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Mobility after major limb amputation for arterial occlusive disease

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Abstract

This study is concerned with the degree of mobility achieved by patients following major amputation for arterial occlusive disease of the legs and its relationship to the level of amputation. Eighty-four out of a possible 85 consecutive amputees form the basis of the study and the degree of mobility was assessed and graded in survivors six months after amputation.

Of the 69 survivors 74% were mobile to some degree and 57% walked daily with a prosthesis. Sixty-five per cent of all the amputations were below-knee. Seventeen per cent of below-knee stumps in patients surviving two weeks failed to heal. In amputees who attained a unilateral mobile healed stump 78% with below-knee amputations and 50% with above-knee amputations walked daily with a prosthesis. To obtain maximum mobility the knee should be retained whenever practical even though this results in some unhealed stumps requiring revision.

Introduction

When revascularization of an ischaemic limb is not practical or has failed, major amputation is necessary to save life, relieve pain and remove necrotic tissue. An above-knee (A/K) amputation fulfills these aims (Haynes and Middleton, 1981), but many reports have stressed that retention of the knee joint increases the chances of mobility using a prosthesis, improving independence and quality of life (Robinson, 1980; De Cossart et al, 1983; Jamieson et al, 1983). Attempts to retain the knee joint can result in a significant proportion of unsatisfactory stumps due to non-healing or flexion contracture of the knee (Moffat et al, 1981; De Cossart et al, 1983). However, since 1969 the authors have increasingly retained the knee joint. From 1969 to 1973, 34% of all amputations were below-knee (B/K), from 1974 to 1978, 53% were B/K, and from 1979 to 1983, 65% were B/K. This study represents the experience, in the last five-year period, of mobility and stump healing in amputees followed up for six months post-operatively.

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Patients and methods

All amputations described in this paper were performed by one general surgical firm, with an interest in arterial surgery, situated in a rural hospital. Many of the amputations were done by a succession of rotating registrars under the supervision of one consultant.

Between 1979 and 1983, 85 consecutive patients had their first major amputation for arterial occlusive disease of the legs. Many had previously had aortography, direct arterial surgery, sympathectomy or local amputation of the toes or forefoot. Eighty-four out of the 85 amputees were followed up for six months and then the mobility of the survivors was graded by a physiotherapist according to the scale described in Table 1. Those amputees who walked daily with the prosthesis, as categorized C2, C3, C4, were judged to be walking usefully.

Selection of amputation site

Patients with severe cardiac, respiratory, neurological, skeletal or mental disorders which

Table 1. Grading of mobility in amputees six months after amputation.

A		Chairbound
B		Walking with aids but without a prosthesis
C		Walking with a prosthesis
	C_1	Occasionally
	C_2	Daily indoors
	C_3	Daily indoors and outdoors
	C_4	Indoors, outdoors and stairs

would preclude them from walking with a prosthesis had an A/K or supracondylar amputation. The supracondylar amputation was favoured by the authors as they believed it produced a long balancing stump.

Massive gangrene or skin ischaemia at the potential site of a B/K amputation necessitated an A/K amputation. With absent femoral and distal pulses an A/K amputation was also favoured unless the ischaemia was confined to rest pain with or without limited gangrene of toes. However with a palpable femoral pulse and absent distal pulses a B/K amputation was preferred unless some of the above contra-indications were present. The visible skin circulation in the elevated foot proved helpful in doubtful cases. Doppler ultrasound ankle blood pressures identified some patients, usually diabetics, who had predominantly small vessel disease with clinical femoro-popliteal blocks. The presence of a popliteal pulse was usually an indication to attempt a B/K amputation.

Operative Details

In A/K amputations equal anterior and posterior flaps were fashioned with suture of the muscles. The Gritti-Stokes technique was used in supracondylar amputation, recently with lateral skin flaps. In B/K amputations the tibia was usually divided 9cm distal to the knee joint, although the distance could vary between 8 and 14cm. The gastrocnemius muscle was retained in a long posterior skin flap. Drainage in early cases in the series was by corrugated plastic drains via the wound and latterly by redivac suction drains. The skin was closed with interrupted nylon sutures. A well padded plaster of Paris was applied to B/K stumps for five days. Antibiotics were given.

Post operative care

Physiotherapy started pre-operatively in a minority of patients and continued immediately post-operatively in all patients. Pneumatic post-amputation mobility aids were used for walking as soon as practical, usually between seven and 14 days.

Once healed, the amputee was usually referred to the Artificial Limb and Appliance Centre at Selly Oak, Birmingham. The A/K amputees had ischial weight-bearing sockets with prostheses of either metal exo-skeletal construction or modular carbon fibre construction, each having semi-automatic knee locks. The B/K amputees had modular patellar-tendon-bearing prostheses with plastic sockets of polypropylene or glass reinforced plastic construction. The delay between operation and the first prosthesis was 7-10 weeks in B/K prostheses and 6-20 weeks in A/K prostheses.

