Rehabilitation Outcomes for Elderly Lower Limb Amputees

The outcome following rehabilitation for 92 vascular amputees admitted to the Queen Elizabeth Geriatric Centre, Ballarat between 1 January 1982 and 31 December 1987 is presented.

Data includes age, sex, concomitant disease, mortality, length of hospital stay and acceptance of prosthesis.

Statistical analysis reveals no predictive factors for mobility levels attained by amputees other than amputation type, no predictive factors for acceptance of prostheses, and no predictive factors for total length of hospital stay.

As a consequence, the Queen Elizabeth Geriatric Centre will continue the practice of admitting all amputees who wish to use artificial limbs to the prosthetic programme, regardless of age or concomitant disease.

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Health care teams involved in the rehabilitation of elderly vascular amputees are often disheartened to note the number of clients who die either during or soon after rehabilitation. It has been reported that it can take an average of 27 weeks to receive the maximum benefits of rehabilitation (Kerstein et al 1980). If the probability of death or re-amputation within that time is sufficiently high, the time spent in hospital or within an active prosthetic programme must be weighed carefully against the likely rehabilitation outcome and the quality of life that programme affords.

As a result of their studies, Davis, Blanchard and Jackson (1967) and Mazet (1967) advocated physical status and past medical history as criteria for selection into a prosthetic programme. Others have given specific physical contra-indications to prosthetic fitting including `significant congestive heart failure...or chronic obstructive pulmonary disease' (Steinberg et al 1985, p 743). Those selected into their prosthetic programme had to be able to ambulate with a walker `at least 20m at a comfortable speed without dyspnea or excessive tachycardia and... heart rate returned to resting level within two or three minutes after the walk' (p 743). Presence of flexion contractures delayed fitting, as did ulcers on the opposite leg. Those who had not walked for weeks or months prior to amputation were not considered suitable, and strength tests were carried out on all patients to ensure that strength was sufficient for prosthetic ambulation. Eighteen of the 116 amputees in that study were not prescribed prostheses, most commonly for the reason of congestive heart failure with inadequate response to medical treatment (Steinberg et al 1985). Sakuma et al (1974) noted that 38 of the 53 bilateral amputees in their study were not prescribed prostheses for medical reasons.

In many cases, studies into the outcome of rehabilitation of elderly amputees do not outline the selection criteria for a prosthetic rehabilitation programme, but a high mortality rate and a high incidence of amputation of the other limb in those who survive is often pointed out. Kihn et al (1972) report that 41.2% of 427 subjects had died within two years of amputation surgery while Ebskov and Josephson (1980), using a sample of 2029 amputations, found that the mortality rate for vascular amputees was 22.5% within four years of amputation and the incidence of amputation of the opposite limb within that time was 44.3%.

Clearly, when decisions about rehabilitation goals and probable prosthetic management of elderly vascular amputees are being made, these statistics should be borne in mind. According to Sayles (1981), quality of life is a central theme in any programme and the process is a dynamic one, focusing on the individual's participation decision-making within the health care professional team. Consequently, the wishes of an informed client are the major criteria for selection into a prosthetic programme at the Queen Elizabeth Geriatric Centre, Ballarat, and it is the structuring of the programme which reflects physical capabilities or limitations.

Given that quality of life is the ultimate rehabilitation goal, it is necessary then to find a measure of that quality if a rehabilitation programme is to be evaluated appropriately. Quality of life can be reflected in many ways, from subjective views of happiness and contentment which are difficult to quantify and compare, to the practical evaluation of the ability to perform basic personal skills such as managing personal hygiene, eating, and dressing independently.

Since independence of movement permits performance of both essential and leisure activities without the need to call or rely upon outside help, it must certainly be an objective measure of quality of life, and thus of success or failure of a rehabilitation programme. To ascertain each person's quality of life requirement and incorporate it into a rehabilitation goal, the rehabilitation team must determine the level of activity desired and match that as closely as possible with the physical capabilities and prosthetic practicalities for each individual.

