

Anaesthesia for vascular surgery on the extremities

Richard J Telford

Abstract

Peripheral arterial surgery is challenging, operations are frequently long and associated with insidious blood loss. Because of the high incidence of co-morbidities these patients are a high-risk group with a high incidence of morbidity and mortality. The key to successful outcome is meticulous attention to detail by all those professions involved in their care.

Keywords Amputation; embolectomy; peripheral vascular disease

Royal College of Anaesthetists CPD Matrix: 3A05

Pathophysiology

Peripheral arterial disease (PAD) is a common manifestation of generalized atherosclerosis. The pathogenic processes underlying the disease are the same as those affecting the coronary and cerebral circulations. Multiple factors are implicated including dyslipidaemia, endothelial dysfunction, inflammation, oxidative stress, hypercoagulability and chronic infection.

Atherosclerotic plaques form in the medium- and large-sized arteries – the lower limb being affected more frequently than the upper limb. These plaques may cause a chronic slowly progressing luminal reduction leading to exercise-induced symptoms of tissue ischaemia (intermittent claudication (IC)) or to an acute vessel occlusion, usually due to plaque rupture and thrombosis which causes acute ischaemia. Each year 500–1000 new cases of critical limb ischaemia are diagnosed per million population with an estimated annual cost to the NHS of more than £200 million. Critical limb ischaemia can lead to limb loss or death if not treated promptly.

Epidemiology

The prevalence of PAD increases with age, affecting 15–20% of people aged over 70. Many of these individuals are asymptomatic – only one in three or four people with PAD develop IC. PAD confers a similar risk of cardiovascular death as a history of coronary or cerebrovascular disease. Patients with PAD have a sixfold increase in the risk of death from cardiovascular disease than those without PAD. It is important that risk factors are managed as aggressively as possible.

Risk factors

Sex: the male to female ratio is 2:1 rising to 3:1 in patients with critical ischaemia.

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Learning objectives

After reading this article, you should:

- understand that patients with peripheral arterial disease are a high-risk group
- be able to describe the management of patients presenting for surgical revascularization of the lower limb and amputation
- have an understanding of the management of patients with thoracic outlet syndrome

Smoking: smokers are four times as likely to develop PAD as non-smokers. Those who continue to smoke are more likely to need intervention or amputation than those who give up smoking.

Diabetes: diabetics are twice as likely to have PAD. Amputations are five to 10 times more frequent in diabetics than non-diabetics. Good glycaemic control is paramount; a meta-analysis found that a 1% increase in glycosylated haemoglobin is associated with a 26% increase in the chance of developing PAD.

Dyslipidaemia: those with high levels of cholesterol, low-density lipoprotein (LDL) cholesterol and triglycerides and low levels of high-density lipoprotein (HDL) cholesterol are associated with an increased likelihood of developing PAD.

Hypertension: a blood pressure of greater than 160/95 is associated with a 2.5 times risk of developing intermittent claudication in men and a fourfold risk on women.

Chronic kidney disease (CKD) is associated with accelerated atherosclerosis. CKD promotes dyslipidaemia and hypertension which are in themselves risk factors for the development of atherosclerosis. In addition inflammatory mediators are often elevated and the renin–angiotensin system is frequently activated in patients with CKD, enhancing production of reactive oxygen species and further contributing to the accelerated atherosclerosis observed in CKD.

Black ethnicity: doubles the likelihood of developing PAD.

Chronic limb ischaemia

Patients with PAD usually develop IC, the site of which is determined by the location of the disease. Disease in the superficial femoral artery tends to present with calf claudication. Disease in the iliac, common femoral or tibioperoneal arteries present with pain in the buttock, calf or foot respectively. There is usually a gradual reduction in walking distance over months or years. Rapid exacerbation of symptoms or an acute onset of claudication are important warning signs as they may herald acute arterial occlusion secondary to plaque rupture or embolus. Major amputation is rare in claudicants – only 1–3% of patients with IC require major amputation within 5 years.

Acute limb ischaemia (ALI)

Approximately 5000 patients present each year with acute limb ischaemia in England and Wales. Associated mortality at 1 year is significant (~20%) as is subsequent limb loss (~35%).