Physiotherapy continued on an outpatient basis until the amputee was able to use the prosthesis reliably on his own.

Results

Mortality

Table 2 shows the progressive mortality for the peri-operative period up to two weeks, from two weeks post-operatively to discharge from hospital, and from discharge to six months after amputation. The total hospital mortality up to discharge was 11%. There was no mortality amongst the four amputees who lost their second leg, or amongst the six B/K amputees requiring A/K revision.

Age and sex

The average age at amputation was 73 years for A/K amputees, 82 years for supracondylar amputees and 71 years for B/K amputees. Seventy-five per cent of the amputees were male.

Diabetes

The prevalence of diabetes in 84 amputees was 30%. In patients with iliac blocks the

Table 2. Mortality rates in major amputations for lower limb ischaemia.

Amputations	No.	Within 2 weeks of amputation	2 weeks to discharge from hospital	Discharge to 6 months after amputation	Total No.	Total %
A/K	25	2	1	3	6	24
Supracondylar	4				0	—
B/K	55	3	3	3	9	16
TOTAL	84	5	4	6	15	18

prevalence was 18%, in femoral popliteal blocks 25% and in tibial blocks 78%. In 30 non-diabetic patients with femoral popliteal blocks, 23% of B/K stumps failed to heal, while in 11 diabetic patients with femoral popliteal blocks all B/K stumps healed.

Stump healing

All amputation stumps in A/K or supra-condylar amputees, who survived two weeks, healed. Table 3 relates stump healing in B/K amputees, who survived two weeks, to the clinical level of the arterial block. Seventeen per cent of A/K stumps and 33% of B/K stumps, which eventually healed, showed a delay in healing due to minor ischaemic lesions or sepsis. Thirty per cent of patients with iliac blocks, 73% of those with femoral popliteal blocks and 89% of those with tibial blocks had B/K amputations.

Table 3. Stump healing in relation to level of amputation and arterial block in amputees surviving two weeks.

Amputation	Site of Arterial Block	Total Numbers	Healed	Necrosed
B/K	Iliac	3	2 (67%)	1 (33%)
	Femoro-popliteal	41	33 (80%)	8 (20%)
	Tibial	8	8 (100%)	
	TOTAL	52	43 (83%)	9 (17%)

Flexion contractures

Three out of 46 B/K amputees discharged from hospital had a significant flexion contracture of the knee joint. Identifiable causes included early pre-operative contraction, delayed healing, painful stumps and inability to cooperate.

Mobility

Table 4 shows grades of mobility in the 69 survivors of the 84 amputees followed up for six months. Of all the amputees who walked usefully (C2 + C3 + C4), 20% walked daily indoors (C2), 16% walked indoors and outdoors (C3) and 20% also climbed stairs (C4). With a unilateral healed mobile stump 78% of B/K amputees and 50% of A/K amputees walked usefully.

Table 5 shows the progress of amputees surviving six months. Out of six B/K amputees

Table 4. Mobility in amputees six months after amputation.

Initial Amputation		A/K	Supra-condylar	B/K	Total
Survivors		19	4	46	69
Mobility	A	7	4	7	18
	B	2		4	6
	C_1	1		5	6
	C_2	2		12	14
	C_3	3		8	11
	C_4	4		10	14
B + C					
% of survivors		63		85	74
$C_2 + C_3 + C_4$					
% of survivors		47		65	57

Table 5. progress of amputees surviving six months.

Initial Amputation	A/K	Supra-condylar	B/K
Survivors	19	4	46
Healed mobile stumps	18	4	32
Revision to A/K			6
Unhealed*			2
Flexion contracture			3
Bilateral	1		3

* 1 amputee was judged unfit for futher surgery
1 amputee had A/K revision at 7 months

requiring A/K revision, two walked usefully (C2, C3). Neither of the two B/K amputees with unhealed stumps walked usefully. Out of three B/K amputees with flexion contracture of the knee, one walked usefully (C2). Of the three bilateral B/K amputees, one walked usefully (C2). In spite of 30% of the B/K amputees not having unilateral mobile B/K stumps, this group of 46 amputees showed marked improvement in overall mobility (B + C) and in useful mobility with a prosthesis (C2 + C3 + C4) compared with the 19 A/K amputees.

Nine patients became bilateral B/K amputees during 1979-1983, six having had their first leg amputated before this period. Fifty-six per cent of these walked usefully with bilateral pros-theses (C2, C3). None of the authors' bilateral A/K amputees has walked with two full-length pros-theses.