Many studies have been published on the fate of amputees in many countries and cultures (Kihn et al 1972, Kerstein et al 1980, Harris et al 1974, Steinberg et al 1985). However, no investigations have linked, through statistical analysis, predictive factors for rehabilitation outcomes.
The purpose of this paper is to describe the population of amputees rehabilitated at the Queen Elizabeth Geriatric Centre, compare them to those described in other countries, and to analyse the patient profile data, specifically cerebro-vascular accident, previous arterial surgery, and level of amputation, are not predictive factors for rehabilitation outcome (measured as level of mobility attained, and acceptance of prostheses) or length of hospital stay.

The null hypothesis to be tested is that age, sex, concomitant disease, previous arterial surgery, and level of amputation, are not predictive factors for rehabilitation outcome (measured as level of mobility attained, and acceptance of prostheses) or length of hospital stay.

Method

Subjects

The study included amputees with a primary diagnosis of peripheral vascular disease (PVD), admitted to the Queen Elizabeth Geriatric Centre's amputee programme following major amputation of the lower limb or limbs between 1 January 1982 and 31 December 1987.

Data was collected retrospectively from medical records and included age at amputation, sex, amputation level, pre-existing conditions (specifically cerebro-vascular accident, diabetes, and congestive cardiac failure), previous arterial surgery, and time in both the acute and rehabilitation hospitals. Although it was originally planned to use death certificate summaries to identify cause of death, these were found to be insufficiently detailed. Cause of death is, thus, not addressed in this paper.

All statistical analyses were carried out using the Chi-squared at a $p<0.05$ level of significance.

Procedure

The Rehabilitation Process

The process is, by its very nature, impossible to describe in specific 'recipe' terms. An overview is presented.

The usual course of action, after admission and assessment by rehabilitation team members, was group discussion to ascertain individual goals, followed by the formulation of a planned personal programme to achieve them.

Prosthetic prescription for each amputee was the result of consultation and liaison between the medical practitioner, the prosthettist and the physiotherapist, with modifications to that prescription possible as needs changed and rehabilitation progressed. Fabrication and alignment of prostheses was done on-site (in consultation with the rehabilitation team) by a prosthettist employed at the Centre. Any changes were discussed by the team and monitored for evaluation of necessity and subsequent effectiveness.

The rehabilitation team consisted of a medical practitioner, a prosthettist, nursing staff, a physiotherapist, an occupational therapist and a welfare officer. The prosthettist and the physiotherapist acted as the primary therapists. Continuity of care was ensured by the practice of primary therapists following each amputee throughout rehabilitation from the ward to Day Hospital and thence into the community as out-patients for follow-up.

'Treatments' included prosthetic fabrication, fitting and alignment, oedema control, maintenance or improvement of strength, range of motion and general endurance, gait re-education and training in the use of appropriate gait aids, education regarding stump care and care of the remaining limb, diabetic and drug management, the provision of welfare and social support networks and the prescription and supply of necessary equipment to ensure a safe home environment.

The ultimate aim of 'treatment' for all subjects was the attainment and maintenance of optimal functional mobility.

Results

During the designated time 92 vascular amputees were admitted to the programme at the Centre. Of these amputees, 56 (61%) were male and 36 female. Two of those admitted had already lost the contralateral limb.

Age

The average age at amputation of subjects was 71 years (standard deviation 9.0, range 47 – 91 years); 71% of subjects were between the ages of 61 and 80 (see Figure 1). The average age of male amputees was 68 years, while that of the females was 76 years (standard deviations 7.9 and 8.7 years respectively).

![Figure 1: Age distribution](image-url)
Rehabilitation Outcomes for Elderly Lower Limb Amputees

Level of Amputation
There were 40 (44%) below knee amputees (BKAs), 37 (40%) above knee amputees (AKAs) and 15 (16%) bilateral amputees - 11 bilateral BKAs and four combination AK/BKAs.

Concomitant Disease
Concomitant diabetes existed in 35% of the subjects, while 30% had a history of a previous myocardial infarct and 16% had suffered a previous cerebrovascular accident (CVA).

