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Primary survival and prosthetic fitting of lower limb amputees

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Abstract

During the period 1984-1985 amputation of the lower limb at a level potentially requiring a prosthesis was performed on 577 patients in 16 operative units. The mean age was 75.7 years for females and 68.1 for males. The most common site of the amputation was above the knee (49.9%). The majority of amputations (93.8%) were performed for vascular diseases and diabetes. Survival figures showed that 25.5% of amputees died within 2 months of amputation, 60.7% were alive after one year and 43.2% after two years. Out of a total of 577 patients, 26.9% were fitted with a prosthesis. Out of below-knee and above-knee amputees surviving over 2 months, 61.5% and 27.2% respectively were fitted with a prosthesis. There were markedly fewer prosthetic fittings in the over-60 age group. Diabetic patients of both sexes were fitted with a prosthesis more often than arterio-sclerotic patients. Among tumour patients 82.4% received a prosthesis. In the study area more emphasis must be put on the concept of preserving the knee joint and preoperative assessment of vascular patients for selection of amputation level. Every effort must be made to avoid delay in the postoperative mobilization and rehabilitation. Prosthetic fitting of amputees could be improved by better liaison between surgical unit and specialized rehabilitation unit and by closer team approach of amputee care.

Introduction

In Finland about 1,500 lower limb amputations are performed annually (Pohjolainen and Alaranta, 1988). Most of these amputations are performed on geriatric patients with peripheral vascular disease. It is predicted that the number of amputations will increase as the age structure of the Finnish population advances, producing a higher proportion of elderly age groups (data supplied by the Central Statistical Office of Finland).

The disability following limb amputation is permanent and it can also be enormous: in many cases amputation makes the patient heavily dependent on other people. The amputee requires considerable in-patient and out-patient care and frequently makes heavy demands upon the social services and welfare workers of the hospital and the community. Every attempt must be made to return the individual to as near normal a functional status as possible and to his original environment, or to an improved environment if previous living conditions were poor. Moreover, elderly patients often have changes in organs other than the limbs: they may have heart trouble, brain disorders and, especially in diabetics, eye, kidney and neurological disorders. However, it is possible for a high percentage of elderly amputees to make a successful return to society, either ambulant or in a wheelchair (Weaver and Marshall, 1973; Steinberg et al., 1985). The services which plan and organize the provision of prostheses and rehabilitation for amputee patients would benefit from information concerning the extent of the problems mentioned above which obviously differ from one country to another. In Finland, there are at present no earlier epidemiological figures relating to survival or to prosthetic fittings among lower limb amputees.

Methods

To assess the current situation regarding the rehabilitation of amputees in Southern Finland, data were collected on all lower limb amputations carried out by all 16 operative

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units of the catchment area of the Helsinki University Central Hospital during the period 1984-1985, as well as data from every prosthetic workshop and rehabilitation unit in the same area. Statistics concerning minor amputations no higher than the foot were eliminated. Data on prosthetic fittings were obtained for the one-year period following amputation.

During the two-year period, amputation of the lower limb at a level potentially requiring a prosthesis was performed on 577 patients, of which 326 were females (56.5%) and 251 males (43.5%). The mean age was 75.7 years for females and 68.1 years for males. Table 1 shows the underlying diagnoses for which the amputations were carried out in patients of different age groups. The majority, 93.8%, were performed for vascular diseases; 3.2% were for tumour and 1.7% followed trauma. Of the 577 amputees, 88.2% were over 60 years old.

The largest group of amputees (49.9%) underwent unilateral above-knee amputation, with below-knee amputees forming the next largest group (27.0%). Bilateral amputation was performed on 109 patients (18.9%) (Table 2).

The chi-square test was used for the statistical calculations.

