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Survival rates in dysvascular lower limb amputees

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Dysvascular amputee;
Diabetes;
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Abstract *Background:* To assess the 5-year and 10-year survival rates of major (above ankle disarticulation level) dysvascular lower limb amputees attending a sub-regional Disablement Services Centre (DSC) specialising in amputee rehabilitation. Also to investigate the association between survival rates, cause of dysvascularity, level of amputation, smoking status and occupational status.

Setting: The study was undertaken in sub-regional DSC for amputee rehabilitation covering a base population of about 3.5 million people. Over 80% of lower limb amputations were done for dysvascularity (peripheral vascular disease, diabetic or combination). All these patients were followed up in the DSC for their prosthetic/amputee rehabilitation. Modular case records of 201 consecutive patients from 1994 to 1995 who had diagnosis of dysvascularity as the cause of major lower limb amputations, were scrutinised regarding their 10-year survival; demographic details, level of lower limb amputations, Above Knee (AK = Transfemoral), Below Knee (BK = Transtibial), smoking status, occupational status, healing of the stump at first assessment, cause of amputation and association of these factors with survival rates.

Results: Of 201 individuals with either AK or BK amputations, 60% (121) had AK amputations and 67% (134) were males, the mean age was 69 years of age. Sixty-seven percent (97) had history of smoking, either current 43% (62) or prior 24% (35) smoking, and 59% (68) were skilled or non-skilled manual workers. Fifty-one percent (99) had diagnosis of peripheral vascular disease, whilst 34% (65) had combination of peripheral vascular disease and diabetes, diabetes on its own in 4% (7). In 12% (23) other causes were noted such as embolism, acute ischaemia, venous ulcers, etc. Regarding stumps healing at first assessment, healing was noted in 54% (109) whilst stump was unhealed in 46% (92). The median survival was 48 months. Using Cox proportional hazards regression to identify association with survival, the hazard ratio (HR) was significant regarding level of amputation: HR 2.34; 95% confidence interval (CI) (1.58, 3.47), $P < 0.001$ (a recent BK amputation increases the risk by 2.3 compared to a recent AK amputation in diabetic cohort and also in the peripheral vascular disease/diabetes cohort). Hazard ratio was less than 1.0 in bilateral amputees: HR 0.35, 95% CI (0.21, 0.60), $P < 0.001$ (bilateral amputation decreases risk by 0.35).

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Conclusion: Our study indicates that the median survival remains at 4 years, which is similar to the previously published evidence in the Finish study of 1998 and the earlier study from Scotland in 1992. Unlike the previous data, our study indicates that patients with BK amputations have a higher hazard ratio than the AK amputees, and an association with diabetes has poorer prognosis regarding survival.

Introduction

Manchester Disablement Services Centre (DSC) is a sub-regional Centre in a University Teaching Hospital and is a one-stop centre for amputee/prosthetic rehabilitation covering a population base of approximately 3.5 million people. The DSC sees an average of 300 new amputees per year, of which 80% are dysvascular lower limb amputees. This dysvascular group is made up of patients with lower limb amputations mainly for peripheral vascular disease (PVD), diabetes or a combination of diabetes and peripheral vascular disease. With dysvascular changes in their lower limbs, these amputees also have other systemic manifestations of cardiac impairment, cerebrovascular changes, generalised arterial sclerosis, and long-standing compounding diabetic complications. Currently the majority of the lower limb amputations performed in the United Kingdom is in elderly patients with dysvascularity.[1]

The lower limb amputee needs considerable input as regards in-patient and outpatient care, and thereby places significant demands upon health, social and welfare services.