Previous Related Surgery
Prior to amputation, 30 (33%) had undergone lumbar sympathectomies and 32 (35%) had had major arterial surgery; 11 amputees (12%) had undergone both surgical procedures before coming to amputation.

It could be expected, then, that many had already spent time in hospital prior to amputation. Neither the actual time spent in acute hospitals preoperatively nor pre-operative mobility levels were available.

Mortality
Three subjects died whilst inpatients in the Centre - all AKAs, all female, and all in their ninth decade. Twenty-nine subjects (32%) died prior to completion of the study, 18 (20%) within two years of amputation.

Length of Hospital Stay
Hospital stay is categorized in three ways. First, the time from amputation to admission to the Queen Elizabeth Centre; secondly, the time from admission to discharge home; thirdly, the total hospital stay, both in the acute and rehabilitation hospitals.

The average length of stay in the acute hospital for all amputees was 47 days, the average stay in the Centre was 49 days, and the overall average stay was 96 days (14 weeks).

Thirty-nine (44%) of those discharged were treated as inpatients at the Queen Elizabeth Geriatric Centre for less than 28 days (Figure 2).

Statistical analysis revealed that neither age \((p=0.0642)\), sex \((p=0.1769)\), concomitant disorders \((p=0.8331)\), past arterial surgery \((p=0.3595)\), nor level of amputation \((p=0.0611)\) were a significant indicator of total length of hospital stay. However, the length of hospital stay in the acute setting for amputees less than 60 years old was significantly higher than for those over 60 \((p=0.0442)\).

<table>
<thead>
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<th>Variable</th>
<th>Acceptance Level</th>
<th>Mobility Level</th>
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<td>Amputation type</td>
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<td>Age</td>
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<td>Sex</td>
<td>.7604</td>
<td>.5928</td>
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<td>Concom. disease</td>
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<tr>
<td>Prev. arterial surgery</td>
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Rehabilitation Outcome
Of the 92 subjects included in the study, 88 (96%) were fitted with prostheses (two died prior to prosthetic fitting, two chose not to attempt prosthetic rehabilitation) and underwent a rehabilitation programme appropriate to their individual needs as decided by both the amputee involved and the rehabilitation team. All progressed at a rate dictated by physical and psychological status, also mutually determined.

Those who underwent amputation surgery close to the end of the study were still actively involved in a rehabilitation programme and were not yet considered to have reached maximum rehabilitation potential. For simplicity, data has been reported as if all amputees had reached their potential.

Acceptance was said to be attained if the amputee wore a prosthesis at least one hour per day. Five of 40 BKAs (12%) fitted with prostheses rejected them as did 10 of 34 AKAs (29%) and three of the 14 bilateral amputees (21%). The total rejection rate of the amputees fitted with prostheses was 20%.

Subjects who accepted their prostheses are categorized as either ambulant (90% of those accepting prostheses) or wheel-chair dependent. Ambulant amputees are further divided into those ambulant with the aid of

Figure 2: Length of stay in rehabilitation hospital
a walking frame, those requiring two walking aids (semi-independent), and those requiring one or no sticks to walk (independent). Results are summarised in Figure 3.

Significance levels were calculated for those variables which might have affected the acceptance of prostheses or mobility level attained. No significant difference was found between level of amputation and acceptance of the prosthesis (p=0.0643), but significantly fewer above knee amputees (11%) reached independent ambulation status. Results of the other variables analysed are summarised in Table 1.

Discussion

Many early studies published indicate a preference for above knee amputation in the population specified (Davis et al 1967, Kihn et al 1972, Harris et al 1974), while those more recent give figures comparable to those obtained in this study (Katrak and Baggot 1980, Boontje 1980, Jenson 1983, Ham 1986). This is in line with findings reported by Steinberg et al (1985), who reported that 'advances in surgical procedures, appropriate anti­biotic therapy and abandonment of overly restrictive criteria in setting indications for BK amputations' (p 742) had led to the view that BK amputation be attempted first whenever feasible.