Results

Survival

About 73% of the patients with amputations due to vascular disease were alive two months after the operation, while 60% of these patients lived over one year and 41% over two years. Among the 245 diabetics 25% died within two months, about 62% lived for more than one year and nearly 46% more than two years. Among the 267 arteriosclerotics 27% died within two months, while 58% lived for more than one year and 38% more than two years. Among the 18 tumour patients 94% lived over

Table 1. Diagnostic groups according to age (yrs).

Diagnosis	Age groups					Age	
	0-59	60-79	80-	All	%	×	SD
Arteriosclerosis	19	147	101	267	46.4	75.7	9.9
Diabetes mellitus	20	155	70	245	42.4	73.3	10.6
Embolism	2	21	4	27	4.7	70.3	10.4
Tumour	15	2	1	18	3.2	34.4	25.1
Trauma	7	2	1	10	1.7	44.1	25.8
Frost bite	2	1	0	3	0.5	60.0	9.6
Buerger's disease	2	0	0	2	0.3	46.5	10.6
Osteomyelitis	1	0	1	2	0.3	59.0	39.6
Miscellaneous	0	3	0	3	0.5	72.5	0.7
Total n	68	331	178	577			
%	11.8	57.4	30.8		100.0		

Table 2. Amputation levels in different age and sex groups.

Amputation level	Women				Men				
	Age groups (yrs)				Age groups (yrs)				
	0-59	60-69	70-79	80-	0-59	60-69	70-79	80-	All
Lisfranc	3	1	1	2	1	0	0	0	8
Ankle[1]	0	0	3	2	0	0	2	1	8
Below-knee[2]	7	20	38	24	19	12	24	12	156
Above-knee[3]	6	20	59	82	18	29	48	26	288
Hip disarticulation	1	0	3	0	2	1	0	0	7
Hemipelvectomy	0	0	0	0	1	0	0	0	1
Foot/below-knee	1	1	3	2	3	4	2	0	16
BK/BK	2	2	2	7	2	6	3	1	25
BK/AK	0	0	10	0	2	5	3	3	23
AK/AK	0	2	9	10	0	4	12	5	42
Foot/AK	0	1	1	1	0	0	0	0	3
Total	20	47	129	130	48	61	94	48	577

[1] Includes Pirogoff, Boyd and Chopart amputations
[2] BK = Below-knee amputation
[3] AK = Above-knee amputation

two months, 78% over one year and 72% over two years. All patients amputated for trauma lived over two months and 90% lived over two years (Table 3).

Patients who underwent unilateral or bilateral below-knee amputation had a lower mortality than unilateral or bilateral above-knee amputees (Table 4).

The survival curve (Fig. 1) shows a sharp fall initially, especially in older age groups, but thereafter the slope is not very steep. At one year after operation, 61% of the entire group had survived and at two years, 43%. The postoperative mortality of patients under 60 years-old was 93% after two months, 84% after 12 months and 77% after 24 months. The corresponding figures for patients over 60 were 72%, 58% and 39% (Fig. 1).

Prosthetic fitting

Out of a total of 577 patients, 155 (26.9%) were fitted with a prosthesis. The average time between amputation and the fitting of a definitive prosthesis was 117 days. The time lag between surgery and fitting of the prosthesis was 111 days for unilateral below-knee, 125 for unilateral above-knee and 121 for bilateral below-knee amputees.

Figure 2 shows the prostheses fitted during the first postoperative year in different age groups among amputees surviving over two months from the time of amputation. The proportion of those fitted with a prosthesis decreased from 83% in patients aged 0-19 to 13% in patients aged over 80. There was a marked decrease in prosthetic fittings comparing the patients aged over 60 to the younger group ($p<0.001$).

Table 3. Survival following different diagnoses over two postoperative years and percentages of patients fitted with a prosthesis during the first postoperative year among amputees surviving over two months.

