

21 Preoperative care including the high-risk surgical patient

- [ARRANGING AN ELECTIVE THEATRE LIST](#)
- [ASSESSMENT OF RISK](#)
- [Airway assessment](#)
- [COMMON PREOPERATIVE PROBLEMS AND MANAGEMENT](#)
- [CONSENT](#)
- [Cardiopulmonary exercise testing](#)
- [Cardiovascular disease](#)
- [Cerebral vascular disease](#)
- [Choosing the right operation for the high-risk patient](#)
- [Drug-eluting coronary stents \(DES\)](#)
- [Dysrhythmias](#)
- [EMERGENCY SURGERY](#)
- [Endocrine and metabolic disorders](#)
- [Examination](#)
- [FURTHER READING](#)
- [Factors contributing to risk](#)

- [Gastrointestinal disease](#)
- [Genitourinary disease](#)
- [Heart failure](#)
- [Hypertension](#)
- [Implanted pacemakers and cardiac defibrillators](#)
- [Introduction](#)
- [Investigations](#)
- [Ischaemic heart disease](#)
- [Learning objectives](#)
- [Musculoskeletal disorders](#)
- [Neurological and psychiatric disorders](#)
- [PATIENT ASSESSMENT History taking](#)
- [PHYSICAL FITNESS](#)
- [Respiratory disease](#)
- [Risk prediction](#)
- [Role of critical care and outreach services](#)
- [Valvular heart disease](#)

ARRANGING AN ELECTIVE THEATRE LIST

ARRANGING AN ELECTIVE THEATRE LIST

The date, place and time of operation should be matched with the availability of appropriately skilled personnel. Appropriate equipment and instruments should be made available. The operating list should be distributed as early as possible to all staff who are involved in making the list run smoothly (Table 21.12). If this is done electronically , familiarity with the computer system is required. A critical care bed should be prearranged for high-risk cases. Elective list order should prioritise patients who are vulnerable to long starvation times, e.g. children and or a prompt theatre start, planning patients with diabetes. F a straightforward case first can utilise time waiting for preprocedure imaging on the second case, e.g. breast wire insertion, or confirmation of a postoperative critical care bed for a high-risk case. List planning using a surgeon's average operation times for a procedure rather than generic estimates leads to better list utilisation. Staggering admission times can improve patient satisfaction but reduces flexibility for 'on the day' changes to list order. /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF

TABLE 21.12 Perioperative teams. Ward, theatre and specialist nursing staff Anaesthetic and surgical teams Radiology and pathology involvement Rehabilitation and social care workers Administration and scheduling team Speci /f_i c personnel in individual cases, e.g. cardiac devices team

ASSESSMENT OF RISK

ASSESSMENT OF RISK

Despite more comorbid patients presenting for surgery, the perioperative mortality has decreased significantly over the last half century, especially in resource-rich countries. In a published systematic review in *The Lancet* by Bainbridge (2012), perioperative mortality has declined from 10 603 per million (95% confidence interval [CI] 10 423–10 784) in the 1970s to 1176 per million (95%CI 1148–1205) in the 1990s to 2000s ($P < 0.0001$). However, there remains a subgroup of patients who are at higher risk of morbidity and mortality after surgery. Patients who have a predicted mortality $\geq 5\%$ should be considered as 'high risk'. It is estimated that, although the high-risk group accounts for less than 15% of all surgical procedures, they contribute to more than 80% of all perioperative deaths in UK. What causes these patients to be at a high risk of death and complications after surgery? After surgery tissue destruction, blood loss, fluid shifts and changes in temperature, pain and anxiety result in increased demands for oxygen delivery to the tissues. This demand increases from an average of 220 mL/min/m at rest to 170 mL/min/m in the postoperative period. Most patients meet this increase in demand by increasing their cardiac output and tissue oxygen extraction. Patients who are unable to meet these demands, as a result of a limited cardiorespiratory reserve, are at a risk of oxygen debt. Occult hypovolaemia resulting from fluid shift or blood loss can further impair oxygen delivery. Splanchnic vasoconstriction to compensate for this may result in gut ischaemia. Those with coronary or cerebrovascular disease are also at a higher risk of myocardial ischaemia or stroke.

