CHARACTERISTICS OF PATIENTS WITH DIABETIC FOOT ULCER DISEASE BETWEEN 2001 – 2005 IN A PRIVATE HOSPITAL, IN MOMBASA, KENYA.

Dr. J. M. Muthuuri, MMed (Surg.), Trauma (UK), FCSECSA
Consultant Surgeon

Correspondence to: Dr. J. M. Muthuuri, P.O. Box 84074 Mombasa, KENYA

Abstract

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

Design: A 5-year retrospective study.

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

Subjects: 95 patients with diabetic foot ulcer 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.

Measurement: Radiological (Doppler studies), ECG, and laboratory evaluations

Results: The majority of the men were between 50-70 years (76%) while the majority of the females were between 60-80 years (69%), with the mean age for men 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, characterized 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 2 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 (Figure 1, 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. 25% 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.

I have conducted this study 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 ulcer 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 are 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.

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 are included in this study. Figure 3 Show 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 female age of 65 years while the mean age for the males was 58 years. 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 commonest 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 show 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 leucocytosiss (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). 38% of these patients showed high cholesterol levels (75% of the dead) while 29% had abnormal urinalysis (42% of the dead). 28% 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).

The various types of foot conditions that were encountered in the study are shown in Figure 7. The commonest condition is 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. 49 (52%) patients had surgical debridement followed by daily dressings, and in some skin grafting was done later. 25 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 Figure 9. Overall 12 patients (13%) died. Out of the 25 amputations 7 died (28%). Only 3(6%) of those who underwent surgical debridement died.

DISCUSSION

We aimed to examine those risk factors found in patients with diabetic foot that may be 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 Dr. Yeboah M.O., 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 men. Bertoni A.G et al have shown that women have a lower risk of gangrene and amputation than men[6]. In this study the commonest foot condition is foot ulcer infection (37%), with or without ulceration. This was superficial or deep seated abscesses. Other studies have reported diabetic foot ulcer as the commonest finding[2, 6]. Foot ulcers in this study come a distant third (29%). Sepsis is 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 unrecognized 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 emphasized.

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 is 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 revascularization surgery) and increased patient awareness and foot care programs. 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 co-morbidity 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 are 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 Nicholas T. 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 a significant modifiable factor[5]. 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 commonest 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 visualize 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 utilization 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 have shown decreased incidence of major amputation and mortality as a consequence multidisciplinary team approach[13]. 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.

Figure 1 Foot Gangrene.

Figure1. Shows dry foot gangrene in a patient with diabetic foot. Transtibial amputation was done in this case.

Figure2. Severe foot infection and gangrene

Figure2. Shows the foot of a diabetic patient who presented with wet gangrene, indicating infection with a vascular insufficiency.

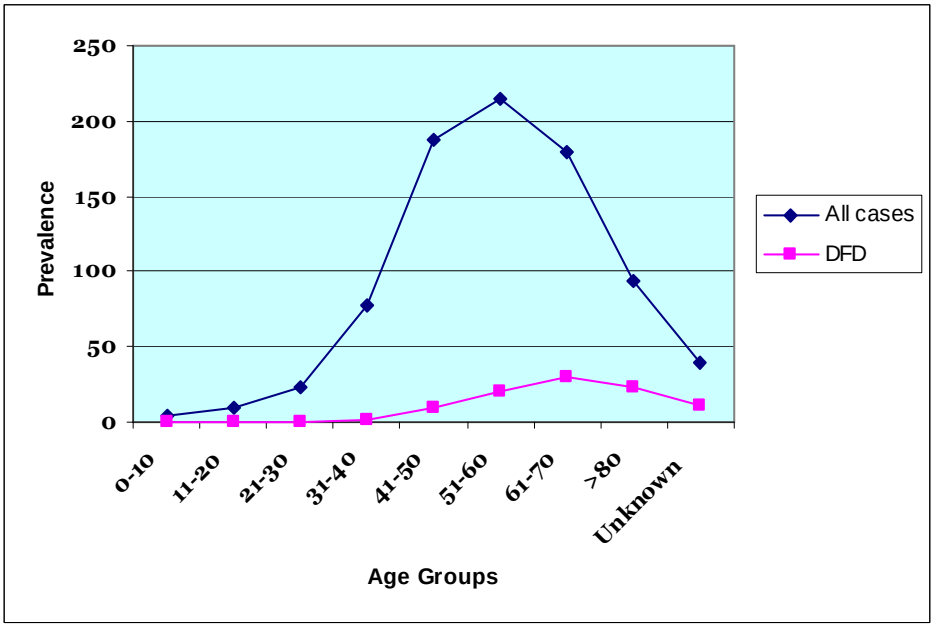


Figure 3 Show the age distribution of the diabetic foot patients as compared to the hospital diabetic population in the study period.

