Preoperative assessment of patients for vascular surgery

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Abstract
Major vascular surgery is associated with a high risk of morbidity and mortality. Targeted assessment of organ systems most likely to suffer morbidity from surgery should be made preoperatively. Thorough history and examination, with appropriate investigation, remain the cornerstone of any such assessment. In addition there is growing evidence as to the benefit of some form of objective functional patient assessment preoperatively. Preoperative assessment made well in advance of surgery allows for risk of adverse events to be discussed with patients, critical care resources to be planned and any medical conditions to be optimized.

Keywords Cardiopulmonary exercise testing; cardiovascular system; functional assessment; preoperative assessment; risk; vascular surgery

Background
Vascular surgery carries major risks due to a combination of frequent comorbidity in this patient population and the high-risk nature of the surgery. National mortality rates up to 8% have been reported for open aortic surgery in the UK, with a high incidence of cardio-respiratory morbidity also a major problem. A multidisciplinary approach has been identified as the best way to deal with such high-risk individuals. As part of this approach the anaesthetist plays a major role in assessing and optimizing patients prior to major vascular surgery. The ideal scenario is for patients to be assessed well in advance of surgery to allow sufficient time for optimization, counselling and speciality referral if required. Early assessment also allows planning of appropriate critical care resources postoperatively. A preoperative assessment clinic with senior anaesthetic involvement has been recommended by the National Confidential Enquiry into Patient Outcome and Death (NCEPOD) to facilitate such optimal conditions. It is vital that appropriate infrastructure, education and resources are made available locally to facilitate effective preoperative assessment.

Cardiovascular system
Cardiac morbidity is the commonest cause of death following vascular surgery. The increase in total body oxygen demand in the perioperative period puts stress on the cardiovascular system, added to the fact that coronary artery disease is common in these patients. A thorough history and examination are the lynchpin of assessment. However there is a growing evidence base recognizing the importance of functional assessment (see below).

History and examination
Patients should be assessed for the following conditions.

1) Coronary artery disease (CAD)
CAD is present in approximately 60% of patients undergoing vascular surgery. Of major concern are individuals who suffer from unstable coronary syndromes (myocardial infarction within 6 weeks or Canadian Cardiovascular Society (CCS) class 3 and 4 angina — Table 1), who generally warrant preoperative cardiological assessment. Chronic stable angina (CCS class 1 and 2) carries a minimally increased risk of perioperative events as long as the condition is medically optimized. Individuals with covert disease are often diagnosed in the preoperative setting, with medical optimization being especially important in this group.

2) Cardiac failure
Cardiac failure has long been recognized as a major cause of morbidity and mortality following surgery. Optimized or non-decompensated ventricular dysfunction rarely requires cardiological referral. Individuals considered to have decompensated cardiac failure must be referred for cardiological assessment and optimization prior to surgery.

3) Valvular lesions
Aortic stenosis is the most common valve lesion in the UK. Severity of stenosis should be assessed, and if severe (gradient...
>60 mmHg, area <1 cm²) or symptomatic, consideration should be given to surgical correction prior to major surgery.

Mitral stenosis carries an increased risk of heart failure and if severe consideration should be given to correction prior to major surgery.

4) Hypertension
Uncontrolled hypertension is a risk factor for both CAD and stroke. Current National Institute for Health and Clinical Excellence (NICE) guidelines suggest a target blood pressure of <140/90 mmHg for secondary risk prevention. Hypertension preoperatively is now considered a more minor risk factor than previously. However uncontrolled blood pressure (systolic >170, diastolic >110) necessitates consideration of surgical delay until optimization is achieved. Current evidence recommends continuing antihypertensive medication perioperatively. However some consideration may be given to omitting angiotensin-converting enzyme (ACE) inhibitors for 12 hours prior to surgery (due to an increased incidence of hypotension). Lability of blood pressure intraoperatively is common in hypertensive patients.

5) Arrhythmias
High-grade arrhythmias include complete heart block, Mobitz type II atrio-ventricular block and symptomatic ventricular arrhythmias. Patients with these conduction defects will require referral to cardiology for treatment prior to major surgery.

Supraventricular arrhythmias (including atrial fibrillation) should be rate controlled to <100 beats per minute preoperatively to minimize the risk of perioperative cardiac ischaemia.

Investigations
All patients should have a resting 12-lead electrocardiograph (ECG) to identify arrhythmias, conduction defects, or pre-existing cardiac pathology. Further cardiac investigations should be selective and done on the basis of clinical findings and functional assessment together with advice from cardiologists. See Table 2.

Functional assessment
Assessment of functional capacity is now recommended prior to major vascular surgery. The American Heart Association (AHA)/American College of Cardiology (ACC) recommends assessing metabolic equivalents (METs) — see Table 3. A score of <4 METs has been identified as the level below which cardiac risk is increased. Assessment of METs based on ‘subjective’ patient reporting of exercise capacity carries an inherent risk of inaccuracy and there is evidence that high-risk individuals may not be identified relying on such a system.

Many authorities recommend objective assessment of functional capacity prior to major vascular surgery. Observing exercise capacity directly, for example stair-climbing, has some evidence base but gives limited information. Cardio-pulmonary exercise testing (CPET) is now being increasingly utilized to dynamically assess exercise capacity. Much useful integrated

### Preoperative cardiac investigations

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<td>• Undiagnosed murmur&lt;br&gt;• Re-assessment of previously diagnosed valve lesion&lt;br&gt;• Assessment of resting ventricular function</td>
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<td>• Dynamic assessment of coronary perfusion</td>
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<td>• Resting ventricular function including fixed abnormalities&lt;br&gt;• Muscle hypertrophy</td>
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<tr>
<td>Dipyridamole thallium scan (DTS)</td>
<td>• Dynamic assessment of coronary perfusion</td>
<td>• Dipyridamole increases HR and cardiac perfusion. Thallium is taken up by heart muscle in proportion to blood supply to an area. Thus thallium scanning can identify areas of reduced perfusion with increasing HR&lt;br&gt;• Risk of precipitating unstable coronary syndrome (1%)</td>
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<td>Coronary angiography</td>
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<td>• Mapping of coronary circulation, stenoses and severity&lt;br&gt;• Assessment of resting left ventricular (LV) function&lt;br&gt;• Facilitates PCI</td>
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Abbreviations: HR = heart rate, CVA = cerebrovascular event, PCI = percutaneous coronary intervention.

