).

Neuropathy causes insensitivity to pain, heat and cold. The patients therefore, develop minor cuts, scrapes, blisters, or pressure sores that they are not aware of and therefore, seek no attention. Poor circulation results in dryness and swelling of the foot, the consequence being ulceration, infection, gangrene or any of them in combination. Neuropathy may also cause deformities such as bunions, hammer toes, and Charcot's feet. These deformities further predispose to injury. Neuropathy affects about 60-70% of people with DM (2). Diabetics tend to suffer immunosuppression due to reduced neutrophil activity. Infection therefore, occurs quite easily so that minor conditions like ingrown toenail and callosities flare up into limb and life threatening infections. Twenty five percent of the diabetic population in USA will develop foot problems while diabetes is the leading cause of foot and leg amputation in the elderly (>65 years) (2). Surgeons are called in to manage the foot problems when they occur. Our practice is usually either to debride an ulcer or amputate the limb or part of it. Limb saving procedures such as re-vascularising procedures are uncommon. Mortality in patients with diabetic foot has been observed in many studies to be higher than the general population of hospital patients (3). This is due to the associated co-morbidity arising from complications of DM; the common ones being ischaemic heart disease, septicaemia, nephropathy and hypertension.

This study was conducted to identify the key predictors of mortality in these patients in our locality and to find out if these predictors are modifiable so as to reduce mortality.

MATERIALS AND METHODS

This is a retrospective study of 95 in-hospital patients with diabetic foot disease (DFD). The patients were

picked from records of 830 patients who were admitted at The Mombasa Hospital, Mombasa, Kenya with diabetes mellitus between January 2001 and December 2005. The patients included in the study were those with foot infection, foot ulcers, foot gangrene or any combination in a known diabetic patient. Patients with intermittent claudication or neuropathic symptoms without ischaemic changes to the foot were not included. Also not included were 37 patients who were found not to have been fully investigated as to fulfill the requirement of the study. A pro-forma was prepared in an excel page to pick up data from the records. In this form we filled the patients name, sex and age, dates of admission and discharge and the diabetic foot condition. The surgical procedure performed where applicable and the concurrent medical conditions (such as hypertension, asthma, angina etc) were recorded in different columns. All the investigations done were recorded and the results obtained.

The key investigations were urinalysis, haemogram, blood sugars, urea and electrolytes, lipid profile, ECG, chest X-ray and colour arterial Doppler of both lower limbs. The outcome was simply recorded as discharged or died. The cause of death was not sought as in many cases there was no post mortem done.

RESULTS

Ninety five out of 132 cases of DFD were included in this study. Figure 3 shows the age distribution of the diabetic foot patients as compared to the hospital diabetic population in the study period. The incidence of diabetes mellitus peaks in the 6th decade while that of the diabetic foot peaks in the 8th decade. Figure 4 shows the age distribution between the sexes. The patients were aged between 40-90 years with the mean females age of 65 years while the mean age for the males was 58 years.

Table 1

Outcome of treatment for various foot conditions

Procedure	Total	Discharged	Died	(%)
Amputations	25	18	7	28
Surgical toilet	49	46	3	6
Non-operative treatment	21	19	2	10
Total	95	83	12	13

Figure 1

Dry foot gangrene in a patient with diabetic foot. Transtibial amputation was done in this case

