

FACTORS AFFECTING HEALING OF BELOW KNEE AMPUTATION

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ABSTRACT

Between January and December 1992, 54 diabetic patients with 60 below knee amputations performed in the Department of Orthopaedic Surgery O, Singapore General Hospital were available for evaluation. The average follow-up period was 16.3 months with a range of 13 to 24 months. Five patients had stump necrosis and above knee amputation was performed. Eight patients had partial stump necrosis and required debridement with or without secondary procedures. The other patients had uneventful stump healing which was defined as healing of the stump wound without complications and remained intact for at least 6 months after surgery. Absence of popliteal pulse, presence of central cardiovascular disease and absence of intraoperative skin flap bleeding were found to be associated with higher incidence of stump necrosis.

Keywords: below knee amputation, stump necrosis, adverse factors

SINGAPORE MED J 1996; Vol 37: 392-393

INTRODUCTION

Below knee amputation is a common procedure performed in diabetic patients for foot gangrene or uncontrolled foot infections. The healing of the stump may be complicated by stump necrosis. This complication has high morbidity as the patients need multiple debridements followed by secondary procedures or a higher level of amputation. The aim of our study is to evaluate factors that affect healing of below knee amputation stump. Such information helps in predicting the outcome of below knee amputation and deciding whether a higher level of amputation is required if the prognosis of below knee amputation healing is anticipated to be poor. By providing favourable factors and removing adverse factors, healing of the stump may be enhanced.

MATERIALS AND METHODS

Between January and December 1992, 58 diabetic patients had 64 below knee amputations (BKAs) performed in the Department of Orthopaedic Surgery O, Singapore General Hospital. Wound union of BKA was defined as uneventful healing of stump wound that remained intact for at least 6 months. Two patients (2 below knee amputations) died before 6 months follow-up, one patient (one BKA) was in a foreign country while another patient (one BKA) had residual infection involving the BKA stump and above knee amputation was performed after 3 days, leaving 54 patients with 60 BKAs available for evaluation.

Below knee amputation was performed in patients with diabetic foot gangrene or foot infection distal to the ankle joint.

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The severity of the diabetic foot was classified using the Wagner's classification (Table I). The standard long posterior flap technique was performed. The operations were performed by experienced surgeons. All cases had adequate clearance of the pathological process. Prophylactic antibiotics were given before induction of anaesthesia and continued for 48 hours after the surgery. The average follow-up period was 16.3 months, with a range of 13 to 24 months. The average age of the patients at the time of amputation was 64.9 years, with a range of 34 to 88 years. There were 22 males and 32 females. BKA was performed on the right leg in 25, the left leg in 23 and bilateral in 6 patients.

Table I - Wagner's classifications of diabetic foot

Grade	Number of legs
0-2	0
3	11
4	17
5	22
Total	60

A retrospective study was performed. The records of the patients were evaluated. Nine factors were analysed to determine which factors had influence on BKA healing. These factors were: 1) age of patients at the time of amputation [<65 vs >65 years], 2) duration of diabetes mellitus [<10 vs >10 years], 3) type of diabetes mellitus [insulin dependent vs non insulin dependent], 4) peripheral glove and stocking neuropathy [presence vs absence], 5) central cardiovascular disease [history of ischaemic heart disease and/or stroke vs no history], 6) popliteal pulse [presence vs absence], 7) intraoperative skin flap bleeding [presence vs absence], 8) haemoglobin [<10 vs >10 g/dL] and 9) lymphocyte count [<1.5 vs $>1.5 \times 10^3$ /mm]. The statistical analysis was performed by using the Fisher's Exact Test. P values of less than 0.05 were considered as statistically significant.

RESULTS

Of the 60 BKAs, 47 had uneventful healing. Five had stump necrosis and above knee amputation was performed at an average interval of 4.2 weeks and a range of 2 to 6 weeks. Eight had partial stump necrosis, of which four required stump revision with shortening of bone, three required wound debridement followed by secondary closure and the last one healed by secondary intention 8 weeks after debridement. In these 8 cases, the stump healed subsequently without complications.

Nine factors were evaluated to determine which factors would affect healing of the stump wound. The results of statistical analysis are summarised in Table II.

Table II - Results of statistical analysis

Factors	Total	Union	Failed	Fisher's test
<i>Age</i>				
< 65 years	18	15	3	p= 0.40
> 65 years	42	32	10	
<i>DM duration</i>				
< 10 years	30	25	5	p=0.27
> 10 years	30	22	8	
<i>Type of DM</i>				
NIDDM	52	40	12	p=0.44
IDDM	8	7	1	
<i>Neuropathy</i>				
Presence	18	14	4	p=0.60
Absence	42	33	9	
<i>Popliteal pulse</i>				
Presence	20	19	1	p=0.024
Absence	40	28	12	
<i>Cent. CV Dx</i>				
Presence	27	18	9	p=0.048
Absence	33	29	4	
<i>Haemoglobin</i>				
< 10 g/dL	25	19	6	p=0.47
> 10 g/dL	35	28	7	
<i>Intraop. bleeding</i>				
Presence	24	23	1	p=0.006
Absence	36	24	12	
<i>Lymphocytes</i>				
> 1.5 x 10 ³ /mm	23	20	3	p=0.17
< 1.5 10 ³ /mm	37	27	10	

DM: diabetes mellitus, IDDM: insulin dependent DM, NIDDM: Non-insulin dependent DM, Cent CV Dx: Central cardiovascular disease, Intraop. bleeding: Intraoperative bleeding.

DISCUSSION

In diabetic patients, many risk or adverse factors for ulcer formation⁽¹⁻³⁾ are common to those with limb loss⁽²⁻⁵⁾. These factors include absence of foot pulses^(1,2,4), presence of multiple cardiovascular disease⁽²⁾, ankle arm pressure index of < 0.45⁽⁵⁾, older age^(2,3), longer diabetic duration⁽³⁾, high glycosylated haemoglobin⁽³⁾ and diabetic nephropathy with proteinuria^(2,3). Absence of foot pulses and ankle pressure index of < 0.45 imply inadequate perfusion of the limb. More severe peripheral vascular disease (atherosclerosis of lower limb vessels) is more common in patients with central cardiovascular disease, older age, longer duration of diabetes mellitus, uncontrolled diabetes (high glycosylated haemoglobin) and diabetic nephropathy. The prognostic or favourable factors for ulcer healing⁽⁶⁻⁸⁾ are also common to those for amputation stump healing⁽⁹⁻¹²⁾. Presence of palpable foot pulses^(7,9,10) and skin perfusion pressure of > 60 mmHg⁽¹²⁾ are associated with primary ulcer or stump healing. These factors indicate adequate perfusion to the limb.

Our study showed that palpable popliteal pulse, absence of

central cardiovascular disease and intraoperative flap bleeding were associated with higher chance of primary stump healing. Palpable popliteal pulse and bleeding from the skin flap edges are indicators of adequate perfusion to the stump. As atherosclerosis is a generalised disease, patients with central cardiovascular disease may also have severe peripheral vascular disease.

In our study, age, duration of diabetes, type of diabetes and neuropathy were found to have no predictive value on BKA wound healing.

Haemoglobin level and lymphocyte count were selected for analysis because both factors could reflect the nutritional status of the patients at the time of amputation. However, they were found to have no prognostic value on BKA healing.

CONCLUSION

Our study showed that blood supply to the stump was important for BKA healing. Before amputation, presence of popliteal pulses and absence of cardiovascular disease were two simple clinical factors that could predict a successful outcome of healing. Intraoperatively, bleeding from the skin flap edges was also a useful prognostic factor.

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