The Royal College of Surgeons of England

VASCULAR

Ann R Coll Surg Engl 2009; **91**: 637–640
doi 10.1308/003588409X12486167521271

Update experience of surgery for acute limb ischaemia in a district general hospital – are we getting any better?

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ABSTRACT

INTRODUCTION The aims of this study were to audit results of a 10-year experience of surgery for acute limb ischaemia (ALI) in terms of limb salvage and mortality rates, and to compare results with a historical published series from our unit.

PATIENTS AND METHODS All emergency operations performed during the period 1993–2003 were identified from theatre registers and patient notes reviewed to determine indications for, and outcome of, surgery. Data were compared to a similar cohort who underwent surgery from 1980 to 1990.

RESULTS There was a 33% increase in workload from 87 to 116 patients between the two time periods. The number of patients with idiopathic ALI reduced (24% versus 4%; $P < 0.05$), and there were fewer smokers (71% versus 39%; $P < 0.05$) and a greater number of claudicants (17% versus 35%; $P < 0.05$) in those treated from 1993–2003. Latterly, more patients underwent pre-operative heparinisation (33% versus 80%; $P < 0.05$), received prophylactic antibiotics (14% versus 63%; $P < 0.05$), and had anaesthetic presence in theatre (46% versus 88%; $P < 0.05$). There was also a reduction in local anaesthetic procedures (80% versus 41%; $P < 0.05$). Despite increased pre-operative (15% versus 47%; $P < 0.05$) and on-table imaging (0% versus 16%; $P < 0.05$) technical success did not improve. Whilst complication rates were identical at 62%, there were fewer cardiovascular complications in the recent cohort. The 30-day mortality rate for embolectomy fell from 45% to 33%. Multivariate analysis revealed age > 70 years, prolonged symptom duration, ASA score ≥ III, lack of prophylactic antibiotics, absence of an anaesthetist, and operations performed under local anaesthetic to be associated with increased risk of mortality. Factors adversely affecting limb salvage included prolonged duration from symptom onset to operation, and a history of claudication or smoking.

CONCLUSIONS Despite improvements in pre- and peri-operative management, arterial embolectomy/thrombectomy remains a procedure with a high morbidity and mortality. Further attempts to improve outcome must be directed at early diagnosis and referral as delay from symptom onset to surgery is a major determinant of outcome.

KEYWORDS

Arterial emboli – Embolectomy – Morbidity – Mortality

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Introduction

Acute limb ischaemia (ALI) is both limb- and life-threatening. Whilst management strategies for ALI have alternated from non-surgical to surgical treatment over time, many surgeons still consider surgery to be the best treatment option, despite reports of high mortality (20–30%) and limb salvage rates often as low as 60%.[1–3]

As the population ages, the incidence of ALI is increasing with a diverse range of aetiologies.[4] With a reduction in the prevalence of rheumatic fever, the main aetiological factor now appears to be atherosclerosis and the mean age of the population has shifted from around 50 years to > 70 years. Patients with signs suggestive of imminent limb loss are traditionally treated with emergency surgery, often without pre-operative imaging, since amputation rates are proportional to the delay in relieving the occlusion. However, as a result of the urgency of treatment, common co-morbidities, such as cardiac disease, may not be able to be addressed adequately leading to significant cardiovascular morbidity which is frequently observed.

The aim of this study was to assess a modern series of patients who underwent emergency arterial surgery for ALI and to compare this with a historical series from the same unit[5] in order to evaluate changes in mortality and limb salvage rates.

Patients and Methods

All patients undergoing emergency surgery for ALI during the period 1993 to 2003 were identified from the prospectively maintained theatre register. Only patients in whom an embolectomy or thrombectomy was attempted on a native artery are included and those who had occluded vascular graft were excluded. Patients experiencing trauma as the cause for ALI were likewise excluded.

The case notes were assessed and data retrieved in relation to: demographic features, patient history and risk factors for limb ischaemia, investigations, peri-operative management, and outcome including postoperative complications.

The data were compared to a similar 10-year cohort between 1980 and 1990 in which identical data were collected. Exclusion criteria applied were similar to that of the previous study being compared.

Comparison of proportions was by the chi-squared test with statistical significance was taken at the 5% level.

Results

The number of patients treated in the 1993–2003 cohort (n = 116) represents a 33% increase on the 1980–1990 cohort (n = 87). The patients in the later group were older but not significantly so (mean age 73 years [range, 43–99 years] versus 67 years [range, 50–90 years]). Of the 128 embolectomies performed in the later cohort, 113 were for lower limb embolectomies and 15 were for upper limb emboli. This distribution is identical to that of the 1980–1990 cohort. In comparing patients in 1980–1990 to those treated from 1993–2003, there was a reduction in the number of smokers (71% versus 39%; $P < 0.05$), and an apparent increase in the number reporting claudication prior to presentation (17% versus 35%; $P < 0.05$).

In the later series, atrial fibrillation was the main predisposing factor (Table 1). The number of patients having atheroma identified during the embolectomy was significantly higher in the later cohort. There was a significant reduction in the number of patients in who there was no pre-operative aetiology identified for the emboli from 24% to 4% ($P < 0.05$).

