



Guidance on the provision of Vascular Anaesthesia Services

When considering the provision of anaesthesia, the Royal College of Anaesthetists recommends that the following areas should be addressed. The goal is to ensure a comprehensive, quality service dedicated to the care of patients and to the education and professional development of staff. The provision of adequate funding to provide the services described should be considered.

Summary

- Services should be organised so that anaesthesia for all patients undergoing major vascular surgery is provided by a consultant experienced in vascular anaesthesia.
- Anaesthetists undertaking major vascular surgical cases should be supported by adequately trained assistants¹ who work regularly in the vascular theatres.
- Vascular anaesthetists should have some managerial responsibility and should be involved in planning decisions that affect the delivery of vascular services.
- Adequate Level 2 and Level 3 critical care facilities must be available on site for all patients undergoing major vascular surgery.^{2,3}
- Facilities should be available to allow the anaesthetist to be fully involved in decision making for patients undergoing major vascular surgery. This includes access to the tools required for adequate pre-operative assessment. Ideally, this should be within the setting of a formal pre-operative assessment clinic, which should be adequately staffed, supported and allocated sessional programmed activities.²
- Provision should be made for those who may cover vascular emergencies, but do not have regular sessions in vascular anaesthesia to spend time in a supernumerary capacity with a consultant anaesthetist who has a regular vascular commitment.
- Units undertaking major vascular anaesthesia should nominate a named lead clinician to assist dialogue and relationships with vascular surgeons, radiologists, and other appropriate specialists. Departments should facilitate joint audit and management meetings between these parties.
- Patients undergoing major vascular surgery should have access to a multidisciplinary acute pain management service.⁴⁻⁶
- Facilities should be available to conserve blood (e.g. cell salvage or acute normovolaemic haemodilution)⁷ and be supported by the facilities to manage major haemorrhage.⁸
- Local guidelines should exist to assist with the appropriate administration of blood and coagulation products immediately when required.⁹⁻¹³

Introduction: the importance of vascular anaesthesia services

- Vascular anaesthesia encompasses a number of procedures which range from short day case procedures (such as varicose vein surgery) to prolonged complex major arterial surgery. The majority of patients requiring major arterial surgery are elderly, with a high incidence of cardiovascular and respiratory disease.¹⁴⁻¹⁷
- Because of these factors, pre-operative evaluation of patients presenting for vascular surgery presents many challenges.
- The vascular anaesthetist has particular expertise in pre-operative risk assessment, and formal anaesthetic assessment should be part of the decision-making process for patients contemplating high-risk major vascular surgery.
- It has been suggested that individual anaesthetists should not be caring for very small numbers of patients undergoing major elective and emergency aortic or carotid surgery. Anaesthetic departments should review the allocation of vascular cases in order to ensure optimal concentration of experience and expertise.²
- Major vascular surgery includes a significant urgent and emergency workload. The ability to provide emergency cover means that facilities and expertise should be available 24 hours per day. Staffing and resources should also be planned and funded to allow for unpredictable changes in service requirements for urgent vascular procedures.
- Aortic surgery carries high risks of morbidity and mortality,^{16,17} which are greater after emergency than elective procedures.² Patients undergoing aortic surgery require post-operative Level 2 or Level 3 critical care, and these facilities must be available before elective surgery is contemplated. If elective aortic aneurysm surgery is cancelled because of a lack of critical care resources or ward beds, the patient may be exposed to risk of aneurysm rupture.^{18,19} It has been recommended that surgery should be undertaken within eight weeks of the decision to operate.²
- Delay in performing carotid endarterectomy also increases the risk of death or disabling stroke, particularly in symptomatic patients. Current evidence suggests surgery should be performed within two weeks of initial symptoms.²⁰
- Access to diagnostic radiological services may be accorded a lower priority than access for patients with or suspected to have cancer.² Since delays in

treatment for major vascular surgery may lead to death or permanent disability, patients with vascular disease should be accorded a similar priority to other groups of patients.

