

Factors Related to Adverse Outcome in Inpatients With Diabetic Foot

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Summary

Sixty inpatients with diabetic foot were studied prospectively at the Orthopaedic wards of Hospital Kuala Lumpur. Data was evaluated to document the patient profile and the factors that were associated with a major amputation (either above knee or below knee) of the lower limb. Factors that were associated with increased risk of amputation were a low education level, manual occupation, poor foot care, peripheral vascular insufficiency of the lower limb, insulin dependence, anaemia and leucocytosis. However only anaemia, leucocytosis and hyperglycaemia were statistically significant in predicting a more adverse surgical procedure. This study recommends that foot care awareness and practice is important. This can be effectively dealt with at specially organised, multi disciplinary Diabetic Foot Clinics.

Key Words: Diabetic foot, Patient profile, Amputations, Outcome

Introduction

Diabetes mellitus (DM) is a chronic non-communicable disease that is often incapacitating. It affects over 16 million people in the U.S., including 15% of those over 65 years. In Malaysia, the prevalence of diabetes mellitus has increased from 6.3% in 1986¹ to 14.6% in 1996². Diabetic foot complications were responsible for 12% of all admissions attributed to diabetes in Malaysia, which in turn comprised 17.9% of all admissions at Hospital Kuala Lumpur³. Five point six percent of diabetics attending outpatient clinic at Hospital Sultanah Aminah, Kelang had foot lesions⁴.

Quality of life is poor for the patient with a chronic foot ulcer, and worse still after a major amputation. The physical and psychological burden to the patient, their family and the community is enormous, making

prevention of foot complications an important aspect of diabetic care. Effective prevention of foot complications depends on the appreciation of factors that put the foot at risk, factors that precipitate it, and those that contribute to the deterioration of foot, with the aim of reducing adverse outcome⁵. The Diabetes Control and Complications Trial reported marked decrease in rates of progression of neuropathy, retinopathy, and nephropathy with tight blood sugar control⁶. However, little is understood about the pathophysiology of the diabetic foot disease, despite the numerous theories that exists to explain it⁷.

The objectives of this study were to determine the profile of patients at Hospital Kuala Lumpur admitted with diabetic foot disease, and to determine the factors, if any, that were possibly associated with an adverse outcome of major amputation.

Materials and Methods

Sixty consecutive patients who were admitted to the orthopaedic wards of Hospital Kuala Lumpur were studied prospectively. They were referred from the diabetic foot clinic, outpatient and peripheral clinics, Accident and Emergency Department, units within Hospital Kuala Lumpur, and other referring hospitals and private medical practitioners. Each patient was interviewed and examined by the first investigator, and subsequently independently by the second investigator. Where a discrepancy existed, a consensus between both investigators was determined. Classification of Diabetes was determined along the lines of the 1979 NDD consensus conference and study group⁸.

Data that was specifically collected were basic demographic data, diabetic data, socioeconomic status, foot care practice, foot syndrome profile, vascular status, haematological parameters, basic biochemical parameters, and treatment outcomes. For simplicity, foot syndrome profile was classified by site and type of lesion at presentation; site classified into 1.toe, 2.metatarsal head, 3.midfoot, 4.heel, and 5.ankle; while type was classified as 1.cellulitis, 2.ulcer, 3.abscess and 4.gangrene. Vascular data was evaluated by a portable hand held ultrasonic doppler transducer with 8mHz probe. The character of the signal was evaluated as normal (triphasic) or abnormal (monophasic or absent). Surgical treatment was classified as 1.debridement or incision and drainage, 2. local foot sparing amputations (toe, transmetatarsal and ray), and 3. major amputations, below knee (BKA) and above knee (AKA). All patient profiles were statistically evaluated to determine the factors, if any were associated with the outcome of a major amputation.

Statistical testing was performed using Statistical Package for Social Sciences (SPSS) version 7.5. The analysis of variance (ANOVA) test was used and a p-value of <0.05 was taken to be statistically significant.