Hospital stay, 1979-1983

The average hospital stay to discharge or death of the 25 A/K amputees was 32 days, and

for the 55 B/K amputees 38 days. If deaths and amputees becoming bilateral within the initial hospital admission are excluded, the hospital stay for A/K amputees was 35 days and for B/K amputees 34 days. If, in addition, amputees requiring A/K revision are discounted the stay of B/K amputees dropped to 28 days.

Discussion

The loss of a leg is a major disaster for all patients, limiting mobility and independence. The possibility of revascularizing ischaemic legs by arterial surgery, interventional angioplasty or sympathectomy must always be considered.

The progressive mortality and involvement of the contra-lateral leg in this study confirms previous reports (Finch et al, 1980; Rush et al, 1981; Bodily and Burgess, 1983). It emphasizes the importance of a short hospital stay and early rehabilitation to fully exploit the limited life expectancy. The higher mortality rate in A/K amputations compared to B/K is known (Robinson, 1980; Rush et al, 1981). The high proportion of diabetic amputees with distal arterial blocks and the marked improvement in below stump healing in diabetics with clinical femoro-popliteal blocks over non-diabetics confirms the prevalence of small vessel disease in diabetics.

The percentage of B/K amputees in other reported series varies between 11% and 67%, reflecting the wide range of importance given to retaining the knee joint (Robinson, 1980; Finch et al, 1980; Haynes and Middleton, 1981). When this is given high priority the knee joint can be retained in two-thirds of cases, and this is similar to the authors' experience (Barnes et al, 1976; De Cossart et al, 1983).

In A/K amputees healing occurs in over 90% of stumps (Kihn et al, 1972; Haynes and Middleton, 1981). In B/K amputees reports of stump healing vary between 65% and 89% (Kihn et al, 1972; Barnes et al, 1976; Couch et al, 1977; Finch et al, 1980; De Cossart et al, 1983; O'Dwyer and Edwards, 1985). In series giving a high priority to retaining the knee, non-healing is reported in 15 to 20% of amputees (Barnes et al, 1976; De Cossart et al, 1983).

As previously described, following past experience, the authors' indications for offering B/K amputation in patients with iliac blocks have been severely restricted, so no conclusions should be drawn from the results in the small numbers in this series. The healing rate in B/K amputees with femoral popliteal blocks was 80%, and with tibial blocks 100%.

The main problem is to judge which patients with femoral popliteal blocks will heal a B/K stump. Although A/K revision in an unhealed B/K stump carries a low mortality and heals well, further surgery with added suffering, prolonged hospitalization and rehabilitation must remain unsatisfactory. There is an urgent requirement for a reliable technique for selecting the most distal level at which an amputation stump can be relied upon to heal. Peripheral blood pressure estimations using Doppler ultrasound, transcutaneous oxygen pressures, isotope scanning, skin perfusion pressures and fluor-escein angiography have been found useful by some writers (Couch et al, 1977; Barnes et al, 1976; Robinson, 1980; Creaney et al, 1981; Holstein, 1982; Tanzer and Horne, 1982; Ito et al, 1984). However they have not been generally accepted (Finch et al, 1980; De Cossart et al, 1983; O'Dwyer and Edwards, 1985).

In B/K amputation the incidence of flexion contracture of the knee joint can be limited by intensive physiotherapy and by predicting pre-operatively those patients who are especially at risk. Moffat et al (1981) suggested that useful mobility with a prosthesis was still possible if the contracture was under 15° and this has also been the authors' experience.

Mobility studies ideally need to indicate grades of mobility and include all amputees and not just special groups. Jamieson and Ruckley (1983) reported from a general surgical unit that 70% of survivors were able to walk with or without assistance. Barnes et al (1976) reported that 60% of 50 amputees with a B/K prosthesis walked independently. Finch et al (1980) reported that 56% of a mixed group of A/K and B/K amputees were walking, 46.5% with a prosthesis. Robinson (1980) reported from the Roehampton Limb Fitting Centre that 82% of B/K and 38% of A/K amputees walked. Reports from the centres with integrated facilities specializing in the management and rehabilitation of the amputee appear the most encouraging (Robinson, 1980; Finch et al, 1980; Malone et al, 1981). However, the published reports for mobility are difficult to compare due to the variation in groups, criteria and times of review (Kihn et al, 1972; Barnes et al, 1976;

Couch et al, 1977; Robinson, 1980; Finch et al, 1980; Moffat et al, 1981). The authors' results, with 74% of all amputees who survived 6 months achieving some degree of mobility (B + C) and 57% walking usefully with a prosthesis (C2 + C3 + C4) to varying standards, appear favourable. There is a need for more detailed studies to allow comparisons to be made and targets set.

These results provide encouragement to continue giving a high priority to retaining the knee joint, so allowing two-thirds of amputees the best chance of mobility and independence. The presence of diabetes in patients with femoral popliteal blocks is a factor in favour of B/K amputation. If patients become bilateral B/K amputees there is still over a 50% chance of walking with two prostheses.

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