- Minor vascular procedures may be straightforward but some procedures such as thoracic or thoraco-abdominal aortic surgery may involve collaboration with cardiac surgeons or involve the use of extracorporeal circulation. These uncommon or especially high-risk procedures should only be performed in specialist centres which have the experience, skills and facilities to manage them successfully.
- Increasing numbers of vascular procedures are undertaken by radiologists (e.g. endovascular aneurysm surgery). The morbidity and mortality of some of these procedures can be lower than conventional surgery.^{21,22} However, the risks of anaesthesia in such frail patients remain and may be compounded by the problems of undergoing procedures in an unfamiliar or remote environment (e.g. the radiology department).
- Major lower limb amputation is required in a significant proportion of patients who undergo peripheral vascular reconstruction for acute or chronic limb ischaemia. Mortality and morbidity are very high after major amputation²³ and these patients should receive appropriate peri-operative care from experienced practitioners.

Levels of provision of service

1 Staffing

- 1.1 Vascular surgery is performed in many hospitals in the UK, ranging from district general hospitals to specialist units in large teaching hospitals. Because of the surgical and support infrastructure required, the significant emergency workload, and the problems of maintaining expertise when low volumes of cases are performed, there is some pressure to concentrate services in larger units.³
- 1.2 Vascular anaesthesia is increasingly recognised as a sub-specialty in its own right, with its own specialist society.²⁴ The special skills and knowledge required by all anaesthetists involved in the care of vascular surgical patients overlap with those in other areas of sub-specialisation. In particular they include expertise in the pre-operative assessment of the high-risk patient for major surgery, pre-operative optimisation of co-existing medical conditions, the use of invasive cardiovascular monitoring and

cardioactive or vasoactive drugs, peri-operative renal myocardial and cerebral protection, maintenance of normothermia and the management of major haemorrhage.

- 1.3 Additional skills required in specialist units include expertise in spinal cord protection, visceral perfusion and 'one lung' ventilation.
- 1.4 The pre-operative assessment and decisions regarding the risks of vascular surgery are often complex, time-consuming and require detailed discussions with the patient and other colleagues. It is inappropriate that these decisions are devolved to trainees, and vascular anaesthetists involved in regular pre-operative risk assessment require the appropriate time and facilities to perform this (see section 2.1 below).
- 1.5 The workload generated by urgent and elective vascular pre-operative assessment referrals should be acknowledged by appropriate recognition in terms of consultant programmed activities (PAs) within a department, whether or not a formal clinic operates.
- 1.6 A vascular anaesthetist should be nominated as lead clinician for vascular anaesthesia. This role should include close collaboration with the wider vascular team and other specialists (e.g. radiologists, cardiologists, renal and respiratory physicians), attendance at vascular multidisciplinary meetings, promotion of local evidence-based guidelines and co-ordination of joint audit/research.
- 1.7 An anaesthetist who understands the implications for vascular anaesthesia should be a member of the hospital or trust transfusion committee.
- 1.8 Anaesthesia for major vascular surgery of moderate complexity can be performed by experienced trainees with supervision by a consultant. However, trainees who are not directly supervised should not undertake complex vascular cases in medically unfit patients; there should be a named consultant anaesthetist responsible for every major vascular surgical case. These considerations also apply to vascular patients who require major lower limb amputation after unsuccessful interventions at limb salvage or reperfusion. Mortality and morbidity are very high and these patients may present additional problems because of co-morbidity, immobility and chronic pain. As a high-risk group, lower limb amputees should receive appropriate peri-operative care from experienced practitioners.
- 1.9 When major arterial surgery is performed the anaesthetist must be assisted by a fully trained anaesthetic assistant who has specific training and experience in vascular anaesthetic practice.
- 1.10 Additional theatre staff, who are trained and who possess appropriate competencies, should be available if cell salvage techniques are utilised.
- 1.11 Adequate numbers of trained critical care staff must be available before undertaking major aortic surgery in patients who will require Level 2 or 3 care post-operatively.
- 1.12 For more minor procedures, patients may be initially managed after surgery in a recovery unit or post-anaesthesia care unit. Appropriate numbers of trained staff must be available to manage these patients on a one-to-one basis; staff should be trained in the use of invasive cardiovascular monitoring. Facilities to provide continued Level 1 care should be available on a 24-hour basis.
- 1.13 Medical, nursing and other staff should be adequate to facilitate transfer to an alternative or more specialised vascular unit for emergency patients when required.
- 1.14 Where vascular surgical procedures are performed in the radiology department, requirements in terms of anaesthetic assistance and post-operative nursing are identical to those of patients undergoing vascular surgery in the operating theatre suite. Units performing such procedures must be staffed accordingly.

2 Equipment, support services and facilities

The following equipment, support services and facilities are required for the efficient and safe functioning of the vascular anaesthetic service.

