

Cause of death of lower limb amputees

C. P. U. STEWART and A. S. JAIN

Dundee Limb Fitting Centre, Broughty Ferry, Scotland

Abstract

A study was carried out on the cause of death of 100 lower limb amputees who had been admitted to the Dundee Limb Fitting Centre, Tayside, Scotland for prosthetic management or wheelchair training. A comprehensive database has been established in the Centre for 25 years and the database is updated regularly. The date of death was collected and recorded. One hundred sequential deaths were investigated to review the cause of their death and compare this with the recorded causes of death for the Tayside population for the year of study. Ninety three per cent had an amputation for vascular related causes, with 73% having a below-knee amputation and 17% above-knee. Heart disease was the most frequent recorded cause of death (51%) of the amputee whereas only 28.1% of the Tayside group died from this pathology ($p < 0.01$). Carcinomatosis was reported as a cause of death in 14% of the amputees and 23.5% of the Tayside group. Cerebrovascular disease caused death in 6% of the amputees and in 12.3% of the Tayside group (both $p < 0.01$). These findings confirm earlier suggestions that vascular amputees die from heart disease more often than the general population.

Introduction

Peripheral vascular disease (PVD) is the commonest cause of amputation in the western world. The incidence varies from 27% to 85% (Kerstein *et al.*, 1974; Malone *et al.*, 1979). Between 30% and 50% of these PVD patients in addition have diabetes mellitus and many also have other concurrent medical problems.

All correspondence to be addressed to Dr. C. P. U. Stewart, Dundee Limb Fitting Centre, 133 Queen Street, Broughty Ferry, Dundee DD5 1AG, Scotland.

Troup (1976) reported that up to 75% of primary amputees admitted to the Dundee Limb Fitting Centre (DLFC) had at least one other significant pathology.

It is well recognised that dysvascular amputees have a reduced survival as compared with their age related peers. It has been found in a Dundee population that median survival of lower limb amputees was 4 years over a 25 year period, whereas the survival of their peers was greater than 10 years (Stewart *et al.*, 1992).

The cause of the early demise of the lower limb amputees has not frequently been reported but is likely to reflect the aetiology of the amputation. This study reviews the cause of death in patients with lower limb amputations. Previous reports Kallero (1981) and Lindegar (1984) indicated an increased incidence of myocardial problems in these patients as being the commonest likely cause of death. This study confirms that finding.

Method

Tayside operates a comprehensive amputee service with 98% of the amputations being performed in one surgical unit by two teams. Patients are transferred to the DLFC within one week of amputation for prosthetic management or wheelchair training. About 3% of the amputees die prior to admission to the DLFC and a further 6% are considered unfit for either prosthetic management or wheelchair training and are discharged back to the referring hospital.

All patient records are kept in the Centre and are updated regularly.

Prospective information on all primary amputees admitted to DLFC has been recorded, over a 25 year period initially on specially designed charts (1965 - 1981) and

subsequently on an enhanced data sheet. The information is transferred to an Olivetti M24 PC using dBase III+ (1985).

The 9% of amputees described above who were not admitted, were excluded from the study.

The date of death of the amputee is collected and recorded as a routine procedure, for accurate maintenance of records.

The record of the cause of death of 100 sequential deaths was obtained from a variety of sources including the family doctor attending the deceased during the last illness, the hospital doctor who was responsible for the terminal care or from the Tayside Health Board Primary Care Division. The cause of death was linked to the patient file in the database.

Information from the Registrar General for Scotland was also obtained relating to cause of death for the Tayside population for 1987, the year of the study. Results of these two groups were studied and compared.

Results

Table 1 shows the 100 DLFC patients, the cause of amputation and the level of amputation.

Table 2 shows the comparative causes of death in the 100 DLFC patients and the Tayside group. Some 51% of the DLFC group had a death related to heart disease whereas only 28.1% of Tayside group died from this pathology ($p < 0.01$).

Cerebrovascular accident was significantly less in the DLFC cases ($p < 0.01$). Carcinomatosis was only recorded in 14% of DLFC patients whereas in the Tayside group the incidence was 23.5% ($p < 0.01$).

Bronchopneumonia led to the death of 13% of the DLFC group whereas in the Tayside

Table 1. Causes of amputation and final level of amputation achieved.