Airway assessment

Airway assessment

The difficulty encountered when performing airway manoeuvres, i.e. hand ventilation, intubation and front of neck access, can be predicted to some extent by simple examination. Failure to assess and plan airway management can have fatal consequences. The patient is assessed for: modified Mallampati class (Table 21.3); mouth opening >3 cm (Figure 21.1); thyromental distance >6.5 cm; thyrosternal distance >12.5 cm; ability to protrude the jaw (Figure 21.2); ability to extend the head at the atlanto-occipital junction (Figure 21.3). An essay on the shaking palsy in 1817. When more than one of the above tests are abnormal, the chances of experiencing difficulty in obtaining and securing the airway become greater. Poor dentition, facial hair, upper airway tumours/scarring/infections, obesity and neck size are also important factors that will affect the airway management plan. Previous anaesthetic charts or alerts carried by patients for a difficult airway are invaluable sources when assessing a patient.

modified by Samsoon and Young). Grade 1 Fauces, pillars, soft palate and uvula seen Grade 2 Fauces, soft palate with some part of uvula seen Grade 3 Soft palate seen Grade 4 Hard palate only seen Figure 21.1 Normal mouth opening (>3 cm), demonstrating Mallampati grade 1.

COMMON PREOPERATIVE PROBLEMS AND MANAGEMENT

COMMON PREOPERATIVE PROBLEMS AND MANAGEMENT

- Specific medical problems encountered during preoperative assessment should be corrected to the best possible level. Many patients with severe disease will need to be referred to specialists; the referral letter should contain all the details, including history, examination and investigation results.

CONSENT

CONSENT

Consent is a key part of preoperative care. The process of consent has evolved over the years and, in the UK, is determined by relevant Acts of Parliament, legal judgement and in detail in Chapter 14 .

Cardiopulmonary exercise testing

Cardiopulmonary exercise testing

CPET is the gold standard measurement of a patient's fitness. The oxygen consumption ($\dot{V}O_2$) and carbon dioxide production ($\dot{V}CO_2$) of the patient are measured while they undergo a 10-minute period of incrementally demanding exercise (usually on a cycle ergometer) up to their maximally tolerated level (Figure 21.9). CPET is based on the principle that, when a subject's delivery of O_2 to active tissues becomes inadequate, anaerobic metabolism begins; lactate is buffered by bicarbonate and the resulting CO_2 increases out of proportion to the escalation in physical difficulty and O_2 consumption. The 'anaerobic threshold' (AT) is the $\dot{V}O_2$ in mL/kg/min at which this occurs. Peak oxygen consumption is also measured. This is the end-product of a subject's combined respiratory, cardiac, vascular and musculoskeletal fitness, and subjects with either an AT below 11 mL/kg/min or a $\dot{V}O_2$ peak below 15 mL/kg/min are at higher risk of morbidity and mortality after major surgery. Patients who are found to be unfit can be enrolled in pre-habilitation. This involves supervised exercise over 4–6 weeks with the aim of improving the patient's AT and reducing their risk profile. Where CPET is not available, the low-cost incremental shuttle walk test (ISWT) is an attractive option. It depends on the patient's ability to walk at increasing speed over a flat surface. Patients who fail to achieve 350 metres on the ISWT have been shown to be at higher risk for oesophageal surgery. It correlates well with $\dot{V}O_2$ peak but does not identify all low-risk patients as it is subject to patient motivation and is affected by sex, age and height.

1 MET = 3.5 mL $\dot{V}O_2$ /kg/min (oxygen consumption by a 40-year

old, 70-kg man at rest) 1 MET = eating and dressing 4 METs = climbing two flights of stairs 6 METs = short run



10 METs = able to participate in strenuous sport Figure 21.9 Cardiopulmonary exercise testing (CPET). . Note

-

Cardiovascular disease

Cardiovascular disease

Perioperative cardiovascular complications are frequent. Patients who can climb a flight of stairs without getting short - of breath, having chest pain or needing to stop are likely to tolerate a wide range of surgeries with an acceptable risk of perioperative cardiovascular morbidity and mortality . However, at preoperative assessment it is important to identify those patients who have a high perioperative risk of a major adverse cardiovascular event (MACE) and to try to reduce this risk. Patients at high risk are those with ischaemic heart disease (IHD), congestive cardiac failure, arrhythmias, severe peripheral vascular disease, cerebrovascular disease or signifi - cant renal impairment, especially if they are undergoing major intra-abdominal or intrathoracic surgery .

Cerebral vascular disease

Cerebral vascular disease

Patients who have suffered a cerebrovascular accident have been shown to have a higher rate of MACE postoperatively. This is highest in the first 3 months after a stroke. The urgency of surgery needs to be discussed with the surgeon, anaesthetist and a stroke physician. Ideally elective surgery is postponed until MACE risks stabilise after 9 months. The bleeding versus thrombosis risk of continuing dual antiplatelet therapy needs to be considered.