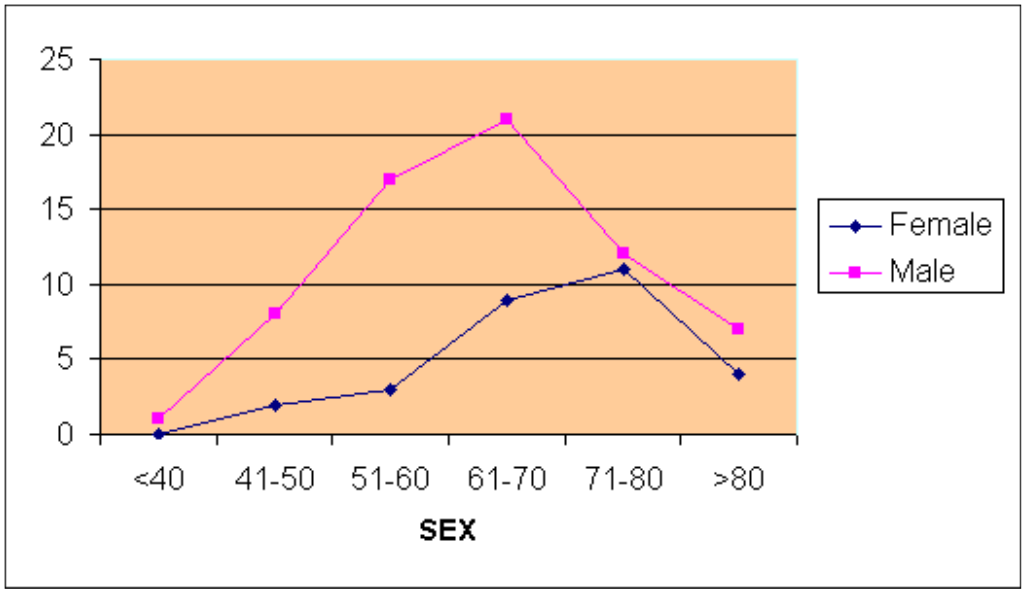
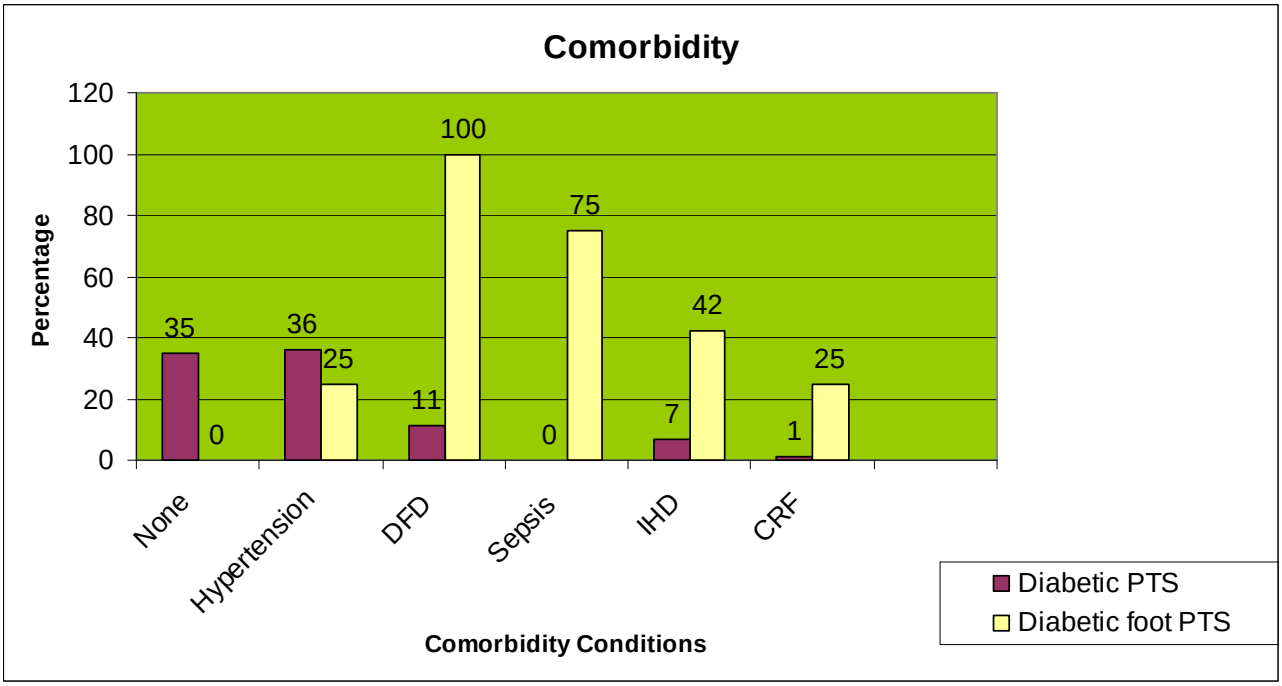


Figure 4 shows the age distribution between the sexes. Please note that the peak age for the Male's is the 7th decades while the female's peak in the 8th decade.