Diagnosis	Patients	Months of survival						Prosthesis fitted	
		2		12		24			
		n	%	n	%	n	%	n	%
Arteriosclerosis	267	194	72.7	156	58.4	101	37.8	55	28.4
Diabetes mellitus	245	185	75.5	152	62.0	112	45.7	74	40.0
Embolism	27	15	55.6	11	40.7	7	25.9	5	33.3
Buerger's disease	2	2	100.0	2	100.0	2	100.0	2	100.0
Tumour	18	17	94.4	14	77.8	13	72.2	14	82.4
Trauma	10	10	100.0	9	90.0	9	90.0	2	20.0
Frost bite	3	3	100.0	3	100.0	3	100.0	2	66.7
Miscellaneous	5	4	80.0	3	60.0	2	40.0	1	25.0
Total	577	430	74.5	350	60.7	249	43.2	155	36.0

Table 4. Survival of amputees at different amputation levels over two postoperative years and prosthetic fitting of amputees during the first postoperative year among the amputees surviving over 2 months.

Amputation level	Patients	Survival months						Prosthesis fitted	
		2		12		24			
		n	%	n	%	n	%	n	%
Ankle and foot[1]	16	14	87.5	12	75.0	12	75.0	2	14.3
Below-knee	156	130	83.3	109	69.9	87	55.8	80	61.5
Above-knee	288	195	67.7	155	53.8	98	34.0	53	27.2
Hip disarticulation	7	5	71.4	5	71.4	4	57.1	3	60.0
Hemipelvectomy	1	0	0.0	0	0.0	0	0.0	0	0.0
BK/BK[2]	25	21	84.0	18	72.0	15	60.0	8	38.1
AK/AK	42	30	71.4	22	52.4	9	21.4	2	6.7
BK/AK[3]	23	18	78.3	15	65.2	11	47.8	5	27.8
Foot/BK	16	14	87.5	13	81.3	12	75.0	2	14.3
Foot/AK	3	3	100.0	1	33.3	1	33.3	0	0.0
Total	577	430	74.5	350	60.7	249	43.2	155	36.0

[1] Includes Chopart, Pirogoff, Boyd and Lisfranc amputations
[2] BK = Below-knee amputation
[3] AK = Above-knee amputation

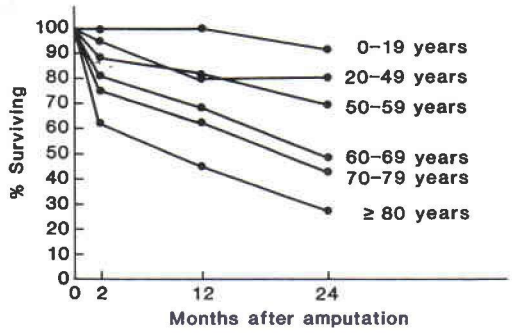

Fig. 1. Percentage surviving after amputation within different age groups.

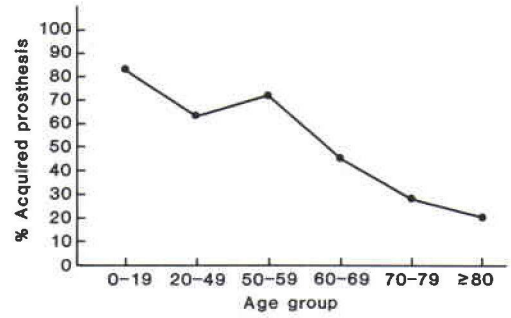

Fig. 2. Percentage of amputees within different age groups surviving over two months and fitted with a prosthesis during the first postoperative year.

Of the 326 females, 65 (19.9%) and of the 251 males, 90 (35.9%) received a prosthesis after amputation. Diabetic patients of both sexes were fitted with a prosthesis more often than arteriosclerotic patients. Of the 18 tumour patients and 10 trauma patients, 82.4% and 20% respectively received a prosthesis (Table 3).

Among all the patients undergoing unilateral amputation, 18.4% (53/288) of the above-knee group and 51.3% (80/156) of the below-knee group received a prosthesis. A prosthesis was fitted to 8 (32%) of the 25 bilateral below-knee amputees, but to only 2 (4.8%) of the bilateral above-knee amputees (Table 4).