Causes of acute limb ischaemia

- **Thrombosis** (60%) – Usually secondary to pre-existing atherosclerosis compounded by acute plaque rupture or reduced flow secondary to cardiac failure or hypovolaemia.

Predisposing factors include:

1. Hypotension
2. Unusual prolonged posture
3. Malignancy
4. Dehydration
5. Hypercoagulability syndromes
6. Hyperviscosity syndromes

Embolus (30%) – The majority of emboli are cardiac in origin e.g. atrial fibrillation or acute myocardial infarction. Most emboli lodge at arterial bifurcations

- **Aortic dissection**
- **Acute peripheral aneurysm thrombosis** (~5%)
- **Trauma** (~3%) Limb fractures and dislocations
- **Iatrogenic** – Arterial cannulation, inadvertent intra-arterial drug administration, extended tourniquet use during surgery, major pelvic surgery

Box 1

The main causes of acute limb ischaemia are outlined in [Box 1](#).

The clinical features of the most common aetiologies differ. Those of **thrombosis** include a previous history of IC, an onset over hours or days and reduced or absent peripheral pulses in the contralateral limb indicating chronic peripheral arterial atherosclerosis. An **embolus** is characterized by an acute onset of symptoms associated with an identified embolic source. Patients rarely have a history of previous IC.

Clinical classification

ALI severity dictates the initial treatment of the patient and is determined by the presence of pain, paraesthesia or paralysis. Severity is classified according to the recommendations of the Society for Vascular Surgery/International Society for Cardiovascular Surgery 1997 ([Table 1](#)).

Clinical management

- Category I patients need treatment with intravenous heparin and analgesia. There is usually adequate time for patients to be fully investigated both surgically and medically and optimized prior to any surgical intervention.
- Category II patients also require heparinization and analgesia. In contrast to category I, complete acute ischaemia (category II) is a medico-surgical emergency as irreversible tissue necrosis results if perfusion cannot be restored within 6 hours of the onset of symptoms. There is minimal time for investigation. Resuscitation and preoperative optimization should not overly delay the proposed urgent intervention.

Treatment: Embolectomy is usually the first-line surgical management of category II ALI. This may be followed by on-table arteriography with subsequent thrombolysis, angioplasty, stenting or arterial bypass. Compartment syndrome secondary to reperfusion injury within the calf muscle necessitates fasciotomy in about 5% of patients whose ALI is successfully treated. Direct pressure measurement of compartment pressures is important. A compartment pressure of 30 mmHg or a diastolic blood pressure less than 30 mmHg above the compartment pressure is an indication for fasciotomy. Patients should be closely monitored for acute rhabdomyolysis with serial creatine kinase measurements and close monitoring of renal performance. A brisk diuresis should be maintained to avoid renal failure.

- Category III patients presenting with irreversible ischaemia may require urgent amputation. This procedure should not be unduly delayed for medical optimization in order to minimize the life-threatening systemic effects of extensive muscle necrosis in the affected limb. Terminal care is sometimes the most appropriate option in patients with extensive tissue involvement and significant co-morbidities.

Anaesthetic considerations

Emergency embolectomy

This is most commonly performed under local anaesthesia. Monitored anaesthesia care is recommended; patients frequently have significant co-morbidity and may be restless and in pain. General anaesthesia may be required if the patient is uncooperative or if more extensive bypass procedures or fasciotomies are

Clinical classification of acute limb ischaemia

Category	Sensation	Paralysis	Suggested treatment
I (Viable)	No loss of sensation	None	Not immediately threatened. Time to investigate
IIa (Threatened)	Minimal loss (e.g. toe)	None	Urgent treatment needed for salvage
IIb (Threatened)	More than toes and associated with rest pain	Partial	Immediate treatment needed for salvage
III (Irreversible)	Profound, anaesthetic	Profound/rigor	Irreversible – primary amputation

From Rutherford, et al. Recommended standards for reports dealing with lower extremity ischemia: revised version. *J Vasc Surg* 1997; **26**:517–538.

Table 1

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