Perioperative and Rehabilitative Outcomes after Amputation for Ischaemic Leg Gangrene

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Abstract

Introduction: *Amputation of the severely ischaemic leg is often done when limb salvage is not possible or the patient is not fit enough for it. It is therefore important to determine the natural history of these amputees as our understanding of this will have significant impact on decision making. The aim of this study was to determine the early and late morbidity and mortality rates and rehabilitative outcome of these patients with lower limb amputation for end-stage arterial occlusive disease.* ***Materials and Methods:*** *A retrospective study was done on 72 patients with 77 lower limb amputations for critical limb ischaemia (rest pain, gangrene, ischaemic ulcers) from 1993 to 1998 at the Singapore General Hospital.* ***Results:*** *The mean age of the amputees was 69.7 years. Fifty-one per cent of the patients were male. Forty-five (58%) of the amputations were performed because the limb vasculature was not reconstructable, 12 (16%) because the limbs were too late for salvage and the remaining 20 (26%) because vascular reconstruction failed. Below knee amputations account for 63.6% of all amputations, above knee amputations account for 35.1% and through knee amputations account for 1.3%. Fifteen (19%) of the amputations had wound infection and 8% of amputations required re-amputation at a higher level for wound infection or failure of wound healing. The contralateral amputation rate was 21%. The 30-day mortality for all amputations was 11.1% and the commonest cause was acute myocardial infarction which accounted for 37.5%. Vascular reconstruction did not alter the overall or perioperative mortality rate. Cumulative survival figures showed that at the end of four years, only 38% of all amputees were still alive. 52.5% of amputees were wheelchair-bound, only 15% were household ambulators and 27.5% were community ambulators. Of all the patients with unilateral below knee amputations, 40% could walk out of home while only 20% of unilateral above amputations and 12.5% of bilateral below knee amputations could walk out of home.* ***Conclusion:*** *Early and late rehabilitation after amputation for critical limb ischaemia remain poor and efforts should be made to salvage critically ischaemic limbs wherever possible in patients who are fit enough.*

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Key words: Amputation, Critical limb ischaemia, Gangrene, Rehabilitation

Introduction

In the last century, Sir William Ferguson said: "amputation—one of the meanest and yet one of the greatest operations in surgery: mean, where resorted to where better may be done, great as the only step to give comfort and prolong life." Progress in peripheral vascular surgery over the past twenty years have resulted in the salvage of many lower limbs with critical ischaemia (rest pain, gangrene or ischaemic ulceration) otherwise destined for amputation. Indeed limb salvage surgery involving bypass procedures is the primary treatment for such conditions and amputation is only resorted to in patients with advanced gangrene or in whom arterial reconstruction is not possible or has failed. Amputation of the lower limbs is a major health issue as the outlook for many amputees is poor with high early and late mortality,[1,2] frequent problems with stump healing[3] and difficulty with rehabilitation.[4-6]

It is therefore essential to know the natural history of these patients with lower limb amputation. This study details our experience with lower limb amputation over the years for end-stage arterial occlusive disease. The aim of this study was to determine the early and late morbidity and mortality rates as well as the rehabilitative outcome of these patients.

Materials and Methods

Between 1993 and 1998, 77 amputations carried out in 72 patients at the Department of Surgery, Singapore General Hospital were reviewed. Only amputations for ischaemic gangrene were included in the study. The decision about the level of amputation was made by the attending surgeon. Primary above knee amputation was performed when extensive ischaemic necrosis precluded below knee amputation or when knee joint contracture was present or

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when tissue perfusion was thought to inadequate for primary stump healing.

Data on the 72 patients were obtained from hospital records. The late follow-up was obtained by direct phone communication with the patient and/or family, by correspondence or by home visits. The data were analysed to determine the perioperative morbidity and mortality and the rehabilitative outcome of the patients. Life-table analysis and Kaplan-Meier survival curves were done using the SPSS 6.0 statistical package. The *t*-test and chi-square test were used to test for significant differences and a *P* value less than 0.05 was considered significant.

Results

During the period from 1993 to 1998, 72 patients had 77 lower limb amputations for ischaemic gangrene. The mean age of amputees was 69.7 years (range 39 to 94 years), with 83% of the patients being more than 60 years old. Fifty-one per cent of the patients were male and 49% were female, with a male to female ratio of 1:1. The mean age for males was 67 years while the mean age for females was higher at 74 years.

Indications for Amputation

Forty-five (58%) of the amputations were performed because the limb vasculature was considered to be not reconstructable due to severe distal vessel disease with no run-off to the feet, or the vessels were found at operation to be too calcified for bypass surgery to be done. Sometimes, the patient's co-morbid status (e.g. poor cardiac status with greatly reduced left ventricular ejection fraction) or pre-morbid condition (e.g. bed-ridden with dementia) precluded reconstruction.