Discussion

During the period under review the large majority of lower limb amputees were in the geriatric age group: 88% were over 60 years old and 31% were over 80 years old (Table 1). Most of the patients were amputated for complications of peripheral vascular disease and diabetes. The mortality rate was high in patients aged over 60 and in amputees suffering from vascular diseases. Lassila et al., (1986) have observed that the state of advanced lower limb ischaemia is associated with overall involvement of the arterial system and predict fatal cardiovascular events among these patients. A large proportion of elderly patients have a reduced physiological reserve and high mortality is partly associated with advanced cardiovascular problems and pulmonary diseases. Furthermore, advanced lower limb ischaemia may often be a manifestation of unbalanced homeostasis of patients in their terminal stages. The authors do not know what proportion of elderly, severely ill patients with arterial gangrene amputation should have been treated conservatively.

With regard to mortality over a longer period, Hansson (1964) reported 45%, 58%, 71% and 76% mortality 1, 2, 3 and 4 years postoperatively. According to the Danish Amputation Register (Ebskov and Josephsen, 1980) the percentages for 1 year to 4 years were 18.4%, 19.2%, 20.3% and 22.5%. In the series reported here the percentages for the first two years were similar to those in Hansson's study (Hansson, 1964).

The average age of vascular amputees in the authors' material was higher than in many other published studies (Harris et al., 1974, Finch et al., 1980, Lexier et al., 1987) and this may be one reason for the relatively high mortality rate. The mortality of above-knee amputees was greater than that of below-knee amputees. This is probably due to the severity of the ischaemia of the affected limb and associated generalized disease.

The relatively high mortality rate and the delay between surgery and prosthetic fitting may be due to the fact that the Finnish system of post-operative training and ambulation has been too passive. Early ambulation has been shown to be advantageous for geriatric patients since early gait training with a pneumatic walking aid in parallel bars diminishes complications and mortality (Pollack and Kernstein, 1985). By ambulating the patient as soon as possible it is possible to reduce complications such as pulmonary and urinary tract problems, stump oedema, stump infection and mortality, to inhibit loss of balance and psychological stress and to provide a definitive prosthesis (Redhead, 1983; Pollack and

Kernstein, 1985; Rausch and Khalili, 1985). Early ambulation is particularly important in patients aged over 60, as in the authors' experience their prosthetic fitting tends to be unsatisfactory and their mortality is fairly high.

In this series the prosthetic fitting in females was less satisfactory than in males. This is obviously due to the fact that the mean age of the males is lower. Patients who underwent a below-knee amputation showed the highest rate of prosthetic fitting, mainly because their disease was less advanced than in patients who had more proximal amputations.

The amputation level correlates with the diagnosis and the cause of amputation. In younger patients tumours are often associated with above-knee amputations (Pohjolainen and Alaranta, 1988). In trauma cases as much of the limb as possible must be saved. Of 10 trauma patients, six were amputated at ankle or foot level. The low percentage of prosthetic fitting in trauma (Table 3), ankle and foot level (Table 4) is explained because due to the distal amputation level most of these patients were adequately rehabilitated with orthopaedic shoes and did not require lower limb prostheses. This also partly explains the low percentage of prosthetic fitting of traumatic amputees.