Pre-operative assessment facilities

- 2.1 A vascular pre-operative assessment clinic provides the ideal environment for risk assessment, patient referral and optimisation in advance of surgery. Regular sessional time and PAs should be made available to adequately fulfil these requirements.
- 2.2 The clinic should be consultant led with an adequate support infrastructure, i.e. nursing, secretarial and adequate office space.
- 2.3 The clinic should be supported by immediate access to baseline investigations, e.g. blood tests, electrocardiogram (ECG) and chest X-rays (CXR).
- 2.4 Funding should be also made available for the purchase of simple clinical equipment which may influence risk analysis during the clinic visit. This

includes pulse oximetry, spirometry and blood gas analysis.

- 2.5** Appropriate time should be allocated to individual patients for risk assessment and informed discussion of complex issues relating to patient care.
- 2.6** Clinicians involved in vascular pre-operative assessment should have ready access to senior colleagues in other specialties, e.g. cardiology, respiratory medicine or radiology, who can facilitate specialised or invasive investigations and provide specialist input for certain cases. These referrals should be prioritised so that undue delays to surgery are avoided. Locally drawn up referral criteria will facilitate this process.
- 2.7** Where vascular services are centralised, many patients may live at distant locations. Transport facilities should be available for patient convenience. Facilities should be available for regular audit and improvement of clinic performance.

Equipment

- 2.8** Major vascular surgery often requires the use of large ancillary equipment not usually required by other surgical specialties. These include radiological equipment, rapid blood transfusion devices, cell salvage devices, additional monitoring and infusion devices, and occasionally extra-corporeal circulation devices. Vascular theatres should be of adequate size to safely utilise this equipment, with additional storage space nearby.
- 2.9** Sufficient space should be available in any areas where patients about to undergo vascular surgery are anaesthetised, to perform invasive monitoring and regional anaesthetic techniques in a safe and sterile manner.
- 2.10** All areas where patients undergoing vascular surgery are anaesthetised must be equipped with the facility to perform invasive pressure monitoring. If anaesthesia is induced in an anaesthetic room, then the monitoring should be of similar specification and condition to that used in the operating theatre.
- 2.11** All theatres where aortic surgery is performed should ideally have the capability to perform cell salvage and/or normovolaemic haemodilution. Essential equipment includes a rapid fluid infusion device, fluid and patient warming devices, and infusion pumps.
- 2.12** Facilities and equipment to perform one-lung ventilation must be available when thoracoscopic

or thoraco-abdominal procedures are performed.

- 2.13** Equipment must be available nearby for rapid blood gas analysis and the measurement of haematocrit and blood glucose. The provision of near patient biochemistry and coagulation analysers is highly desirable.¹⁰

Support services

- 2.14** On-site pharmacy services are required for the provision of necessary routine and emergency drugs, including sterile pre-mixed drug solutions for regional analgesia and patient controlled analgesia.
- 2.15** Acute pain management services should be available for all patients undergoing major vascular surgery with the facilities for both post-operative patient controlled analgesia and epidural analgesia services in the ward setting. Sufficient equipment and support must be available for all patients requiring such post-operative pain relief at all times.
- 2.16** Recovery from major vascular surgery may be prolonged, and units must be supported by suitable rehabilitation services, including physiotherapy, occupational therapy and prosthetics services.
- 2.17** Physiotherapy services should be available 24 hours a day.
- 2.18** As with all anaesthetic services, medical physics technicians are required to maintain, repair and calibrate anaesthetic machines, and monitoring, measurement and infusion equipment.
- 2.19** Haematology and biochemistry services must be available to provide rapid analysis of blood and other body fluids and to make blood and blood products for transfusion available without delay, according to clinical need.
- 2.20** Facilities should be available for the rapid and appropriate provision of blood and blood products for all major vascular cases. Hospitals should ensure that personnel directly involved in the distribution and administration of blood and blood components are qualified to perform those tasks and are provided with timely, relevant and regularly updated training.^{8,25}
- 2.21** Protocols and guidelines should be drawn up locally for the management of major haemorrhage so that necessary blood products and drugs are available without delay.^{9,11-13} This should be facilitated through the trust or hospital transfusion committee.