Table 2
A full overview of CPET is beyond the scope of this article (see with several previous studies). However, there was a significant confirmed the cardioprotective effect of beta-blockers, in line the AHA/ACC:4

The following recommendations have therefore been made by

- Patients established on therapy should have medication continued perioperatively to avoid withdrawal side-effects.
- In individuals with known CAD, or evidence of inducible ischaemia on preoperative testing, institution of beta-blockade is recommended.
- Consideration should be given to starting beta-blockers prior to high-risk surgery, for example open aortic surgery.

Bisoprolol is now considered to be the drug of choice, initially at a low dose and titrated to achieve a target heart rate of 60–70 beats/minute. Ideally new treatment should be instigated 4 weeks in advance of surgery.5

Statins: have a protective effect perioperatively. Plaque stabilization coupled with an anti-inflammatory action are the hypothesized mechanisms which reduce the incidence of acute plaque rupture and subsequent cardiac morbidity. Continuation of statins perioperatively is associated with a 59% reduction in mortality risk following vascular surgery.4,5 Current class 1 recommendations are:

- all patients with established vascular disease, or undergoing high-risk surgery, should be commenced on statin therapy 1–4 weeks prior to surgery
- statins should be continued perioperatively.

Aspirin: current opinion recommends aspirin should be continued throughout the perioperative period. Consideration should be given to commencing low-dose aspirin (75 mg) preoperatively in individuals with established vascular disease not on treatment.

Clopidogrel: clopidogrel has irreversible effects on platelet function and should be stopped for at least 5 days prior to surgery to minimize bleeding risk. Where central neuraxial blockade (CNB) is to be undertaken, consensus guidance (American Society of Regional Anesthesia – ASRA) recommends cessation 7 days prior to surgery. The specific case of patients with coronary stents is discussed above.

Warfarin: warfarin should be stopped 3–5 days prior to surgery, and if at high risk of thrombo-embolic disease, either an intravenous infusion of unfractionated heparin or high-dose low-molecular-weight heparin should be commenced (as per local guidelines). The international normalized ratio (INR) should be checked immediately preoperatively, and surgery undertaken at an agreed safe level (usually <2). Consensus guidance (ASRA) recommends regional anaesthesia and CNB to be safe at INR levels <1.5.

Respiratory system

Smoking and respiratory disease are common in patients presenting for vascular surgery. The incidence of postoperative respiratory complications, such as infection, atelectasis and the need for ventilatory support is high in this patient group.
operative interventions which have been demonstrated to reduce risk are:

- smoking cessation for >6 weeks prior to surgery
- bronchodilator optimization in individuals with reversible airways disease, for example asthma, chronic obstructive pulmonary disease (COPD)
- eradication of active infection
- steroid treatment — reduces perioperative bronchospasm in individuals with reactive airways
- physiotherapy — instruction in postoperative breathing exercises.

Severity, type (that is obstructive or restrictive) and reversibility of respiratory disease can be assessed using static lung function tests. A forced expiratory volume in 1 second (FEV$_1$) of <70% predicted or FEV$_1$/FVC (forced vital capacity) ratio of <65% indicates high risk of perioperative complications. Arterial blood gas analysis may be useful in patients with poor lung function and may reveal underlying respiratory failure. Cardio-pulmonary exercise testing can be used to assess lung function under dynamic conditions.

It may be necessary to admit some individuals with pre-existing respiratory disease to hospital 24–48 hours in advance of surgery to achieve optimization.

Renal system

Renal dysfunction is prevalent in vascular surgical patients and postoperative renal dysfunction correlates with increased mortality. A creatinine level of >170 mmol/litre has been identified as a risk factor for cardiac morbidity. Few interventions preoperatively have been shown to reduce overall perioperative risk of renal dysfunction. However attention should be given to the following during major vascular surgery:

- avoid prolonged hypotension
- maintenance of normovolaemia and renal perfusion pressure
- minimize aortic clamp times
- minimize use of nephrotoxic drugs, for example radiology contrast during endovascular surgery.

Diabetes mellitus (DM)

Diabetes is common in vascular patients and is associated with renal dysfunction, cardiac disease and autonomic neuropathy. Diabetic control should be stabilized prior to surgery and HbA$_1$C can be used as an indicator of long-term glucose control. Autonomic neuropathy predisposes to perioperative hypotension and may be predicted prior to anaesthesia by the presence of a resting tachycardia, orthostatic hypotension and peripheral neuropathy. Care should be taken to maintain normoglycaemia throughout the perioperative period. Diabetics are at risk of silent myocardial ischaemia and it is important for the anaesthetist to be aware of potential problems.

Discussion

Major vascular surgery provides a multidisciplinary challenge to vascular teams involved in patient management. Preoperative assessment is becoming increasingly recognized as a pivotal component of the care of such patients. The above guidance provides an overview of the current evidence base for preoperative management of vascular patients. As part of the decision-making process it should always be considered that on occasions the risk of surgery may be excessive, and conservative management may be in the patient’s best interests.

REFERENCES


FURTHER READING