There were a number of significant differences in terms of the pre- and peri-operative factors which are summarised in Table 2. There were significant increases in the use of pre-operative heparinisation (33% versus 80%; $P < 0.05$) and prophylactic antibiotics (14% versus 63%; $P < 0.05$) between the two time periods. Furthermore, there was a significant reduction in the performance of procedures under local anaesthetic (80% versus 41%; $P < 0.05$) and an increasing presence of an anaesthetist during the operation (46% versus 88%; $P < 0.05$). Despite the increased use of pre-operative vascular investigation (Duplex or angiography; 15% versus 47%; $P < 0.05$) and peri-operative angiography (0% versus 16%; $P < 0.05$), the rate of confirmation of a good quality inflow (39% versus 74%; P = ns) and good back-bleeding (75% versus 61%; P = ns) at the end of the procedure did not improve.

The percentage of patients experiencing one or more treatment complications was identical in the twp groups at 62% (Table 3). However, there was a significant reduction in the rate of cardiovascular complications in the later cohort. The overall wound infection rate was 23 of 203 (11.3%). Seventy of the total cohort of 203 received prophylactic antibiotics of whom 14 of 70 (20%) developed a

Table 1 Changing aetiology of arterial emboli between the two cohorts

Aetiology	1980–1990 (n = 87)	1993–2003 (n = 116)
Atrial fibrillation	57	50
Myocardial infarction	6	2
Atheroma	2	41
Supraventricular tachycardia	1	2
Valvular heart disease	0	10
Other	0	6
Not known	21	5

Table 2 Factors associated with outcome following presentation with arterial emboli

Peri-operative factors	1980–1990 (n = 87)	1993–2003 (n = 116)
Pre-operative imaging	15%	47%*
History of smoking	71%	39%*
History of claudication	17%	35%*
ASA grade III or IV	48%	59%
Pre-operative heparinisation	33%	80%*
Prophylactic antibiotics	14%	63%*
Delay from pain onset to embolectomy (range)	29 h (1–264 h)	24 h (2–256 h)
Local anaesthesia	80%	41%*
Presence of anaesthetist	46%	88%*
On-table angiography	0%	16%*
Good quality inflow	39%	74%
Good quality back-bleeding	75%	61%
Thrombolysis	0%	22%*

*$P < 0.05$ (chi-squared test).

Table 3 Complications of embolectomy and relationship to treatment cohort

Postoperative complications	1980–1990 (n = 87)	1993–2003 (n = 116)
Number with complication (%)	54 (62)	72 (62)
Total number of complications	71	96
Myocardial infarction	13 (15)	2 (2)*
Cerebrovascular accident	9 (10)	3 (3)*
Amputation	13 (15)	21 (18)
Wound infection	8 (9)	15 (13)
Further embolus	10 (11)	21 (18)
Chest infection	6 (7)	10 (9)
Haemorrhage	8 (9)	5 (4)
Renal failure	2 (2)	3 (3)
Gastrointestinal haemorrhage	2 (2)	4 (3)
30-Day mortality (%)	39 (45)	38 (33)

*P < 0.05 (chi-squared test).

wound infection as did 9 of 133 (7%) of those not receiving antibiotics. Recurrent ALI was identified in 31 of 203 patients of which 27 occurred in patients not fully heparinised postoperatively. Despite an increase in the proportion of patients of ASA grades III or IV, the 30-day mortality rate for embolectomy fell from 45% to 33%.

Multivariate analysis revealed that factors associated with a significant increase in mortality (P < 0.05) included: age > 70 years, prolonged symptom duration, ASA score ≥ III, lack of prophylactic antibiotics, absence of an anaesthetist, and operations performed under local anaesthetic. Factors found to adversely affect limb salvage (P < 0.05) were a prolonged duration from symptom onset to operation, and a history of claudication or smoking.

Table 4 Relationship between interval to presentation and outcome for the 1980–1990 and 1993–2003 cohorts

Delay in treatment	1980–1990 (n = 87)		1993–2003 (n = 116)	
	Amputation rate (%)	Mortality rate (%)	Amputation rate (%)	Mortality rate (%)
< 5 h	8.5	54	0	0
5–36 h	10	40	11	43
> 36 h	20	57	32	27

The relationship between the delay from onset of symptoms to operation and subsequent mortality or limb loss is summarised in Table 4 and demonstrates superior results with early surgery.

When patients from the 1993–2003 cohort with a diagnosis of atrial fibrillation (n = 50) or atheromatous disease (n = 41) were further assessed, it was noted that the recurrence rates were lower in the arrhythmia group (12% versus 29%; P < 0.05) as was the mortality (10% versus 61%; P < 0.05) although there was no difference in the amputation rate (20% versus 17%). The necessity for additional vascular surgery at the time of embolectomy/thrombectomy was significantly higher in the atheroma group (20% versus 2%; P < 0.05).