Twelve (16%) of the amputations were performed in cases where the vasculature of the lower limb could have been reconstructed but the patient either refused surgery or presented too late with sepsis or ascending infection or extensive gangrene.

The remaining 20 (26%) amputations were performed for cases where vascular reconstruction failed. Amputations were required because of graft thrombosis, graft infection or failure of healing of gangrene/ulcers despite patent grafts.

Co-morbid Status

The majority of patients had other co-morbid diseases besides peripheral vascular disease as shown in Table I. The large proportion of patients with diabetes (83%) is reflective of the high incidence of diabetes (8%) in our population.

Amputations

The type of amputations and the flaps used for closure are shown in Table II. Skew flaps or long posterior flaps were used for below knee amputations depending on the surgeon's preference.

The average operating time was 55 minutes (range 20 to 100 minutes). Two patients (3%) were in ASA (American Society of Anaesthesiologists) category 1, 30 patients (39%) were in ASA category 2, 35 patients (45%) were in ASA category 3 and 10 patients (13%) were in ASA category 4. The majority of patients (84%) were of ASA 2 or 3.

Altogether 15 (21%) patients had bilateral amputations. Nine patients had bilateral below knee amputations, 2 patients had bilateral above knee amputations and 4 patients had mixed amputations. Some of these amputations were performed in other hospitals before the study period. The mean interval period between contralateral limb amputations was 14 months (range 1 month to 6 years). More males than females had bilateral amputations (10 males, 5 females) giving a male to female ratio of 2:1.

Complications

Table III shows the complications encountered postoperatively. Six (8%) of the amputations had to be converted to higher level amputations because of infection of stump (4 cases) or failure of healing of the wound (2 cases). The time interval for the re-amputations ranged from 16 days to 3 months with a mean of 44 days.

Hospital Stay and Follow-up

The mean duration of stay in the hospital following below knee amputation was 17.8 days and for above knee amputation was 18 days. The duration of stay was

TABLE I: CO-MORBID STATUS

Disease	No. of patients (%)
Ischaemic heart disease	36 (50)
Hypertension	42 (58)
Diabetes	60 (83)
Cerebrovascular accident	20 (28)
Hypercholesterolaemia	3 (4)
Chronic renal failure	4 (6)
End-stage renal failure	14 (19)

TABLE II: TYPES OF AMPUTATION

Type of amputation	No. of patients (%)	Type of flaps
Below knee amputation	49 (63.6%)	Skew – 29 (59%) Posterior flap – 20 (41%)
Above knee amputation	27 (35.1%)	Fish-mouth
Through knee amputation	1 (1.3%)	Sagittal

independent of the level of amputation, being generally determined by the presence of complications or the time taken for home placement.

The mean follow-up period was 7 months after discharge. Patients were referred for prosthetic fitting when the stump wound has healed and when they were considered physically fit for rehabilitation.

Mortality

The 30-day mortality rate for all amputations was 11.1% (8 cases). The causes of death are shown in Table IV. The most common cause was acute myocardial infarction which accounted for 37.5% of the cases. The average postoperative time interval to death was 12 days.

The late mortality rate was 29.2% (21 cases) with fatalities occurring at a mean time interval of 2.14 years postoperation (range >30 days to 4.6 years). As shown in Table IV, acute myocardial infarction was still the commonest cause of late mortality (42.8%) followed by cerebrovascular accident (14.3%).

Figure 1 shows the cumulative survival of all amputees. Sixty-eight per cent of amputees survived at least 1 year after amputation. By the end of 4 years, only 38% of the amputees were alive.

The overall mortality rate of amputees who had previously failed vascular reconstruction was 40% (8 cases out of a total of 20 failed revascularisation), while that of amputees with no previous vascular surgery was 40.4% (21 cases out of 52 amputees). There was no difference in the overall mortality rates of amputees in these two groups ($P = 0.967$). The perioperative mortality rate of patients with failed vascularisation was 10% (2 cases out of 20), while that of patients with no previous vascular surgery was 11.5% (6 cases out of 52). There was no significant difference in the perioperative mortality rates in these 2 groups ($P = 0.852$).

Rehabilitation

The rehabilitative outcome of the remaining 40 patients is shown in Table V (3 amputees have not yet been referred for limb fitting). The majority of patients were wheelchair-bound (52.5%), and only 42.5% walked with prosthesis, of whom 15% were household ambulators and 27.5% were able to walk out of home.

For unilateral amputations, 8 (40%) of below knee amputees and only 2 (20%) of above knee amputees were community ambulators.