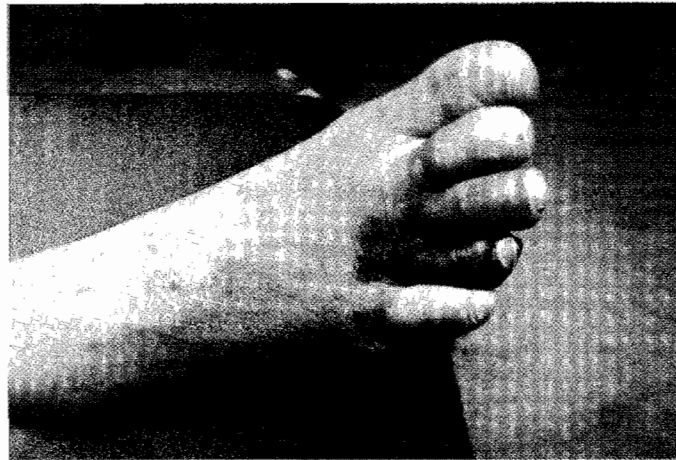


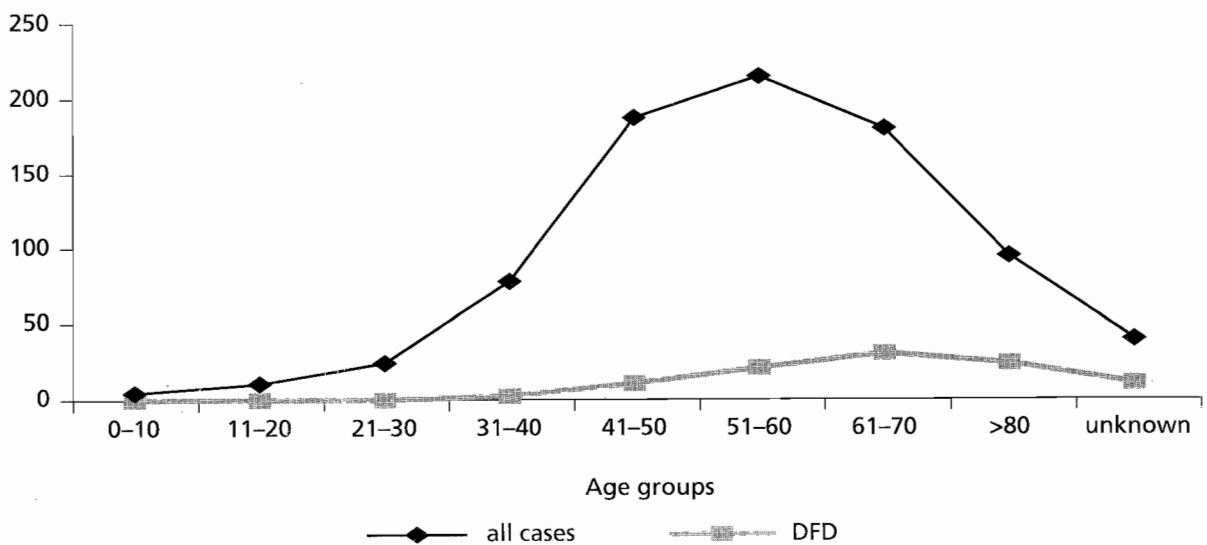
Figure 2

Foot of a diabetic patient who presented with wet gangrene, indicating infection with a vascular insufficiency



Figure 3

Age distribution of the diabetic foot patients as compared to the hospital diabetic population in the study period



There were 66 males and 29 females (a ratio of about 2:1). Figure 5 shows the co-morbidity conditions associated with diabetic foot disease contrasted with the co-morbidity of the hospital diabetic population in the study period. The most common co-morbid conditions in association with diabetic foot were found to be infection (75%), ischaemic heart disease (42%), hypertension (25%), and renal insufficiency (25%). Figure 6 shows the results of various investigations, contrasting the occurrence of abnormal measurements in the study population with those of the patients within the study that later died. Ninety three percent of the patients (100% of the dead) had high blood sugars

and another 79% (83% of the dead) had leucocytosis (WBC count of >11,000 K/UL). The other significant finding was that 49% of these patients showed reduced arterial flow in the arterial Colour Doppler of the affected lower limb (100% of the dead). Thirty eight percent of these patients showed high cholesterol levels (75% of the dead) while 29% had abnormal urinalysis (42% of the dead). Twenty eight percent had an abnormal ECG (75% of the dead) indicating some form of myocardial ischaemia. Creatinine was raised in 17% (67% of the dead) and 11% had an abnormal chest X-ray 50% of the dead).