Legend

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

Figure 5 show the co-morbidity conditions associated with diabetic foot disease contrasted with the co-morbidity of the hospital diabetic population in the study period.

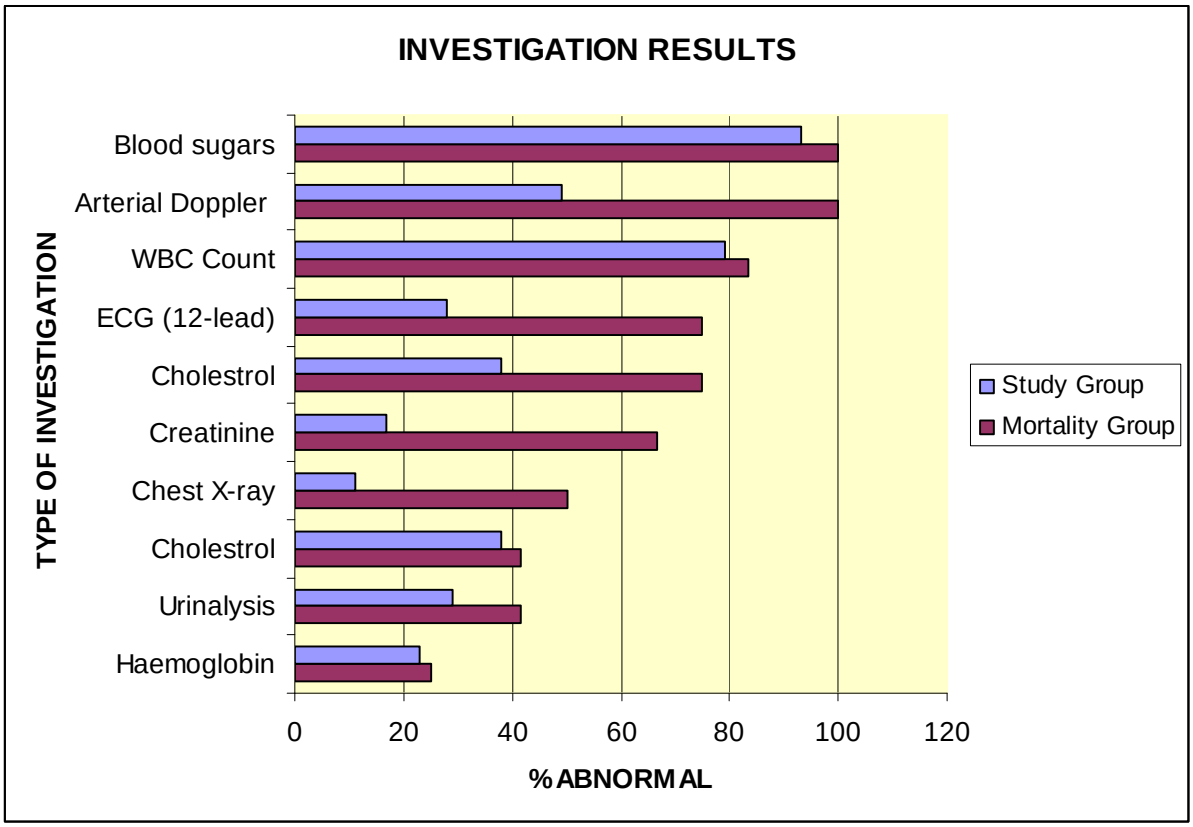


Figure 6 show the results of various investigations, contrasting the occurrence of abnormal measurements in the study population and in the patients who later died.