Table 2: Number of amputees for each study cited

<table>
<thead>
<tr>
<th>Author</th>
<th>Number</th>
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<tbody>
<tr>
<td>Boontje (1980)</td>
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</tr>
<tr>
<td>Cameron et al (1979)</td>
<td>55</td>
</tr>
<tr>
<td>Davis et al (1967)</td>
<td>103</td>
</tr>
<tr>
<td>Ebskov and Josephson (1980)</td>
<td>2029</td>
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<tr>
<td>Ham (1986)</td>
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<td>Hamilton (1972)</td>
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<tr>
<td>Jensen (1983)</td>
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</tr>
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<td>Katrak and Baggot (1980)</td>
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<td>Kegel et al (1978)</td>
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<td>Mazet (1967)</td>
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<td>Sakuma et al (1974)</td>
<td>53</td>
</tr>
<tr>
<td>Steinberg et al (1985)</td>
<td>116</td>
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Age range and means for like patients in other countries are also comparable (Jenson 1983, Ham 1986, Malone et al 1981). Further general comparisons with other studies are difficult to make, however, due to the diversity of data collected by each researcher. Where possible, comparisons have been made with aspects of these studies.

Numbers of amputees in each of those studies cited appear in Table 2.

The proportion of diabetics in populations of people who had amputations due to vascular disease varies greatly, from a rate of 17.3% in England (Harris et al 1974), to 61% in the Netherlands in 1980 (Boontje 1980). The 35% level of concomitant diabetes in this study lies within this range.

The incidence of previous myocardial infarct and previous CVA found in this study is similar to those reported in other studies. Davis et al (1967), in their study of amputations at the Veterans’ Administration hospital in Pittsburgh, U.S.A., noted that 11.7% of amputees had had previous arterial surgery and 8.7% had had lumbar sympathectomy prior to amputation. Boontje (1980) reported that 15% of his population had had previous arterial surgery, while 32% had undergone lumbar sympathectomy prior to amputation. Harris et al (1974) reported 29.3% having had previous arterial surgery and 65.3% as having previous lumbar sympathectomy. (Possible reasons for this relatively large number of sympathectomies were not put forward.) The incidence of previous vascular surgery noted in this study is in line with these findings.

The number of amputees who had died within two years of amputation surgery is similar to the number reported by Ebskov and Josephson (1980), but markedly fewer than found by Kihn et al (1972). Deaths postsurgery are not recorded for this study and may account for the lower figure.
The length of hospital stay quoted yields interesting differences. Average stays of 38.1 and 65.8 days (Malone et al. 1981); 54 days (Ham 1986); 57.6 days (Harris et al. 1974); and 68 days (Jenson 1983) are reported. These figures seem markedly lower than the Australian studies: Katrak and Boggot (1980) quoting an average of 98 days, and this study with an average of 66 days in hospital post-amputation. No explanation can be offered for this difference at this stage, but it will be the subject of further studies.

Despite close scrutiny of the data, no specific ‘type’ of vascular amputee appears to be prone to prolonged hospital stay. The broad spread of time in the Centre (Figure 2) should be noted, however, with the subsequent skewing of the data by a few long-stayers. No statistically significant differences were found between those who stayed as inpatients for a long time and those in for a short period. This includes age, sex, comorbid disorders, past arterial surgery, or level of amputation. Reasons for the apparent increase in length of acute hospital stay for amputees less than 60 years old are not known, since admission procedure to the Queen Elizabeth Geriatric Centre in Ballarat, display similar outcomes to those in a short period. This includes age, sex, comorbid disorders, past arterial surgery, or level of amputation. Reasons for the apparent increase in length of acute hospital stay for amputees less than 60 years old are not known, since admission procedure to the Queen Elizabeth Geriatric Centre in Ballarat, display similar outcomes to those in more recent studies.