Figure 4

Age distribution between the sexes. Please note that the peak age for the male's was the 7th decade while the female's peak was in the 8th decade

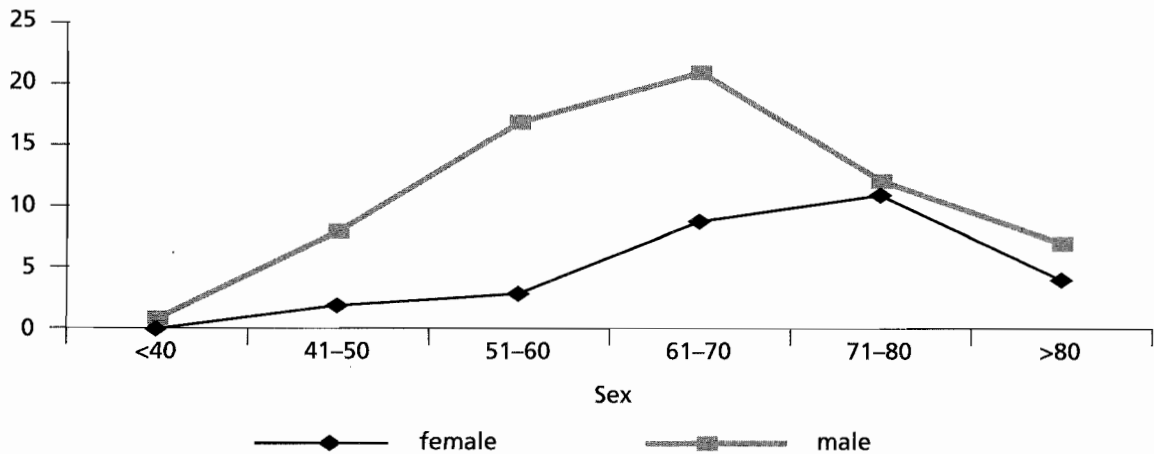
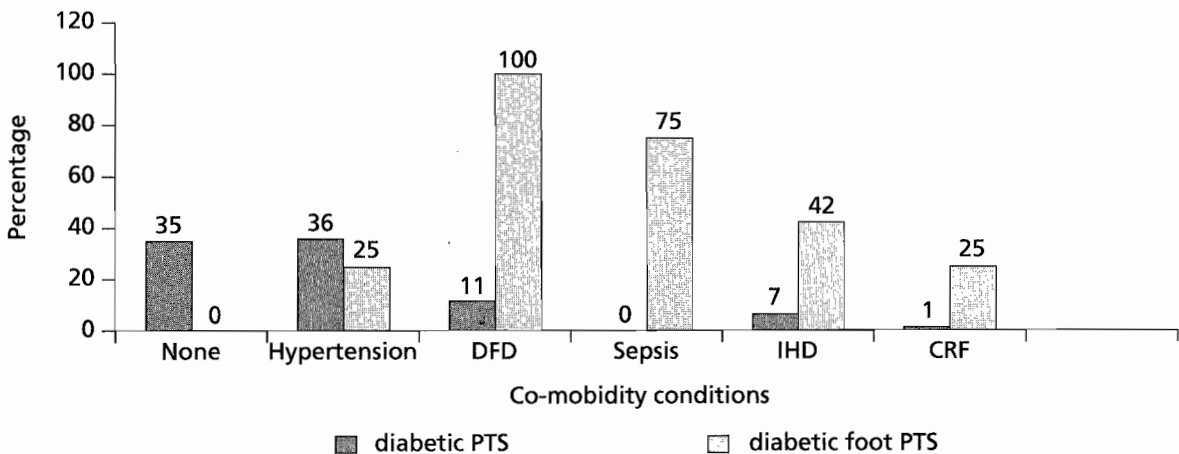


Figure 5

Co-morbidity conditions associated with diabetic foot disease contrasted with the co-morbidity of the hospital diabetic population in the study period



HT = Hypertension, IHD = Ischaemic heart disease, CRF = Chronic renal failure and DFD = Diabetic foot disease