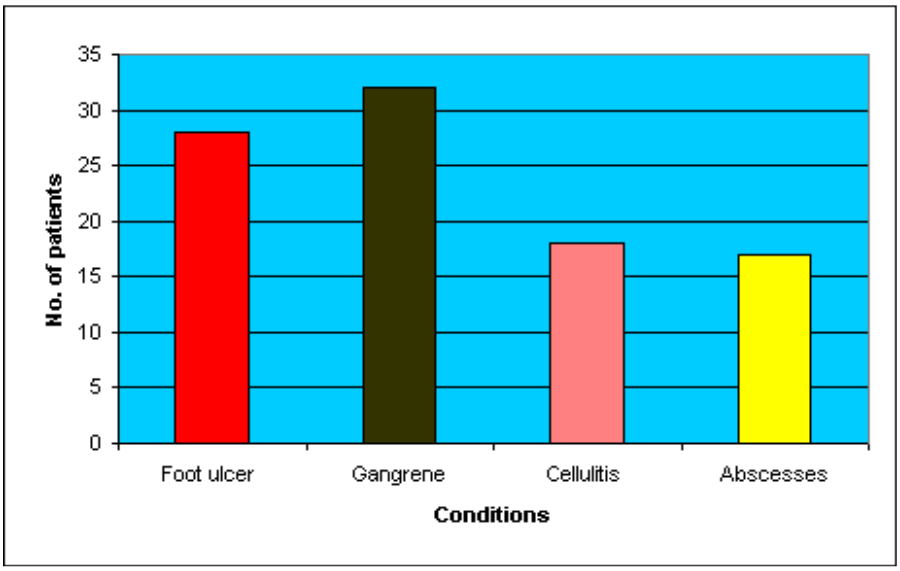


Figure 7 shows the occurrence pattern of conditions forming the diabetic foot ulcer syndrome

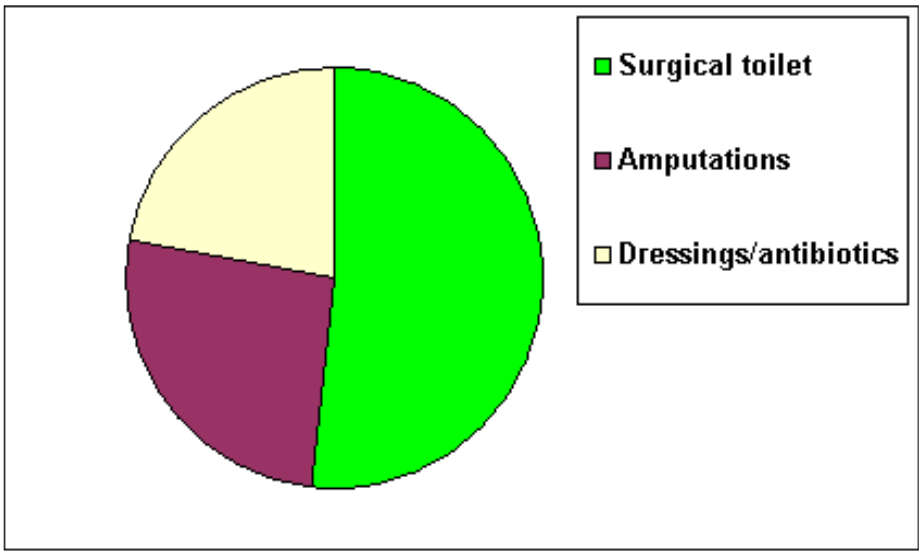


Figure 8 shows the surgical procedures carried out. 26% of the patients had some form of amputation

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

Figure 9 show the outcome of treatment for various foot conditions. The end points are discharge from hospital or death.

REFERENCES

1. Johnston D. G., Robinson S. & Forbes S.
What should we measure in the diabetic patient and how does this respond to therapy? Brit J Clin. Pharm 2002; 54 (1): 81

2. Muha J. Local wound care in diabetic foot complications: aggressive risk management and ulcer treatment to avoid amputation.
Postgrad. Med. 1999; 106(1): 97-102

3. Chaturvedi N., Stevens L.K., Fuller J.H, Lee E.T., 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/Heidlelberg, ISSN 0012-186X (paper) Sept. 2001:44 (14).

4. Michael Ohene-Yeboah, 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., Andrew J.M. Boulton, and Jude E. B., Mortality in Diabetic and Nondiabetic 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., NiskanenL. K., Siitonen.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: 36:11 (1175 – 1184).

8. King P., Peacock I. and Donnelly R. The U.K Prospective Diabetes Study (UKPDS): Clinical and therapeutic implications for type 2 diabetes. Brit J of Clin Pharm 1999: 48 (5): 643.

9. Cina C, Katsamouris A, Megerman J, Brewster DC: Utility of transcutaneous oxygen tension measurements in peripheral arterial occlusive disease. J. Vasc. Surg 1984: 1:362-71

10. Oishi CS, Fronek A, Golbranson FL: The role of non-invasive vascular studies in determining levels of amputation. J Bone Joint Surg 1988: 70-A: 1520-30

11. Christensen KS, Falstie-Jensen N, Christensen ES, Brochner-Mortensen J: Results of amputation for gangrene in diabetic and nondiabetic patients. J Bone Joint Surg 1988:70-A: 1514-19

12. Burgess E.M. Marsen T.A. Grassi R.W. Simmons C.W. Robert. Segmental transcutaneous measurement of PO2 in patients requiring below knee amputation for peripheral vascular insufficiency. J Bone and joint Surg 1982: 64, 378-382.

13. Larsson J, Apelqvist J, Agardh CD, Stenstrom A. Decreasing incidence of major amputation in diabetic patients: a consequence of a multidisciplinary foot care team approach? Diabet. Med. 1995 Sep; 12(9):770-6.