Results

The sixty patients age ranged between 29 to 75 years. The majority were in their sixth to seventh decade. Forty-one (68.3%) patients were male and nineteen

(31.7%) were female. Seven patients had IDDM while 53 had NIDDM (Table I). Duration of diabetes before foot syndrome appeared in IDDM was 8.3 years; while in NIDDM it was 13.7 years. Eleven (18.3%) were only diagnosed as having diabetes on presentation of their foot problem. 81.7% had a formal education level of primary schooling or less (Table II). Sixty one point seven percent were manual workers (Table III); and 64.6% earned less than RM1000 per month (Table IV)

Table I
Type of Diabetes And Age at Presentation

Type	n	Mean Age (years)	Range (years)
IDDM	7	48 sd 11.2	29 - 65
NIDDM	53	58.6 sd 9.6	31 - 75

Table II
Formal Education Level

Level Achieved	n	
None	19	31.7%
Primary	30	50.0%
Lower Sec	8	13.0%
Upper Sec	3	5.6%
Tertiary	nil	0.0%

Table III
Occupation

Type	n	
Manual	37	61.7%
Non-Manual	11	18.3%
Home-based	12	20.0%

Table IV
Income per Month

Amount	n	
<RM500	6	12.5%
RM500 - 999	25	52.1%
RM1000 - 1499	14	29.2%
≥RM1500	3	6.3%

*based on 48 patients who were gainfully employed

Of the known diabetics, 5 (10.2%) were on diet control, 37 (75.5%) were on oral hypoglycaemics and 7 (14.3%) were on insulin control. Family history was present in 85.7% of IDDM and 69.8% of NIDDM. Twenty-five (41.7%) were smoking with duration of smoking ranging from 3 to 50 years (mean=24.8, sd=14.2). Number of cigarettes smoked daily ranged from 2 to 50 (mean=17.28, sd=12.0).

Blood sugar was elevated in 47 (78.3%) of patients on admission, normal in 12 (20%), and low in 1 (1.7%) patient. Random blood sugar levels on admission ranged from 1.9 to 30.3mmol/L (mean=15.3, sd=6.3).

Only 30 (50%) were aware of the importance of appropriate care to prevent and / or delay the onset of foot lesions. Good foot practice scores (4 - 5) was seen in only 3 patients (5%), while fair foot practice scores (2 - 3) was seen in 20 (33.3%); and poor scores (0 - 1) was seen in 37 (61.7%) patients (Table V). Thirty eight patients

(63.3%) wore shoes, 13 (21.7%) went around barefooted; and 9 (15%) wore slippers or sandals for most of the time they were foot borne. Of the 38 who wore shoes, 19 (50%) always wore socks, 16 (42.1%) never wore socks, and 3 (7.9%) occasionally wore socks.

Toes were the commonest site of involvement (Table VI); and the commonest type of lesion seen were ulcers and abscesses accounting for 30 percent each (Table VII). Thirteen (21.7%) patients had a previous lesion on the foot responsible for admission. Nine (15%) had already undergone a previous amputation on either leg. Forty-six (76.7%) patients were unaware how and when their foot lesion commenced. Only 14 (23.3%) admitted to a cause of injury or trauma. Duration of lesion was 1 month or less in 52 (86.7%) patients, 3 to 6 months in 2 (3.3%) patients and more than 6 months in 1 patient. Among those who had a duration of 1 month or less, the majority of patients were admitted to hospital 6 - 15 days after noticing their foot lesion.