3 Areas of special requirement

Pre-operative assessment

- 3.1** The pre-operative evaluation of patients presenting for vascular surgery presents particular challenges because of the incidence of co-existing disease, in particular cardiorespiratory disease, diabetes and renal disease.¹⁴ All patients undergoing elective major vascular surgery should be seen well in advance of planned surgery to enable appropriate risk analysis.
- 3.2** Determination of a patient's functional capacity is important to aid risk assessment^{17,26} but this may be difficult if exercise tolerance is limited by peripheral vascular insufficiency, respiratory or other disease. Risk stratification based on clinical history may help guide management.²⁷ Guidelines should be drawn up based on best available evidence for further investigation, referral, optimisation and management.
- 3.3** The aims of pre-operative vascular assessment should be to assist risk assessment and the decision to perform surgery, to establish the best surgical options (e.g. non-invasive or endovascular surgery) for an individual, to allow optimisation of co-existing medical conditions including coronary revascularisation if indicated, to permit consideration and institution of secondary prevention measures, and to allow timing of surgery and required facilities (e.g. ICU) to be organised. In order to fully achieve these aims, a properly resourced multidisciplinary pre-operative assessment clinic is required.
- 3.4** Clinicians involved in vascular pre-operative assessment should have ready access to other specialists and tools for non-invasive risk assessment. Local expertise and facilities vary and the precise type of assessment tool used is probably less important than the local expertise.^{28,29}
- 3.5** Short- and long-term outcome in vascular patients can be improved by certain lifestyle changes (e.g. cessation of smoking, weight reduction) and therapies.³⁰⁻³² The pre-operative assessment clinic should be used as an opportunity to implement these, and should therefore be operated by senior clinicians able to assess the need for such interventions, with access to appropriate support services (e.g. pharmacy, dietetics, smoking cessation services).

Peri-operative monitoring

- 3.6** Patients undergoing major vascular surgery may suffer large blood loss or fluid shifts. Peri-operative invasive cardiovascular monitoring is

usually indicated, and the facilities, equipment and expertise should be available in all cases where clinically indicated. Cardiovascular instability and myocardial ischaemia are common during major vascular procedures and are associated with a worse outcome.³³⁻³⁴ Specific ST segment ECG monitoring should be available routinely^{17,29} and other monitoring modalities (e.g. non-invasive cardiac output monitoring or transoesophageal echocardiography) may be required for certain cases.

- 3.7** Surgery may be prolonged and lead to temperature loss. Hypothermia has a number of adverse physiological effects and is associated with a worse outcome in the short and long term.³⁵⁻³⁷ Hypothermia is usually preventable by manipulation of the ambient temperature in conjunction with the use of appropriate patient and fluid warming devices. These should be available and should be used.
- 3.8** The considerations regarding monitoring, expertise, trained assistance, and hypothermia are important wherever the location of the vascular intervention. This is particularly relevant when procedures are performed in a radiology suite as the environment may be unfamiliar. It is important that all facilities required for peri-procedural care are of the same standard as the operating theatre environment. This includes recovery facilities and post-operative care.

Post-operative facilities

- 3.9** Units should possess adequate critical care facilities to provide adequate and appropriate Level 2 or Level 3 care at all times before the start of any major vascular procedure.
- 3.10** Some patients undergoing vascular surgery (e.g. aortic surgery, procedures associated with the use of radiological contrast media or large blood loss) are at increased risk of post-operative renal impairment.³⁸ Post-operative renal failure is associated with a poor prognosis. Facilities to provide renal replacement therapy on site are highly desirable. Where this is not possible, staffing, relationships and guidelines should be in place to facilitate transfer to a unit where renal support can be provided.
- 3.11** Units performing major vascular surgery should incorporate a fully staffed and functional acute pain management team, with the facility to provide post-operative epidural analgesia services in the ward setting.
- 3.12** Post-operative pain services must be continually audited and evaluated.

3.13 Recovery from major vascular surgery may be prolonged, and units must be supported by suitable rehabilitation services, including physiotherapy, occupational therapy and prosthetics services.

4 Training and education

4.1 Patients undergoing elective major vascular surgical procedures should be managed by anaesthetists who have had an appropriate level of training in this specialty.

4.2 In order to maintain the necessary knowledge and skills, consultant vascular anaesthetists should have a regular commitment to the specialty, and adequate time must be made for them to participate in relevant multidisciplinary meetings and continuing professional development (CPD) activities. This should include the facility and resources to visit other centres of excellence in order to exchange ideas and develop new skills where appropriate.