The various types of foot conditions that were encountered in the study are shown in Figure 7. The most common condition was foot gangrene (34%) followed by diabetic foot ulcer (29%). Cellulitis (19%) and foot abscesses (superficial and deep) constituted 18%. Figure 8 shows the surgical procedures that were done either under general or spinal anaesthesia. Forty nine (52%) of patients had surgical debridement followed by daily dressings,

and some skin grafting was done later. Twenty five patients (26%) had some form of amputation (partial on the foot or transtibial). The 21 cases of superficial infection (cellulitis) were treated non-operatively. The outcome is shown in Table 1. Overall 12 patients (13%) died. Out of the 25 amputations, seven died (28%). Only three (6%) of those who underwent surgical debridement died.

Figure 6

Results of various investigations, contrasting the occurrence of abnormal measurements in the study population and the patients who later died

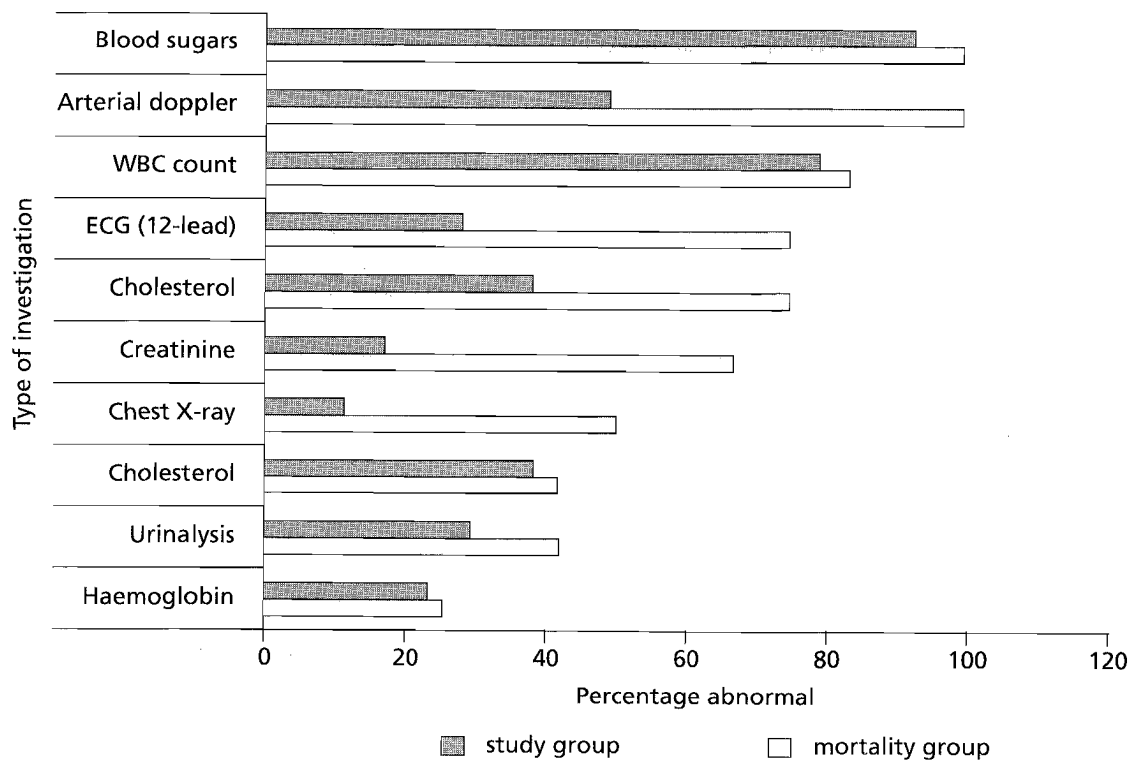


Figure 7

Occurrence pattern of conditions forming the diabetic foot syndrome

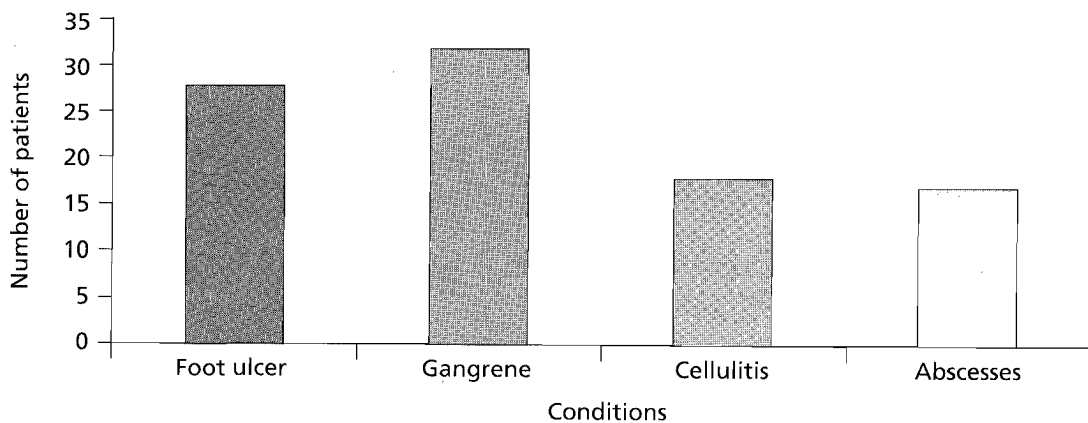
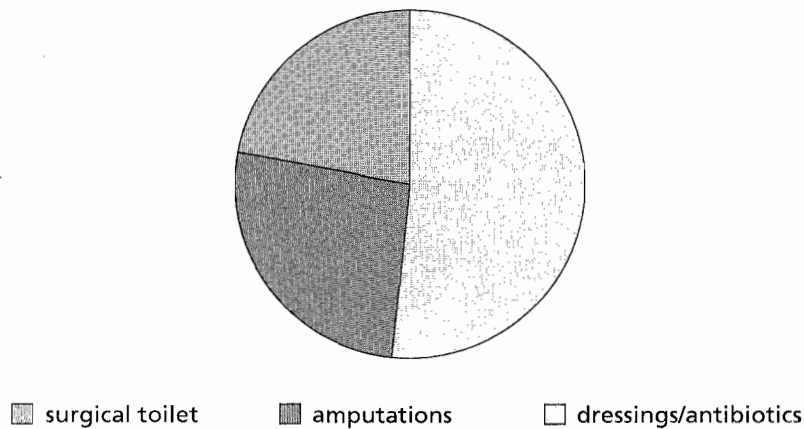


Figure 8

Surgical procedures carried out. Twenty six percent of the patients had some form of amputation



DISCUSSION

The study aimed at examining those risk factors found in patients with diabetic foot that maybe used to predict mortality. The secondary aim was to find if the same factors affect healing and therefore would assist in determining the type of intervention necessary. This part of the study is ongoing and the results will be published later.

This study shows that DFD occurs in the elderly diabetic with a peak age between 60-70 years in our urban population. The study compares very well with a study in a similar population conducted by Ohene-Yeboah in Kumasi, Ghana (4) and with studies in other populations (5). In our study, the females had the disease at an older age than the males. Bertoni *et al* have shown that women have a lower risk of gangrene and amputation than men (6). In this study the most common foot condition was foot ulcer infection (37%), with or without ulceration. This was superficial or deep-seated abscesses. Other studies have reported diabetic foot ulcer as the most common finding (2,6). Foot ulcers in this study came a distant third (29%). Sepsis was followed by gangrene that may affect a single toe, the whole foot or foot and leg (34%). In a large number of cases there were both infection and gangrene. This may be explained by the fact of a foot ulcer that is unrecognised or that is ignored because they are painless. Early diagnosis of peripheral neuropathy by clinical examination and by nerve conduction velocity tests will help in warning the patient of the impending danger and hence care of the foot

and of the ulcers when they occur. In this study the prevalence of neuropathic feet was not examined, as the records were missing on the same. Recent studies have shown a correlation of neuropathy, foot ulcers and peripheral vascular disease with increased mortality in diabetic patients (6). Foot care in patients with diabetes especially as they get older cannot be over emphasised.