A previously published study on Survival of the Lower Limb Amputees in Scotland by Stewart et al. indicated that the median survival in the dysvascular amputees was noted to be 3 years 6 months in above-knee amputees, whilst in the below-knee amputees median survival was 4 years 2 months. Patients with PVD-related amputations survived longer than those who had PVD and diabetes-related amputations. Below-knee amputees survived longer than those in the above-knee group.[2]

The 10-year survival study of Finnish lower limb amputees by Pohjolainen et al. indicated that in the PVD group, 43% lived longer than 2 years and 23% longer than 5 years. The median survival in this group was 1 year 6 months. In the diabetic group 47% survived longer than 2 years and 20% longer than 5 years. The median survival in this group was noted as 1 year 11 months. The survival rate was higher in the below knee patients than in the above knee group. Overall the 5-year survival rate was 27% and 10-year survival rate was 15%.[3]

Arterial occlusive disease is multi-system in its manifestation and thus amputation of the lower limb carries an associated risk. This group of patients have often had previous vascular operations and failed re-vascularisation/salvage procedures. Vascular operations followed by amputation are likely to cause higher risk of morbidity/mortality in elderly patients than the amputation surgery on its own.

We formulated our English amputee population study to assess the 5- and 10-year survival rates of our dysvascular lower limb amputees. Additionally we investigated the association between survival rate, cause of dysvascularity, level of amputation, smoking status and occupational status.

Methods

In our sub-regional University Hospital Disablement Services Centre (DSC) all amputees' records are kept in a modular format. The patient database is updated following regular monitoring of monthly death lists. The death lists are noted from the Trust's Information Department, patients' relatives, contact with General Practitioners and Primary Care Trusts. All information on new/primary amputees in Manchester DSC has been recorded on modular data collection forms since 1994. We obtained formal permission for our study from South Manchester University Hospitals Local Research Ethics Committee and analysed data on 201 consecutive dysvascular amputees from March 1994 to March 1995.

We noted demographic details: the age of the patient at the time of the initial assessment, gender, smoking status and occupational status as per Registrar General's Category of occupations.[4]

The level of lower limb amputation was noted as Above knee (AK = Transfemoral) and Below knee (BK = Transtibial). The cause of amputation was sub-divided as peripheral vascular disease (PVD), diabetes on its own and a combination of diabetes/peripheral vascular disease. Other causes were also noted, e.g., acute ischaemia, embolism etc. We noted the healing status of the stump, as healed or unhealed, and whether the patients had bilateral lower limb amputations.

Kaplan–Meier survival graphs were derived. Both univariate and multivariate Cox's proportional hazards regression were used to assess the relationship between survival and the various associated factors. The assumption of proportional hazards were checked using conventional diagnostic plots and were confirmed.

Results

In the 201 dysvascular amputee patients, the mean age was noted to be 69.4 years of age (range 25–93). Sixty-seven percent (134) of the patients were male and 33% (67) female. Sixty percent (121) had above-knee amputations and 40% (80) had below-knee amputations.

Regarding their smoking status, 43% (62) of the patients were current smokers and 24% (35) were ex-smokers. Thirty-three percent 48) had never smoked. In 56 subjects no data on smoking habit were available.

Regarding their occupational status as per the Registrar General's category of occupation, 59% (68) of the patients

were manual workers—skilled or non skilled. In 87 patients no data were available regarding occupational status.

Regarding causes of amputations, these were PVD in 51% (99), a combination of diabetes and PVD in 34% (65), and diabetes on its own in 4% (7). In 12% (23 patients) other causes—embolism, acute ischaemia, venous ulcers, etc.—were noted. In 7 patients no causation was available.

Fifty-four percent (109) lower limb amputation stumps were healed at first visit whilst 46% (92) were unhealed.

Twenty-four percent (49 out of 201) of patients had bilateral below-knee amputations.

The level of amputation, bilateral presentation and cause of amputation were significantly related to survival (see Table 1). The median survival of all patients was 4 years. The survival graph of all patients is shown in Fig. 1.

The 5-year survival rate was 48%, 95% confidence interval (CI) (41–55%) and the 10-year survival rate was 45%, 95% CI (38–52%). Level of amputation, bilateral presentation and cause of amputation were significantly related to survival. Using Cox proportional hazards regression to identify significant independent risk factors, only bilateral/unilateral status and level of amputation were found to be predictive of survival. The risk of death associated with a recent amputation below the knee is over 230% of that with a recent above-knee level [hazard ratio = 2.34, 95% CI (1.58, 3.47); $P < 0.001$]. Bilateral amputation reduces the risk of death to 35% of that with unilateral amputation [hazard ratio = 0.35; 95% CI (0.21, 0.60); $P < 0.001$].