Table V
Foot Care Awareness and Practice Scores

Awareness and Practice Item		n	
Q1. Washed feet daily with mild soap and lukewarm water		9	15.0%
Q2. Gently drying feet after washing		44	73.3%
Q3. Check feet every day for lesions		5	8.3%
Q4. Applied moisturizing cream or lotion to feet daily		9	15.0%
Q5. Exercised daily		15	25.0%
Scores Achieved	n		Rating
0	14	23.3%	poor
1	23	38.3%	poor
2	15	25.0%	fair
3	5	8.3%	fair
4	1	1.7%	good
5	2	3.3%	good

Table VI
Site of Lesion

Site	n	
Toes	32	53.3%
Metatarsal head	8	13.3%
Mid foot	13	21.6%
Ankle	6	10.0%
Heel	1	1.7%

Table VII
Type of Lesion

Type	n	
Cellulitis	7	11.7%
Ulcer	18	30.0%
Abcess	18	30.0%
Gangrene	17	28.3%

FACTORS RELATED TO ADVERSE OUTCOME IN INPATIENTS WITH DIABETIC FOOT

Twenty-three (38.3%) patients were being treated by General Practitioners prior to admission for their diabetes. 22 (36.7%) were on self treatment; 4 (6.7%) were on traditional medical follow up and only 11 (18.3%) were on government clinic or hospital follow up.

Vascular examinations were conducted in 36 limbs affected by diabetic foot syndrome; and 30 contralateral limbs, 6 having been subject to amputation prior to this admission. Major limb amputations (BKA and AKA) were performed in 12 (20%) patients. Foot sparing surgery (including toe disarticulation and ray amputation) were performed in 19 (31.7%) patients; and debridement (including incision and drainage) were done in 29 (48.3%) of patients.

Evaluation of categorical and ordered variables showed that a major amputation (BKA or AKA) was associated with lower level of formal education, manual type of occupation, IDDM type of diabetes, gangrene type of lesions and lower limb vascular insufficiency (Table VIII).

Evaluation of all continuous variables showed that a major amputation (BKA or AKA) was significantly associated with low haemoglobin (Hb) in males, low red blood cell count in males, and a high white blood cell

Table VIII
Major Amputation Requirement

* BKA or AKA Done during Same Admission		
A. Formal Education Level	No Education	31.6%
	Primary Level	16.7%
	Lower Sec.	12.5%
	Upper Sec.	Nil
	Tertiary	Nil
B. Occupation Type	Manual	27.0%
	Home Based	16.7%
	Non Manual/ Professional	Nil
C. Diabetic Type	IDDM	28.6%
	NIDDM	18.9%
D. Type of Lesion	Gangrene	47.0%
	Abscess	16.0%
	Ulcer	5.6%
	Cellulitis	Nil
E. Doppler Signal	Peroneal	N=16.0%, AbN=84.0%
	Dorsalis Pedis	N=28.6% AbN=71.4%
	Posterior	N=71.4% AbN=28.6%
	Tibialis	

Table IX
Summary of Statistics

A. Income	Amputation	RM 780	
	Foot sparing/local procedure	RM 840	p=0.628
B. Duration of Lesion	Amputation	19.0 days	
	Foot sparing/local procedure	14.4 days	p=0.123
C. Education (years)	Amputation	2.58	
	Foot sparing/local procedure	4.39	p= 0.073
D. Hb concentration (male)	Amputation	9.91 g%	
	Foot Sparing/local procedure	12.20 g%	p=0.0014*
E. Red Blood Cells (male)	Amputation	3.65	
	Foot sparing/local procedure	4.39	p=0.024*
F. Total White Cells	Amputation	23.10	
	Foot sparing/local procedure	13.99'	p=0.0000*
G. Random Blood Glucose	Amputation	16.22 mmol/l	
	Foot sparing/local procedure	11.62 mmol/l	p=0.023*

*statistically significant at $p < 0.05$

count. Though not significant, a lower mean monthly income, shorter mean duration of formal education and a longer mean duration of lesion was associated with the outcome of a major amputation (Table IX).

Discussion

The majority of non traumatic lower extremity amputations are performed in diabetics^{9,10}. Individuals with diabetes have a 15 to 30 fold greater risk of lower extremity amputation¹¹ than non diabetics. There have been no previously published or known studies on the profile of diabetic foot patients, and the risk factors for major amputation in Malaysia. We studied the patient profile and factors associated with a major amputation (BKA or AKA) in patients admitted in Hospital Kuala Lumpur.

