The Costs of Managing Lower Limb-threatening Ischaemia

S. Singh, L. Evans, D. Datta, P. Gaines and J. D. Beard*

Sheffield Vascular Institute, Northern General Hospital, Sheffield, U.K.

One hundred and fifty consecutive patients presenting with limb-threatening ischaemia were studied prospectively to determine treatment and rehabilitation costs in the first year. Limb salvage was attempted in 104 (69%) patients but failed in 13%. Mortality at 1 year was 27%. The cost of treatment, inpatient stay, occupational therapy, physiotherapy, convalescence, disablement services, home adaptations, home care, district nursing, transportation and outpatient visits were determined for each patient. The patients were classified according to their presentation and initial treatment into five groups (number of patients) whose median management costs (interquartile range) for 12 months were:

Gp 1 (23) - Revascularisation for acute ischaemia = £3970 (2984 – 5511)
Gp 2 (29) - Angioplasty for critical ischaemia = £6611 (3630 – 10200)
Gp 3 (52) - Reconstruction for critical ischaemia = £6766 (4337 – 9677)
Gp 4 (34) - Primary amputation = £10162 (7894 – 13026)
Gp 5 (12) - Primary bilateral amputations = £13848 (11440 – 18056)

At 1 year, there was no significant difference in the cost of managing a patient with a critically ischaemic limb by angioplasty or surgical reconstruction. The cost of revascularisation for acute ischaemia was comparatively low because these patients required minimal rehabilitation. The median cost of managing a patient following amputation was almost twice that of successful limb salvage justifying an aggressive revascularisation policy. However, justification of such a policy on economic grounds requires salvage failure episodes to be minimised as they increase costs considerably.

Key Words: Limb ischaemia; Treatment costs.

Introduction

An aggressive policy of revascularisation in limb-threatening (critical ischaemia) can reduce amputation rates1-3 and such a policy is economically sound.4,5 However, episodes of failed revascularisation increase costs considerably6 whilst evidence suggests that revascularisation by angioplasty results in shorter inpatient stay7 and is thus more cost-effective.

This study prospectively evaluated the costs of managing both acute and chronic limb-threatening ischaemia according to the treatment initiated at presentation.

Patients and Methods

Over a 3 year period, 150 consecutive patients presenting with limb-threatening ischaemia were prospectively entered into this study and followed-up for a year. Limb-threatening ischaemia was defined in chronically ischaemic limbs as the presence of rest pain and an ankle-brachial pressure index (ABI) of < 0.5 whilst in acutely ischaemic limbs, the presence of a sensorimotor deficit and absent Doppler signals at the ankle were required. Limb salvage was attempted in 104 (69.3%) of these patients.

The cost over a period of 12 months of treatment, inpatient stay, occupational therapy, physiotherapy, disablement services, convalescence, home adaptations, home care, district nursing, transportation and outpatient visits were determined for each patient. Treatment costs included those of radiology, theatre and consumable usage. Inpatient stay, occupational therapy, physiotherapy, disablement services (including wheelchair and prosthetic costs), convalescence and outpatient visit costs were calculated for each patient based on estimates of cost per unit time for these facilities (including depreciation costs) obtained from the Department of Corporate Planning, Royal Hallamshire Hospital. The cost of home adaptations and home care were obtained for individual patients from Sheffield Family and Community Services.

*Please address all correspondence to: Mr J.D. Beard, Consultant Vascular Surgeon, Northern General Hospital, Herries Road, Sheffield S5 7AU, U.K.
Transportation costs were provided by South Yorkshire Ambulance Service. Further details of costings are provided in Table 1.

For the purposes of analysis, patients were grouped according to their presentation and the treatment they initially received. Group 1 included all patients presenting with an acutely ischaemic limb who underwent attempted revascularisation. Groups 2, 3 and 4 comprised patients with critically ischaemic limbs who underwent initial treatment in the form of angioplasty, surgical reconstruction and amputation respectively. Patients undergoing bilateral amputation or amputation of a second limb were grouped (group 5) separately because of their greater rehabilitation needs. In analysing the median costs for each treatment group, we included the costs associated with episodes of failed revascularisation. The costs of this sub-group of patients in whom revascularisation failed were also analysed separately. Table 2 shows the median age, ratio of males to females and proportion of diabetics in each group. Patients who underwent primary amputation were younger than those in whom limb salvage was attempted (MW; Z = -2.465; p = 0.0136). There was also a greater proportion of males (Chi-squared = 6.496; df = 1; p = 0.011) and diabetics (Chi-squared = 7.025; df = 1; p = 0.008) amongst those who underwent primary amputation.

Statistical analysis

Statistical comparisons between groups were made using the Kruskal-Wallis analysis of variance (ANOVA). Patients who underwent attempted limb salvage were compared with those who underwent primary amputation using the Mann-Whitney U (MW) test whilst proportions were analysed with a Chi-squared test.