Discussion

The primary finding of this study is that, despite efforts to optimise patients prior to surgery, patients with ALI continue to be a high-risk group with significant morbidity including limb loss as well as mortality. Interestingly, there has been some improvement in mortality despite the treatment of a sicker cohort of patients although this failed to reach statistical significance.

In patients with a history of claudication prior to embolectomy, particular effort was made to investigate and delineate the disease; where possible, such patients were treated by thrombolysis. However, as a result of the emergency nature of ALI and the difficulty in differentiating between thrombosis of an atherosclerotic segment and acute embolus, many patients with lower limb atherosclerosis are still going to theatre for presumed emboli.

This study demonstrated that, through increased use of preoperative investigations such as echocardiography, abdominal ultrasound, Doppler studies and arteriography, there was a significant reduction in the number of patients in whom the cause of acute ischaemia was not known. There was an apparent reduction in the number of smokers which may be due to efforts in the community by general practitioners to provide advice on reducing atherosclerotic risk.

Other improvements included increased use of pre-operative anticoagulation and prophylactic antibiotics as well as targeted use of intra-operative arteriography and peri-operative thrombolysis. Unfortunately, these interventions did not improve the limb salvage rate.

Two further important advances were the reduction in the performance of local anaesthetic procedures and a greater presence of an aesthetic during the procedure, these two factors being linked. It may be argued that, in sick patients with high ASA scores, it is better to perform the embolectomy under local anaesthetic. However, it is highlighted in our results, in particular in the later cohort, that a significant proportion of patients who develop ALI also report claudication. In these patients, the embolectomy/thrombectomy procedure itself

may be successful but there is often need for a disobliteration of atheromatous plaque and, in some patients, a bypass procedure may be required. In such cases, a general anaesthetic is required and the presence of the anaesthetist facilitates the process. The presence of an anaesthetist has several additional benefits.[6] The anaesthetist also ensures an additional physiological review of the patient which is beneficial especially for those with multiple co-morbidities. Even if it is decided to perform the procedure under local anaesthetic, it is advantageous to have the anaesthetist present to monitor the patient as they will be high risk especially during the reperfusion phase because of the associated hyperkalaemia, myocardial depression, arrhythmias, myoglobinaemia, and acute renal failure.

The lack of positive outcome in terms of a significant reduction in the limb loss rate or mortality despite improved pre- and peri-operative management is probably indicative of the severity of the insult, be it embolus or thrombus. The mean time from onset of pain to surgery did improve by 5 h from 29 h to 24 h but this still represents a significant ischaemic episode and with it a severe reperfusion injury. The results demonstrated significantly better outcome in the recent series when the embolectomy/thrombectomy was performed within 5 h and in these cases there was no limb loss or mortality.

The study has confirmed the importance of differentiating patients with true acute limb ischaemia due to emboli from those with acute on chronic vascular insufficiency as the latter had increased recurrence and mortality rates as well as the need for further vascular intervention. This is well recognised in the literature. In 1996, Weaver *et al.*[7] randomised patients with acute symptoms attributable to non-embolic native artery occlusion to undergo either thrombolysis or revascularisation, and found that surgery was more effective as well as more durable. The study by Weaver and colleagues[7] led to a retrospective review of the surgical outcomes for acute limb-threatening ischemia in Leicester and this also found in favour of surgery.[8] However, a recent Cochrane review has suggested that there is little difference between surgery and thrombolysis in terms of mortality or limb salvage rates at 30 days, 6 months or 1 year.[9] Thus patients with underlying atherosclerosis can probably be treated equally effectively by either thrombolysis or surgery but are unlikely to benefit from embolectomy alone. In these patients, on-table thrombolysis and/or reconstructive surgery may be required and this is probably best carried out by an experienced vascular surgeon. Hence, the importance in obtaining an accurate pre-operative assessment prior to embarking on surgery. This would also suggest that, whenever possible, a vascular surgeon should be available to assess and manage patients with ALI.

The largest experience of embolectomy to date was reported by Abbott and colleagues in 1982.[4] They noted that the limb salvage rate for embolic ALI varied from 93% when operations were performed within 12 h and the mortality rate was 19%; however, with delayed presentation, the limb salvage rate fell to 78% and the mortality increased to 31%. Furthermore, Elliott and colleagues[10] demonstrated a linear relationship between treatment delay and outcome in embolic ALI. The findings of both papers mirror those of our study and demonstrate that, although there have been numerous advances in peri-operative care, the population with ALI tend to present late and still have a significant mortality and limb loss rates and hence a good clinical acumen in establishing a diagnosis and commencing appropriate surgery is probably the most important factor in improving results in ALI.

Conclusions

This study has demonstrated that, despite improved peri-operative investigation and assessment, reduction in the use of local anaesthetic techniques and greater involvement of anaesthetic personnel, the results of embolectomy for critical ischaemia have not improved significantly. The reason for this would appear to be the delay from symptom onset to surgery as it is evident that a reduced interval is associated with superior outcome. To improve outcome, we would encourage rapid referral of all patients with ALI to a vascular surgeon so that prompt investigation and therapy can be initiated.

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