4.3 Much of the knowledge skills and attitudes required to successfully manage high-risk patients undergoing major vascular surgery are not specific to the sub-specialty. However, it is recognised that the outcome of major vascular surgery may be better provided by those with a specialist interest.² Whilst all senior anaesthetists will have experience of relevant issues, such as the management of major haemorrhage or the use of invasive monitoring and vasoactive drugs, this may not reflect their current practice. Some such individuals do not have a regular vascular anaesthetic commitment, but may be expected to provide emergency cover, particularly out-of-hours. Arrangements must be in place and funded to enable all consultant and career grade staff providing occasional vascular anaesthetic cover to participate in appropriate CPD, including occasional accompanied sessions with vascular anaesthetic colleagues. Notwithstanding this, all anaesthetists must recognise and work within the limits of their professional competence.

4.4 An appropriate training programme should be in place for anaesthetic trainees according to their grade. This programme should allow the development of an understanding of the widespread nature of cardiovascular disease, and its relation to peri-operative management.

4.5 All vascular anaesthetists should be able to undertake appropriate pre-operative clinical risk assessment based on a sound knowledge of the individual patient's pathophysiology, available clinical evidence, and local outcome data.

4.6 Those providing assistance for the anaesthetist should be trained to the standards recommended by the AAGBI.¹

5 Research and audit

5.1 All departments undertaking major vascular surgical cases should organise regular interdisciplinary audit meetings with vascular surgeons and radiologists in addition to departmental clinical governance meetings.

5.2 In addition to auditing adverse events and patient outcome, departments should audit delays or cancellations in major elective vascular surgery.

5.3 Departments are encouraged to contribute to national audit databases (as organised by the National Vascular Database and the Vascular Anaesthesia Society of Great Britain and Ireland), and the systems needed to provide the necessary data should be available and supported.

5.4 Departments should facilitate the collection of data required for anaesthetists undertaking major vascular cases to keep a personal logbook.

6 Organisation and administration

6.1 Secretarial and administrative support should be available to facilitate patient referrals for pre-operative assessment, within and outside the confines of a formal pre-operative assessment clinic.

6.2 Cancellation of patients requiring major elective vascular surgery can have serious physical as well as psychological consequences for the patient. Departments should provide elective vascular theatres with appropriately trained staff; senior vascular surgeons and anaesthetists should be available to provide a service which reliably covers the needs for planned surgery throughout the year. Funding and provisions should be made to honour these commitments with adequately trained individuals to cover for sickness, annual and professional or other leave.

6.3 Patients requiring major vascular surgery frequently require Level 2 or Level 3 care post-operatively. The funding and provision of critical care beds must be planned to meet the demands of the service and avoid unnecessary cancellations. Appropriate planning can also improve the use of theatre resources. Patients may present with conditions requiring urgent surgery which is best performed on the next available daytime list. Departments should ensure that theatre time is identified and that senior anaesthetists

and surgeons are available to perform these urgent procedures, so as to respond to changes in demand.

- 6.4 Daytime vascular urgent or emergency lists should be organised and staffed by senior anaesthetists and surgeons working to a fixed sessional pattern and who have no conflicting clinical commitments.
- 6.5 Individuals should not be pressurised into undertaking major vascular cases if any of these resources or expertise are not available.
- 6.6 When very long surgical procedures are scheduled on a regular basis, it will be necessary to arrange the funding and resources to support long duration lists.

7 Patient information

- 7.1 Patients undergoing major vascular surgery are at significant risk of major complications, including death.¹⁷ All patients should be able to come to an informed decision about the relative risks and possible benefits of any planned surgical intervention. It is recommended that a specialist in vascular anaesthesia be involved both in assessing an individual patient's general medical condition and fitness for surgery, and in the decision to perform surgery. This is particularly important in the highest-risk cases, and if surgery is declined by any of the parties involved.
- 7.2 All major complications should be explained to the patient, in an appropriate setting and in a language they can understand. Explanations should include the consequences of these complications (e.g. renal failure requiring dialysis, stroke causing disability).
- 7.3 Options for post-operative pain relief and their risks should be discussed with the patient.
- 7.4 Departments should be able to provide written information leaflets explaining the planned procedure and the possible risks.
- 7.5 These discussions should occur well in advance of planned surgery to allow reflection and informed decision making. All such discussions should be documented, although it is still necessary to give relevant explanations at the time of the procedure.
- 7.6 The above evaluations and discussions are ideally held in the context of a pre-operative assessment clinic, and the facilities to support this should be provided.

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