For bilateral amputations, only 1 (12.5%) of bilateral below knee amputees could walk out of home. The patients

TABLE III: POSTOPERATIVE COMPLICATIONS

Type of complication	No. of patients (%)
Wound infection	15 (19)
Bed sores	5 (6.5)
Sepsis (unknown source)	7 (9)
Cerebrovascular accident	2 (2.5)
Urinary tract infection	6 (8)
Congestive cardiac failure	6 (8)
Myocardial infarction	3 (4)
Gastrointestinal bleed	4 (5)
Cellulitis	1 (1.3)
Poorly controlled diabetes	3 (4)
Depression	11 (14)
No complications	39 (51)

TABLE IV: CAUSES OF MORTALITY

Cause	30-day mortality (%)	Late mortality (%)	Total (%)
Acute myocardial infarction	3 (37.5)	9 (42.8)	12 (41.4)
Ischaemic heart disease	1 (12.5)	2 (9.5)	3 (10.3)
Cerebrovascular accident	2 (25)	3 (14.3)	5 (17.2)
Diabetes	0	2 (9.5)	2 (6.9)
Pneumonia	1 (12.5)	3 (14.3)	4 (13.8)
Sepsis	1 (12.5)	1 (4.8)	2 (6.9)
End-stage renal failure	0	1 (4.8)	1 (3.5)

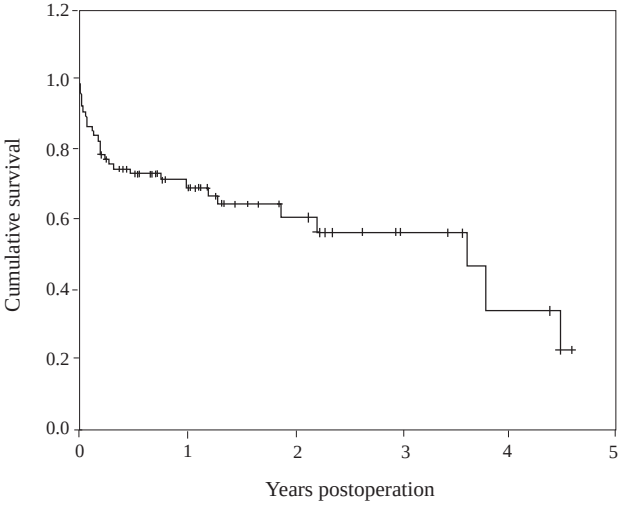

Fig. 1. Survival curve.

TABLE V: REHABILITATION OUTCOME

Rehabilitation outcome	Type of amputee					
	UBKA	UAKA	BBKA	BAKA	Mixed	Total (%)
Bed bound	2	0	0	0	0	2 (5)
Wheelchair bound	10	6	6	1	1	21(52.5)
Household ambulator	3	2	1	0	0	6(15)
Community ambulator	8	2	1	0	0	11(27.5)

UBKA: unilateral below knee amputation; UAKA: unilateral above knee amputation; BBKA: bilateral below knee amputation; BAKA: bilateral above knee amputation

with bilateral above knee amputations and mixed amputations were all wheelchair-bound.

Altogether, 27 of the surviving patients were referred for prosthesis fitting, but only 17 (63%) of the patients make use of them.

The causes for failed rehabilitation are shown in Table VI. The main cause was old age and weakness which accounts for 40% of the cases.

TABLE VI: CAUSES FOR FAILED REHABILITATION

Cause	No. of patients (%)
Old age, weakness	10 (40)
Stump pain	5 (20)
Contralateral ischaemic limb pain	2 (8)
Cerebrovascular accident	3 (12)
Expensive	3 (12)
Unknown	2 (8)

Discussion

The loss of a leg is a major disaster for patients with peripheral vascular disease, limiting both mobility and independence.

The morbidity faced by these amputees is tremendous and includes not only postoperative complications and re-amputations, but also the likelihood of losing the contralateral limb. The most common postoperative complication is wound infection, resulting in 8% of the amputations in this study requiring revision to a more proximal amputation level. Other studies[4,5] also showed a re-amputation rate of 5% to 9%. Peripheral vascular disease often occurs in both legs, and this study showed that the incidence of contralateral amputation was 21% comparable with another study[7] that reported a rate of 26%.

In this study, women were found to be older than men at operation and this may reflect an earlier onset of arteriosclerosis in men. Also, more men had bilateral amputations performed than women. These observations are in accordance with other reports.[6,8]

The length of hospital stay is found not to be affected by the level of amputation but by the complications and time taken for home placement. Therefore, in order to reduce the length of hospital stay and cost, it is important to prevent and treat complications aggressively and to get social services involved early.