The overall mortality in this study was 13%. This compares well with other studies (4,5). In the study the peri-operative mortality associated with diabetic foot was 28%. This is high when compared to other studies that report mortality rates of less than 10% (5,6). The lower mortality rates from the developed world indicate increased level of medical care (including revascularisation surgery) and increased patient awareness and foot care programmes. Amputation itself doubles mortality (3). The difference in mortality between the men and women was not assessed, as the numbers were too small for statistical comparison. However, in other studies women are reported to have a lower risk of gangrene and amputation than men (6). Diabetes is also associated with increased comorbidity especially hypertension, ischaemic heart disease, renal insufficiency, anaemia and chronic infections.

In this study we have shown that uncontrolled diabetes is associated with increased mortality and therefore, high blood glucose levels is a predictor of mortality. This is corroborated by other studies that have shown that persistent hyperglycaemia increases mortality in patients with diabetic foot

(6,7), although other studies report generally no change of mortality by glycaemic control (8).

High WBC count was also highly prevalent in this study group. This was assumed to indicate inflammation (sepsis) either of the foot or elsewhere e.g. chest (50% of the patients who died had an abnormal CXR). However, a high WBC count show no correlation as a predictor of high mortality as reported by Tentolouris *et al* (5).

Dyslipidaemia is associated with the development of vascular disease. It has also clearly been shown that patients with diabetes are predisposed to macrovascular disease (coronary heart disease, stroke and peripheral vascular disease) and microvascular (neuropathy, retinopathy and nephropathy). The typical dyslipidaemia of Type 2 diabetes is an increase in circulating triglyceride and a decrease in HDL cholesterol levels. The severity of the dyslipidaemia is predictive of vascular disease (1,7). In this study 75% of all the patients who died had elevated total cholesterol.

High creatinine levels indicating significant renal dysfunction have been associated with high mortality in this study. This compares well with other studies (1,5). In fact prevention of nephropathy has been quoted as significant modifiable factors. In this study, about 42% of the patients who died had proteinuria and about 25% had hypertension, indicating high prevalence of nephropathy.

In this study too, 75% of the patients who died showed ischaemic changes on ECG, indicating coronary heart disease. In a study of US veterans ischaemic heart disease was the most common complication of diabetes followed by stroke. They also showed cardiovascular disease is associated with increased mortality in patients with diabetic foot (6). Moreover, a WHO multi-centre study of vascular disease in diabetes found the key risk factors for amputation to include high glucose, high triglyceride, and retinopathy (3). Cardiovascular disease is the leading cause of death in patients with diabetic foot (5).

Lower extremity arterial disease has been considered to be among the most important reasons for amputation in individuals with and without diabetes. Arterial colour Doppler is used to visualise the main arterial system of the limb. In this study 49% of all the patients had an abnormal arterial Doppler of the affected limb, while all the

patients that died had an abnormal arterial flow. A more accurate assessment is that of cutaneous arterial flow. Little distinction is usually made between the relative adequacy of cutaneous circulation and its relationship with major arterial circulation. The literature regarding healing of surgical amputation sites strongly suggests that parameters that reflect principally arterial perfusion provide different clinical information regarding cutaneous circulation than more direct techniques for assessing this compartment (3,9, 10). Furthermore, there is evidence that adequate cutaneous perfusion depends not only on the underlying arterial circulation but may be critically influenced by other factors, including skin integrity, mechanical effects of repetitive pressure, and presence of tissue edema (11). Cutaneous blood circulation (measured using transcutaneous oxygen tension, TcPO₂), reflects oxygen diffusion across the skin barrier resulting from tissue equilibration after capillary delivery and tissue utilisation at the dermis (12). TcPO₂ values associated with below knee amputation healing potential suggest that values <20 mmHg are associated with poor healing, values of 20-40 mmHg are associated with intermediate healing potential and values >40 mmHg are associated with high likelihood of healing.