Causes		
PVD non diabetic	—	61
PVD with diabetes mellitus	—	32
Tumour	—	4
Other	—	3
Level of amputation		
Hindquarter	—	1
Above-knee	—	17
Through-knee	—	3
Below-knee	—	73
Symes	—	1

Average age at amputation — 70 years.

Table 2. Cause of death — Tayside (1987)

	Tayside group	DLFC group	
Myocardial infarction	25.2%	42%	} 51%
Other heart disease	2.9%	9%	
Carcinomatosis	23.5%	14%	
Cerebrovascular accident	12.3%	6%	
Pulmonary disease	10.2%	5%	
Bronchopneumonia	5.4%	13%	
Peripheral vascular disease	0.5%	5%	
Septicaemia	0.2%	3%	
Renal failure	1.0%	1%	
Hypoglycaemia	0.9%	1%	
	79.5% (4111 cases)	1 operative mortality (100 cases)	

(Source for Tayside group — Registrar General Scotland 1987).

group this pathology caused the death of 5.4% ($p < 0.01$).

Table 3 lists the median survival of DLFC cases as 3 years 9 months which was further divided into PVD (without diabetes mellitus) 3 years 10 months, and 3 years 5 months for those with diabetes mellitus (p not significant).

The survival of those dying with myocardial infarction 41% of PVD without diabetes mellitus and 46.9% of those with diabetes mellitus was 2 years and 11 months from the time of amputation, whereas those dying of bronchopneumonia was 5 years 11 months.

The survival of the above-knee (AK) amputees in this study was only 1 year 8 months whereas below-knee (BK) patients survived 4 years 0 months.

Table 4 lists the causes of death in the DLFC group with PVD, with and without diabetes

Table 3. Survival times for the 100 amputees.

Mean survival overall	3 yrs. 9 mnths.
PVD (61 cases — non diabetic)	3 yrs. 10 mnths.
(32 cases — diabetes mellitus)	3 yrs. 5 mnths.
Survival of patients dying with:—	
Myocardial infarction	2 yrs. 11 mnths. (25 of 61 patients (41%) with PVD) (15 of 32 patients (46.9%) with DM)
Bronchopneumonia	5 yrs. 11 mnths.
having had:—	
Above-knee amputation	1 yr. 11 mnths.
Below-knee amputation	4 yrs. 0 mnths.

Table 4. Cause of Death in the Amputee whose amputation was a result of vascular disease.

Cause	PVD non diabetic		PVD with diabetes mellitus	
	Numbers	%	Numbers	%
Bronchopneumonia	9	14.8	4	12.5
Myocardial infarction	25	41.0	15	46.9
Cerebrovascular accident	3	4.9	3	9.4
Carcinomatosis	7	11.5	2	6.3
Congestive cardiac failure	3	4.9	5	15.6
Peripheral vascular disease	4	6.6	1	3.1
Renal failure	1	1.6	—	—
Septicaemia	3	4.9	—	—
Hypoglycaemia	—	—	1	3.1
Respiratory disease	2	3.3	—	—
Pulmonary embolism	2	3.3	1	3.1
Aortic an.	1	1.6	—	—
Op. death	1	1.6	—	—
	61	100	32	100

mellitus. It shows that the incidence of myocardial infarction and bronchopneumonia was unrelated to the cause of amputation.

In addition smoking habits were only recorded in 34 cases, 44% of these admitted to smoking, 56% denied it. No significant difference in survival time between the smokers and non-smokers was found.

Discussion

This paper reviews the cause of death in 100 amputees who had been admitted to DLFC for prosthetic management or wheelchair training. The cause of the amputation in this group is similar to those reported elsewhere (Kerstein *et al.*, 1974; Murdoch and Donovan, 1988) and the levels of amputation reflect the effectiveness of the Tayside Amputation Service with a high level of BK amputation as compared with AK (Table 1). Comparison between the cause of death of the amputee group and the Tayside group revealed significant differences.

In the DLFC group 51% were reported as having a cardiac related terminal event whereas only 21% of the Tayside population had a similar event. This significant difference can only be explained by the widespread nature of the vascular related underlying pathology (93%) leading to amputation (Tables 1 and 2).