When a major lower limb amputation is performed for ischaemia, the selection of the correct level is the primary problem. In this study there remains a disappointingly high rate of above-knee amputations in relation to below-knee amputations, although there has been a shift in emphasis towards preservation of the knee joint compared with the clinical series during the period 1950-1963 (Vankka, 1967). It has earlier been pointed out that the selection of amputation level and the operation itself should always be performed by experienced surgeons and the same amputating surgeon should take care of the whole rehabilitation (Romano and Burgess, 1971; Murdoch, 1977; Ham et al., 1986). In the authors' material, 89 per cent of patients were amputed in hospitals outside the vascular laboratory services and the low below-knee/above-knee (BK/AK) ratio 1:2 reflects the lack of resources in preoperative assessment of vascular patients. Amputation services in the study area were not generally centralized resulting in relatively low amputation numbers in some individual hospitals. Most of the amputations were performed by general surgeons without preoperative vascular consultation and few surgeons had access to ancillary methods to aid in the selection of the precise level of amputation. An analysis of individual surgical units in the study area revealed large differences, possibly reflecting different policies. Some hospitals for example, performed almost only above-knee amputations without considering the difficulties involved in the rehabilitation of the patients. The role of the vascular laboratory in the management of major lower limb amputations has been demonstrated also in another Finnish study (Lepäntalo, 1988). Preoperative assessment, employing methods such as segmental pressure studies (Pollack and Ernst, 1980; Barnes et al., 1981) and skin perfusion pressure studies (Holstein, 1985; Lepäntalo et al., 1987), thermography (Spence et al., 1981), skin blood flow measurements (McCollum et al., 1985), and transcutaneous oxygen measurement (Burgess et al., 1982; Ratcliff et al., 1984) has been found useful in the estimation of the level of limb viability.

Walking with an above-knee prosthesis is much more energy-consuming than with a below-knee prosthesis (Waters et al., 1976). This means that the more proximal the amputation, the greater the risk that the patient will never regain his ability to walk at all. Indeed many patients will never be capable of using their prosthesis after above-knee amputation (Romano and Burgess, 1971; Wagner, 1978; Stirnemann et al., 1987). In this series, unilateral and bilateral above-knee amputees displayed markedly poorer prosthetic rehabilitation than unilateral and bilateral below-knee amputees. The rehabilitation potential for above-knee amputees, especially in older age groups, is in fact often poor. The current problem for the geriatric amputee is not primarily one of prosthetic components, prosthetic design, fitting and alignment or gait training, but rather one of preservation of the knee joint. Compared with the figures reported by Burgess et al. (1971), Fleurant and Alexander (1980) and Netz et al. (1983), it seems that in Finland there are more above-knee amputations and a higher postoperative mortality. Thus in Finland, more emphasis must be placed on the concept that every effort should be made to preserve the knee joint.

The aim of the medical team, which includes

a surgeon, physiatrist, physiotherapist, occupational therapist and prosthetist is to reduce in-patient stay, increase the proportion of patients discharged with a prosthesis and increase the effectiveness of long term rehabilitation (Jamieson and Hill, 1976; Ham et al., 1987). The social services can also play an important part in enabling the amputee to live within the community (Finch et al., 1980).

Despite the long tradition of medical statistics compiled by the National Board of Health in Finland, no general statistics are available on the etiological factors in amputations, the incidence of amputation, their complications, postoperative death, the duration of hospitalization, the number and type of prostheses fitted, the degree of mobility and other items of basic social information. In order to obtain information on these standard parameters the creation in Finland of an amputation register similar to the Danish Amputation Register (Ebskov, 1986) should be considered. Such a register would also permit the analysis of trends and the prediction of future needs in terms of staffing and financial resources.

Conclusions

The authors believe that the total problem of amputees, especially geriatric amputees, could be improved in Finland by: (1) more emphasis on preoperative assessment of vascular patients for the selection of amputation level and performance of the operation by surgeons with long experience; (2) better appreciation and application of preoperative and postoperative physiotherapy and early postoperative mobilization; (3) better integration of prosthetic fitting and the total rehabilitation of the patient by his admission from the surgical ward to a residential rehabilitation unit as soon as the stump is healed; (4) closer team approach of amputee care; (5) better liaison between the rehabilitation unit and the welfare services responsible for patient care in the home; (6) organized regular follow-up of amputees by the specialized rehabilitation unit.

A large and comprehensive rehabilitation programme to enhance the prosthetic fitting of lower limp amputees has been started in the study area and the results will be evaluated in forthcoming years.

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