The operative mortality for lower limb amputations is said to have remained the same for the past 30 years, with most studies reporting an operative mortality in excess of 10%,[1,2] a late mortality rate of about 24%[7] and a cumulative survival of about 50% at 3 years after operation.[1,7,8] The 30-day mortality rate in this study was 11.1% and the late mortality rate was 29.2%, with 38% of the patients still alive at 4 years. The most common cause of death was acute myocardial infarction followed by cerebrovascular accident, both being associated complications of atherosclerosis. This is similar to results reported by Roon et al.[9]

It has been felt that failed revascularisation followed by amputation imposes a higher risk of mortality than does amputation alone and that the risk could be avoided if amputation is selected as the primary procedure. It is thought that the risk of subsequent anaesthetics and the greater potential for infection from prolonged hospitalisation and numerous wounds causes higher mortality if revascularisation fails. However, this study and others,[2,7,10] showed that the early and late mortality for patients with unsuccessful vascular reconstruction was not increased over those with no previous vascular surgery. This should not discourage adopting a more aggressive approach to limb salvage.

Most patients with vascular disease are elderly and have to contend with concomitant chronic illness and concurrent disabilities. These disabilities resulting from cardiovascular disease, diabetes, cerebrovascular accident, impaired vision and reduced learning capacity frequently impose extra problems in locomotion and achieving independence.

In our study, only 39.6% of the surviving patients were able to use the prosthesis with 27.5% able to walk out of home. Of all the amputees who had been fitted with prosthesis, only 63% used the prosthesis. Other studies[8,11] reported that 68% to 75% of the amputees referred for prosthesis fitting were able to make regular use of it, but only 50% were mobile beyond their home. However, a recent study[4] showed that with commitment to an optimal multidisciplinary amputee rehabilitation programme, 87% of community ambulators can remain independent, and overall, a similar proportion of patients can maintain walking ability and not use a wheelchair as their primary mode of ambulation.

Early and better mobility can be facilitated by conservation of the knee joint with consequent retention of proprioception and lesser energy requirement.[12,13] Apart from this, weight bearing with the below knee prosthesis is much easier because the knee is sturdy and enables an even circumferential support with 30% of the weight borne by each of the tibial condyles and 40% by the patella tendon. Above knee weight bearing is more difficult because it is entirely ischial and therefore not circumferential. Moreover, rotation of the thigh corset often occurs, and the thigh corset is frequently too tight or too loose. Sitting is also more difficult. Many studies,[5,7,8] including ours, reported a better mobility for below knee amputations than above knee amputations. Thus, the knee joint should be preserved whenever possible. However, this has to be balanced with

clinical judgement to obtain primary stump healing as re-amputation of a poorly healing wound can be demoralising as well as prolonging the patient's recovery period.

The commonest cause for rehabilitative failure was old age and debility. Other factors affecting rehabilitation include stump pain, stroke, ischaemic pain of the contralateral limb and the high cost of prosthesis.

From the foregoing data, it becomes apparent that despite the many medical advances made over the past 30 years, little has been achieved to lessen the need for contralateral limb amputation or to prolong postoperative survival once initial amputation is required. Prior vascular reconstruction, ischaemic heart disease, cerebrovascular accidents, diabetes, hypertension, and renal failure are prominent co-morbid conditions and illustrate the severe and diffuse nature of the atherosclerotic process. The end-stage nature of atherosclerosis is a major cause of mortality.

Since survival does not improved, attention must be focused on enhancing the quality of that survival. This involves rapid rehabilitation of the patient and his early reintegration into society. Time in the hospital must be optimised so that successful rehabilitation can be achieved quickly. An amputation team approach that involves the physiotherapist, occupational therapist, prosthetist, nursing personnel and social worker all working as a team will be able to meet this challenge. The presence of debility, arthritis, gait abnormality or neurological deficit might contribute to non-referral for limb fitting. It should be possible to develop criteria that will help to predict whether a patient will achieve successful mobilisation with a prosthesis. These could then be used as guidelines to help the surgeon and the patient decide the level of amputation. After operation, the team should make every effort to avoid delays in mobilisation and rehabilitation. This may help reduce postoperative mortality due to complications such as pulmonary embolus, pneumonia and atelectasis which are usually the result of prolonged inactivity after amputation.

Conclusion

Successful rehabilitation and long-term survival of lower limb amputees for ischaemic gangrene remain low despite advances in medical care. If limb salvage is not possible for the critically ischaemic limb, expeditious amputation with primary stump healing and early rehabilitation with the help of a dedicated multidisciplinary team will enable the patient to regain a measure of independence and the best quality of remaining life for the individual patient.

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