More than 30% of patients admitted to the DLFC had clinically established cerebral vascular disease (Stewart, 1985), but only 6% of this DLFC group died of cerebral vascular accidents as compared with the Tayside group where the incidence was 12.3% (Table 2).

The low incidence of cerebrovascular accident as a cause of death in the amputee group may be related to the natural history of PVD and diabetes. The myocardium is particularly vulnerable to the pathologies (MacPherson and Feely, 1990), which may lead to earlier demise from myocardial infarction leading to the high incidence of this terminal event in the amputee group.

Neoplasia is a rare cause of amputation. The incidence of amputation related to neoplasia was 4% in this study, in comparison to reported incidence of 1–2% in other studies (Jain and Stewart, 1989).

However it is surprising that only 14% of the DLFC group had carcinomatosis as the reported cause of death in comparison to the Tayside group in whom this terminal pathology was recorded as 23.5%, a significant difference ($p < 0.01$).

Bronchopneumonia was recorded in 13% (13 cases), as opposed to 5.4% of the whole population ($p < 0.01$), this high incidence may be related to the general frailty and lack of activity of the amputees who have been shown to be less active than their peers (Stewart, 1985).

Although similar incidences of death by myocardial infarction and bronchopneumonia was found in PVD patients with and without diabetes, it was noted that congestive cardiac failure featured slightly more in diabetic patients (Table 4).

Survival of the group was only 3 years 9 months with differences between the vascular cases without diabetes and those with diabetes who appeared to have a shorter, although not statistically significant, survival time.

Survival of AK patients was remarkably less than that of the BK which is in keeping with findings reported in other publications. This difference might be explained by considering that an AK amputee has more widespread disease than the patient requiring a BK amputation, and thus the patient may have severe involvement of major organs (Table 3).

It is important to emphasise that none of the

study cases had a post-mortem examination and it is possible that bias towards the amputee with a past medical history of vascular disease may lead to a higher incidence of cardiac related causes being recorded on the death certificate by the certifying doctors. The policy of only conducting post-mortems in a very few cases in the community also means that the figures from the Tayside group also reflect the doctors' opinion based on clinical grounds as to the cause of death rather than laboratory evidence. This provides a satisfactory comparison between the two sets of data. As stated before are based on clinical evidence rather than pathological evidence.

Acknowledgements

Acknowledgement is due to Mrs. M. Copland who spent many hours collecting the cause of death information and to Mrs. F. Clark for typing the script.

REFERENCES

- JAIN AS, STEWART CPU (1989). Tumour related lower limb amputation: a 23 year experience. *Prosthet Orthot Int* 13, 82-85.
- KALLERO KS (1981). Mortality and morbidity in patients with intermittent claudication as defined by venous occlusion plethysmography. *J Chronic Dis* 34, 455-462.
- KERSTEIN M, ZIMMER H, DUGDALE F, LERNER E (1974). Amputations of the lower extremity — a study of 194 cases. *Arch Phys Med Rehabil* 55, 454-459.
- LINDEGARD P, JONSSON B, LITHNER F (1984). Amputations in diabetic patients in Gotland and Umea Counties 1971-1980. *Acta Med Scand* 687, 89-93.
- MACPHERSON JN, FEELY J (1990). Insulin. *Br Med J* Mar 17, 731-6.
- MALONE J, MOORE W, GOLDSTONE J, MALONE S (1979). Therapeutic and economic impact of a modern amputation program. *Bull Prosthet Res* 10 (32), 7-17.
- MURDOCH G, DONOVAN RG (1988). Amputation surgery and lower limb prosthetics—edited by Murdoch G, Donovan RG. — London: Blackwell Scientific Publications.
- REGISTRAR GENERAL FOR SCOTLAND. Annual Report 1987. HMSO No. 134.
- STEWART CPU. (1985). An investigation into the conditions affecting the levels of activity achieved by primary amputees in the first six months after amputation. M. D. Thesis. Dundee: University of Dundee.
- STEWART CPU, JAIN AS, OGSTON S (1992). Lower limb amputee survival. *Prosthet Orthot Int* 16, 11-18.
- TROUP IM (1976). The assessment of amputation level on the management of stump environment in peripheral vascular disease. Dissertation for D. Med. Rehabil. (Personal Communication).