Degrees of prosthetic use have been defined as ‘indoors’, ‘minimal usage’, ‘good general use’ and ‘wheelchair dependent’ (Hamilton and Nichols 1972) or divided into categories of ‘functional wearers’, ‘partial wearers’ and ‘nonwearers’ where nonwearers included those who used prostheses for cosmetic reasons (Steinberg et al. 1985).

Rehabilitation status is discussed in terms of being ‘able to get about to some extent’ and ‘wearing their prosthesis to some extent’ (Harris et al. 1974), or ‘used their prostheses for more than a year’ and ‘able to use prostheses successfully’ (Katrak and Boggot 1980). Others describe amputees simply as ‘walking’ (Kihn et al. 1972), or as ‘prosthesis discarded’ (Mazet 1967).

In 1981, Day reported a questionnaire used to objectively measure the activity level of amputees. This was either not available or not applied in the literature and has not been applied in this study. Kegel, Carpenter and Burgess (1978) devised their own questionnaire to rate functional capacity of amputees, but no tests of reliability or validity are applied. Future studies will do well to categorize rehabilitation status using objective and repeatable measures in order to compare data.

Using the criteria of acceptance of a prosthesis as wearing it for at least one hour per day causes some overlap in categories used in other studies. Prostheses in this study are defined as worn for cosmesis alone were considered as ‘accepted’ while their wearers would be considered non-wearers by others (Steinberg et al. 1985). Of all amputees in this study fitted with prostheses, 80% accepted them and of those 90% were ambulant, 81% better than on a walking frame. Of BKAs fitted, 88% accepted them and 63% of these walked with one or no sticks.

While acceptance of prosthesis is not linked to amputation level, the number of above knee amputees attaining an independent mobility status was significantly lower, which may in part be attributed to the greater energy requirements of ambulation, and in part to the insecurity afforded by the prosthetic knee.

In support of the null hypothesis no other amputee ‘type’ in terms of age, sex, comorbid disease or previous arterial surgery, could be identified which would permit prediction or acceptance of prosthesis, or level of mobility attained by the end of rehabilitation.

Conclusions

 Elderly vascular amputees, rehabilitated at the Queen Elizabeth Geriatric Centre in Ballarat, display similar characteristics to those studied in other populations throughout the world. Similarities exist in the age range, the proportion of people with concomitant diabetes, and the incidence of previous CVA or myocardial infarct. Proportion of amputations at each level is also similar to those in more recent studies.

Since 20% of amputees in this study had died less than two years post-amputation, a very limited life-span can be expected for people with amputations with a primary diagnosis of PVD.

Length of hospital stay from amputation to discharge from the rehabilitation hospital was relatively high in this population, and this was the case in only one other study, also of an Australian population. No factor was found which could explain this, nor the increased length of stay in the acute hospital for subjects aged less than 60 at amputation.

It is extremely difficult to compare rehabilitation outcomes across studies, or even to claim a high proportion of ‘successful’ prosthetic users. Considering the criteria for acceptance into the prosthetic programme at the Queen Elizabeth Geriatric Centre, a large number of rejections of prostheses would be expected than for a programme with stringent physical and cognitive pre-requisites. Although it has been stated that a high quality of life may be assumed for those attaining a high mobility level post-amputation, it is necessary to compare with pre-operative mobility and personal goals before drawing conclusions about success of rehabilitation. A higher mobility level for BKAs was, however, noted, perhaps due to the greater energy levels required for AK prosthetic use, or the greater complexity in manoeuvring an AK prosthesis through each gait cycle, or perhaps the figure reflects a trend for AK amputation for those who had poorer mobility pre-operatively.
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Although the null hypothesis is not supported in the area of mobility levels attained by AK amputees and we may expect fewer AKAs reaching independence, several did attain that level without a disproportionate number of deaths or rejections occurring.

Support of the null hypothesis in the areas of age, sex, concomitant disease, and previous arterial surgery seems to ratify the practice of accepting all amputees into the prosthetic programme and accepting a 20% rejection rate of prostheses, in order to prevent exclusion of those who might otherwise be considered too old or too sick to pursue quality of life through greater mobility than a wheelchair alone affords.

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