Factors that were associated with an amputation were male gender, low education level, manual occupation, lower income group, poor foot care practice, and peripheral vascular compromise. A low haemoglobin concentration and low red blood cell count in males, and an elevated white cell count were significantly associated with the need for major amputation.

The age of presentation, gender distribution and ratio of IDDM to NIDDM do not differ from major published series in USA¹², Italy¹³ and Thailand¹⁴. Patients who had IDDM presented on average 10 years earlier (mean age 48 years vs 58 years) than those with NIDDM; and had a shorter mean duration of known diabetes (8.29 years vs 13.74 years). Earlier onset of foot complications may reflect a more labile glycaemia and difficult control for IDDM with frequent hyperglycaemia which is a risk factor in the pathogenesis of diabetic foot^{13,14,15,16}. The larger proportion of patients with IDDM requiring major amputation (28.6%) compared with those with NIDDM (18.9%) requiring major amputation, though not statistically significant, displays this trend possibly exemplifying a more aggressive disease in IDDM.

Education is important and emphasis in this area may decrease the prevalence of diabetic foot. Eighteen point three percent were diagnosed as diabetic only on presentation of their foot problem. Low level or no

formal education was noted in a higher rate than the national population¹⁷ (81.7% vs 36.4%). This is also seen in Thailand¹⁴. This relatively low level of education could account for the lack of understanding of the importance and necessity of foot care practice and the poor foot care practice; indicated by low practice scores. In addition, 21.7% who despite being diabetic; went about barefooted. Of those who wore shoes, 42% did not wear socks, and lacked the benefit that socks provide against repeated microtrauma to the foot by friction with the inner surface of the shoe. 76.7% were unaware as to how or when their lesions started. This high rate is similar to other series¹⁸; and relates to the cumulative insidious nature of repetitive foot stresses and microtrauma, fissuring and cracking of the skin; leading to final breakdown and ulceration.

Toes are at the greatest risk from friction in the shoe wearing population¹⁸ (Table VI). However, in this study, 36.7% did not wear shoes; and probably suffered accidental puncture wounds frequently. This is depicted in the non random distribution in the sites of foot lesions.

The significance of anaemia is somewhat unclear at the present moment. It is well recognised in diabetic patients; but its association with diabetic foot complications has not been addressed. It is possible that diminished delivery of oxygen to the extremities can adversely impair healing in tissues. Only one study to date¹⁹ has reported this association of anaemia with need for major amputation.

High white cell counts were associated with need for amputation. This indicates advanced infection, and possible irreversible ischaemia and infarction. As it is significantly associated with adverse outcome, this parameter can serve as a guide for ablative surgery.

Factors associated with the need for a major amputation in Hospital Kuala Lumpur in diabetic foot inpatients are low education level, manual occupation, poor foot care, peripheral vascular insufficiency of the lower limb, insulin dependence, anaemia and leucocytosis; however only anaemia, leucocytosis and hyperglycaemia were statistically significant in predicting a more severe surgical procedure.

FACTORS RELATED TO ADVERSE OUTCOME IN INPATIENTS WITH DIABETIC FOOT

Increased foot care awareness and practice is paramount and may possibly avoid or delay the onset of diabetic foot lesions. It should be implemented through education, support and follow up of those at high risk. Furthermore, the correction of anaemia, possible revascularization of the affected limb and control of sepsis may reduce the need for major amputation.

This study evaluated the outcome of inpatients at a major tertiary public hospital. We did not evaluate the outcome in an outpatient setting or in a private medical facility setting. The patient profiles and outcomes may be very different at these facilities.

It is recommended that this close monitoring of cases at risk can be effectively done at specially organized, multi disciplinary run Diabetic Foot Clinics.

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