CONCLUSION

This study clearly shows that high blood sugars, high WBC count, reduced arterial flow as shown by an arterial Doppler scan, an abnormal ECG and high creatinine levels are indicators of increased morbidity and high mortality. These characteristics should also help in the assessment of risk and in turn enable the clinician to adequately inform the patient and/or relatives of the relative risks and potential outcome of the disease and the anticipated procedure. In addition the management of this condition calls for a multidisciplinary team approach. Larson *et al* (13) have shown decreased incidence of major amputation and mortality as a consequence multidisciplinary team approach. There is no reason to rush these patients for amputation or other surgical procedures before they are thoroughly checked and the concurrent conditions managed adequately.

REFERENCES

1. Johnston D.G., Robinson S. and Forbes S. What should we measure in the diabetic patient and how does this respond to therapy? *Brit. J. Clin. Pharm.* 2002; **54**: 81.
2. Muha J. Local wound care in diabetic foot. complications: aggressive risk management and ulcer treatment to avoid amputation. *Postgrad. Med.* 1999; **106**: 97-102.
3. Chaturvedi N., Stevens L.K., Fuller J.H., Lee E.T. and Lu M. Risk factors, ethnic differences and mortality associated with lower-extremity gangrene and amputation in diabetes. The WHO multinational study of vascular disease in diabetes. *Pub. Springer Berlin/Heidelberg, ISSN 0012-186X (paper)*. 2001; **44**:
4. Ohene-Yeboah M. Major limb amputation in Kumasi, Ghana. Department of Surgery, School of Medical Sciences, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana. *surgksi@ghana.com*.
5. Tentolouris N., Al-Sabbagh S., Walker M.G., Boulton A.J.M. and Jude E.B. Mortality in diabetic and non-diabetic patients after amputations performed from 1990 to 1995. *Diabetes Care*. 2004; **27**: 1598-1604.
6. Bertoni A.G., Krop J.S., Anderson G.F. and Brancati F. Diabetes-related morbidity and mortality in a national sample of U.S. elders. *Diabetes Care*. 2002; **25**: 471-475.
7. Uusitupa M.I.J., Niskanen L.K. Siltonen O., Voutilainen E. and Pyörälä K. Ten-year cardiovascular mortality in relation to risk factors and abnormalities in lipoprotein composition in type 2 (non-insulin-dependent) diabetic and non-diabetic subjects. *Diabetologia Issue*. 1993; **36**: 1175-1184.
8. King P., Peacock T. and Donnelly R. The U.K Prospective Diabetes Study (UKPDS): Clinical and therapeutic implications for type 2 diabetes. *Brit. J. Clin. Pharm.* 1999; **48**: 643.
9. Cina C., Katiamouris A., Megerman J. and Brewster D.C. Utility of transcutaneous oxygen tension measurements in peripheral arterial occlusive disease. *J. Vasc. Surg.* 1984; **1**: 362-371.
10. Oishi C.S., Fronck A. and Golbranson F.L. The role of non-invasive vascular studies in determining levels of amputation. *J. Bone Joint Surg.* 1988; **70**: 1520-1530.
11. Christensen K.S., Falstie-Jensen N., Christensen E.S. and Brochner-Mortensen J. Results of amputation for gangrene in diabetic and non-diabetic patients. *J. Bone Joint Surg.* 1988; **70-A**: 1514-1519.
12. Burgess E.M., Macsen. T.A., Grassi R.W. and Simmons C.W.R. Segmental transcutaneous measurement of P02 in patients requiring below knee amputation for peripheral vascular insufficiency. *J. Bone Joint Surg.* 1982; **64**: 378-382.
13. Larsson J., Apelqvist J., Agardh C.D. and Stenstrom A. Decreasing incidence of major amputation in diabetic patients: A consequence of a multidisciplinary foot care team approach? *Diabet. Med.* 1995; **12**: 770-776.