The 5-year survival rates for below knee and above knee amputations were 30% and 60%, whilst the 10-year survival rates were 27% for below-knee and 57% for above-knee amputees. For bilateral and unilateral amputation survival rates were 67% and 42%, respectively. Kaplan–Meier survival graphs for these independent predictive factors are shown in Figs. 2 and 3.

Discussion

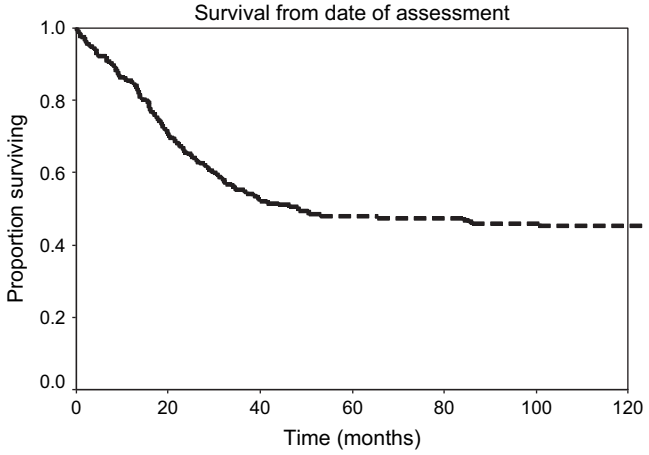
Lower limb amputation in a dysvascular patient is just one manifestation of the multi-system disease in this group of patients. The patients have often had previous vascular operative interventions and failed re-vascularisations. With the progression of peripheral vascular disease over time, patients have multi-system/organ affections, namely cardiac, cerebral, and additional diabetic complications in the diabetic cohort of compounding ophthalmic and neurological impairments.

Previous studies have indicated a median 50% survival of 3–4 years with no significant differences between survival in men and women.[2,3] These previous studies also indicated that the survival rates were better in below-knee amputees who live a year longer than the above-knee amputees, and the vascular non-diabetic amputees survived longer than the diabetic dysvascular amputees. The Scottish study indicated median survival of the dysvascular peripheral vascular disease-related lower limb amputees of 3 years 6 months for above-knee amputees and 4 years 2 months for below-knee amputees, whilst in the diabetic amputee the median survival was 3 years 8 months.

In our study the overall median survival from date of assessment was 4 years. Our study indicated 5-year and 10-year respective survival rates of 60% and 57% for

Table 1 Association with survival

	Hazard ratio (95% CI)	Significance
Gender: Female	1.08 (0.72, 1.62)	$P = 0.71$
(reference category = males)		
Age (1 year increase)	0.99 (0.97, 1.01)	$P = 0.19$
Smoking		$P = 0.15$
Current	1.02 (0.59, 1.76)	
Ex	1.63 (0.92, 2.92)	
(reference category = Never smoker)		
Level of amputation—Below knee	2.18 (1.48, 3.21)	$P < 0.001$
(reference category = above knee)		
Bilateral amputation	0.40 (0.24, 0.69)	$P = 0.001$
(reference category = unilateral)		
Healed	0.99 (0.67, 1.46)	$P = 0.96$
(reference category = not healed)		
Cause		$P = 0.038$
Diabetes	3.03 (1.10, 8.36)	
PVD	1.13 (0.57, 2.24)	
Diabetes + PVD	1.71 (0.86, 3.40)	
(reference category = Other cause)		
Occupation		$P = 0.48$
II	2.04 (0.68, 6.07)	
IIINM	1.12 (0.39, 3.24)	
IIIM	1.23 (0.52, 2.94)	
IV	0.86 (0.32, 2.29)	
(reference category = V)		



Survival:

1 year: 85%

2 years: 66%

3 years: 55%

4 years: 50%

5 years: 48%

6 years: 47%

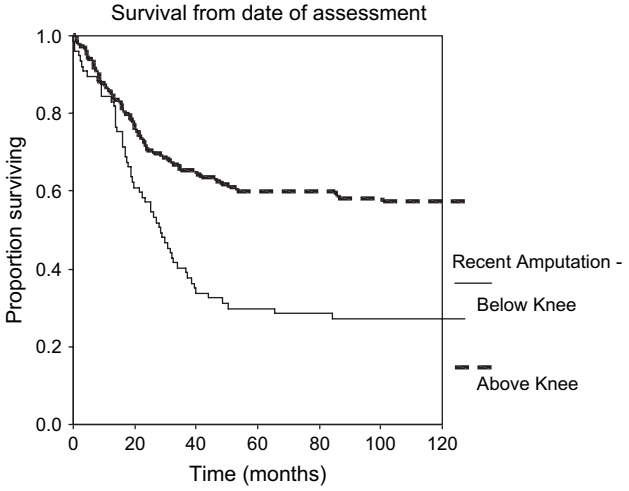
7 years: 47%

8 years: 45%

9 years: 45%

10 years: 45%. [at 11 years the cohort number drops to 15]

Figure 1 Survival for the whole cohort.



Survival	Below knee amputee	Above knee amputee
1 year	84%	86%
2 years	57%	71%
3 years	40%	65%
4 years	32%	63%
5 years	30%	60%
6 years	29%	60%
7 years	29%	60%
8 years	27%	58%
9 years	27%	57%
10 years	27%	57%

Figure 2 Amputation above and below knee.

above-knee amputees and 30% and 27% for below-knee amputees, as compared to the Finnish population study of survival rates of 27% at 5 years and 15% at 10 years. Unlike the other previously published studies, in our group patients with dysvascular below-knee amputations did worse than patients with above-knee amputations. Apart from delayed healing of stumps with resultant increase in morbidity in below-knee amputees, we were unable to delineate any specific reasons for this particular finding.

The improved survival rates in our study of median survival by 6—12 months as compared to the earlier Scottish and Finnish population studies, along with improved (45%) 10-year survival, are likely due to progress in treatment of dysvascularity and diabetes in the last two decades. Early intervention by vascular teams, good glycaemic control by diabetic teams, and comprehensive amputee rehabilitation management of dysvascular lower limb amputees have lea to tangible improvement in survival in the last 15 years.

In the bilateral lower limb amputee the hazard ratio was 0.35. These patients are essentially non-prosthetic users and rely on wheelchair-related independence, as the energy requirements of prosthetic rehabilitation in bilateral above-knee amputees are significantly higher, on the order of 200% more than the normal cohort.[5]

In our study, patients with diabetes, either on its own or in combination with peripheral vascular disease, did worse than the non-diabetic cohort. The hazard ratio was twice as much in the diabetic cohort as compared to the non-diabetic, PVD cohort.

Of interest, there was no significant association between smoking status and association with survival. An earlier

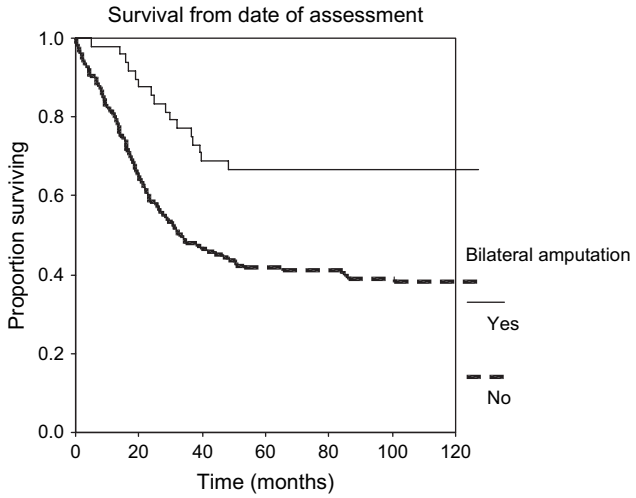


Figure 3 Bilateral amputation.

study by Kulkarni et al. regarding smoking status indicated that in the amputee group 76% of the patients smoked as compared to the national average of 32%.[6]

Hence, all efforts need to be made by both the amputee rehabilitation team and the community teams to try to provide early co-ordinated care for these patients, to improve their quality of life and help them lead a less dependent lifestyle in the community setting.

We recommend that further larger prospective studies be done to confirm our findings.

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