Results

Limb salvage

Limb salvage was attempted in 104 (69%) patients. However, revascularisation failed in 13, four of whom subsequently died. A further 21 patients who underwent attempted limb salvage died giving a mortality at 1 year in these patients of 24%. Limb salvage proved successful in 70 patients (67% of patients in whom it was attempted) which represented 47% of patients in the study.

Mortality

The overall mortality was 27%. There was no significant difference in mortality between the groups (Chi-squared = 1.318; df = 4; p = 0.859).

Costs

Median management costs over 12 months for each treatment group are provided in Table 3. The overall
Table 3. Median costs (interquartile range)

<table>
<thead>
<tr>
<th>Group</th>
<th>Mortality/%</th>
<th>IP Stay/Days</th>
<th>IP Costs/£</th>
<th>OP Costs/£</th>
<th>Total Costs/£</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAI</td>
<td>21.7</td>
<td>23 (13-32)</td>
<td>3799 (2302-5416)</td>
<td>117 (0-491)</td>
<td>3970 (2984-5511)</td>
</tr>
<tr>
<td>ACI</td>
<td>27.6</td>
<td>34 (11-46)</td>
<td>5064 (2285-7023)</td>
<td>1646 (39-2176)</td>
<td>6611 (5380-10200)</td>
</tr>
<tr>
<td>RCI</td>
<td>23.1</td>
<td>28 (17-51)</td>
<td>5167 (3728-8576)</td>
<td>391 (161-1633)</td>
<td>6611 (4337-9677)</td>
</tr>
<tr>
<td>UA</td>
<td>32.4</td>
<td>53 (42-71)</td>
<td>7963 (6475-10001)</td>
<td>1981 (0-3813)</td>
<td>10162 (7894-13026)</td>
</tr>
<tr>
<td>BA</td>
<td>33.3</td>
<td>72 (29-128)</td>
<td>11220 (4723-18056)</td>
<td>1990 (0-2622)</td>
<td>13848 (11440-18056)</td>
</tr>
<tr>
<td>Overall</td>
<td>26.7</td>
<td>34 (19-59)</td>
<td>5747 (3799-8938)</td>
<td>780 (39-2627)</td>
<td>7303 (4314-11566)</td>
</tr>
<tr>
<td>FR*</td>
<td>46.2</td>
<td>79 (56-86)</td>
<td>12402 (8413-13465)</td>
<td>2360 (0-4013)</td>
<td>12927 (11106-15293)</td>
</tr>
</tbody>
</table>

*Sub-group of patients in whom attempted revascularisation failed.

costs incurred in the first year following presentation of primary amputation were far greater than those of attempted salvage (including failures) in limb-threatening ischaemia (MW;Z = -5.502; p = 0.000). The greater proportion of these costs were incurred whilst the patient was in hospital and were related to duration of stay. The cost of attempted salvage in acutely ischaemic limbs was significantly less than in chronic, critically ischaemic limbs (ANOVA; \( H = 42.123; p = 0.000 \)). Whether patients with critically ischaemic limbs underwent attempted salvage by angioplasty or surgery made no significant difference to their management costs (MW;Z = -0.167; p = 0.866). Salvage failure significantly increased management costs beyond those of primary amputation.

**Discussion**

Patients in this study were not randomly allocated to the respective treatment groups and analysis revealed patients who underwent primary amputation were younger and more likely to be male and diabetic when compared to those in whom salvage was attempted. This difference in patient demography may have contributed to part of the difference in management costs but is unlikely to account for virtually doubling the median cost of managing a primary unilateral amputee as opposed to patients in whom salvage was attempted (including failures).

The single largest contributor to cost was duration of inpatient stay which was frequently prolonged in these patients because of slow progress with rehabilitation or delay in discharge because of inappropriate housing or inadequate support. Adequate community care funding and good liaison with community care are vital in order to avoid unnecessary discharge delay/costs. A reduction in inpatient costs could also be effected by shortening the time required for rehabilitation or transfer to a less expensive facility (than an acute vascular surgical ward) which provides the necessary rehabilitation care.

The costs of managing patients with acutely ischaemic limbs were found to be less than those of patients with chronic critically ischaemic limbs. This finding can be explained by the minimal rehabilitation requirements of patients with acutely ischaemic limbs whose inpatient stay was short when compared with that of patients with critically ischaemic limbs. Interestingly, there was no significant difference in the costs of managing patients with critically ischaemic limbs by angioplasty or surgery. This was probably due to the similar degree of ischaemia and tissue loss (comparable number of minor amputations in the two groups) suffered by these patients whose duration of inpatient stay and rehabilitation needs were comparable.

Obtaining accurate estimates of cost for various facilities/services within the health service can be difficult as the cost of certain facilities such as inpatient stay can vary (depending on hospital occupancy rates). However, every effort has been made to obtain accurate estimates in order to limit bias.

This study provides further evidence to support an aggressive revascularisation policy in limb-threatening ischaemia. However, the costs of salvage failure are significantly greater than primary amputation and these episodes need to be minimised to maintain the cost-effectiveness of attempted revascularisation.

**References**

362  S. Singh et al.


Accepted 20 February 1996