Choosing the right operation for the high-risk patient

Choosing the right operation for the high-risk patient

There are situations in which the selection of one surgical technique over another may be significantly influenced by patient risk factors. Some procedures are not primarily high risk but may become so in unsuitable patients. Laparoscopic surgery, for example, has come of age as a preferred technique for patients predisposed to postoperative respiratory complications, but its effect on cardiac physiology means that the same may not apply to patients at risk of cardiac complications. The expanding demand and indications for minimal access surgery are now pushing the boundaries of intraoperative physiological tolerance. Robotic prostatectomy and some laparoscopic colorectal procedures require a pneumoperitoneum with steep Trendelenburg (head down) positioning for several hours (Figure 21.10). This can be associated with adverse cardiovascular and neurological complications, such as myocardial ischaemia and increased intracranial pressure in the high-risk group. This risk may be minimised by attention to patient selection.

Drug-eluting coronary stents (DES)

Drug-eluting coronary stents (DES)

Primary percutaneous intervention is the treatment of choice for acute coronary syndromes, and many patients receive stents and are on dual antiplatelet therapy for 12 months. If surgery is absolutely necessary within the period of dual antiplatelet therapy, the management strategy should be decided jointly by the surgeon, cardiologist, anaesthetist and patient, as it is essential to consider the balance of risk of continuing antiplatelet agents (with the risk of increased bleeding) and stopping them (with the risk of stent thrombosis).

Dysrhythmias

Dysrhythmias

In patients with atrial fibrillation (AF), β -blockers, digoxin or calcium channel blockers should be continued in order to control rate. New AF or atrial flutter should be investigated and treated. These patients should be considered for cardioversion as restoring sinus rhythm can improve cardiac output by 15% (Figure 21.5). Patients with an abnormal rhythm on ECG, for example tachycardia/bradycardia or heart block, should also be discussed with a cardiologist (Figure 21.6). Symptomatic heart blocks and asymptomatic second- (Mobitz II) and third-degree heart blocks, if discovered at the preoperative assessment clinic, will need cardiology consultation and potentially temporary or permanent pacemaker insertion. Warfarin in patients with AF should be stopped 5 days preoperatively to achieve an international normalised ratio (INR) of 1.5 or less, which is safe for most surgery . The newer anticoagulants such as dabigatran (direct thrombin inhibitor) or rivaroxaban, apixaban and edoxaban (direct factor Xa inhibitors) do not have antagonists and must be stopped preoperatively , generally for 2–3 days in patients with normal renal function and longer when renal function is impaired. Alternative anticoagulation is not required in the perioperative

•
V1 II V5 Figure 21.5 Atrial /f_l utter

period unless the risk of stroke is high (assessed using the CHA₂DS₋₂-VASc [congestive heart failure, hypertension, age ≥ 75 years, diabetes mellitus, stroke or transient ischemic attack, vascular disease, age 65–74 years, sex category] score). Decisions on bridging therapy should balance the risks of stroke and bleeding.

V1 I I V5 Figure 21.6 Routine preoperative electrocardiogram in an 83-year-old patient with no symptoms other than lethargy for the last 3 months. This shows complete heart block with dissociated P waves and QRS complexes, requiring preoperative pacing.

EMERGENCY SURGERY

EMERGENCY SURGERY

In emergency surgery the principles of preoperative assessment should be the same as in elective surgery, except that the opportunity to optimise the condition of the patient is limited by time constraints. The urgency of surgery should be graded, e.g. by using the NCEPOD classification of intervention, and emergency theatre cases should be prioritised accordingly, i.e. immediate (within minutes), urgent (within hours), expedited (within days) or elective (timing to suit patient, hospital and staff). Medical assessment and treatments should be started even if there is no time to complete them before the start of a time-critical surgical procedure. Some risks may be reduced but some may persist; whenever possible, these need to be discussed with the patient during the consent process. Optimisation before urgent surgery can be more effective in a critical care environment and patients may need to be admitted to critical care preoperatively. The likelihood of a high-risk emergency patient requiring postoperative critical care should be identified and discussed with the duty critical care physician. Summary box 21.3 Preoperative assessment for emergency surgery

- Start . Similar principles to that for elective surgery Constraints . Time, facilities available Consent . May not be possible in life-saving emergencies Organisational efforts . For example, local/national algorithms for the treatment of patients with multiple injuries

Endocrine and metabolic disorders

Endocrine and metabolic disorders

Malnutrition Body mass index (BMI) is weight in kilograms divided by height in metres squared. A BMI of less than 18.5 indicates nutritional impairment and a BMI below 15 is associated with

Thomas Addison, 1795–1860, physician, Guy's Hospital, London, UK, described the effects of disease of the suprarenal capsules in 1849. mum of 2 weeks before surgery is required to have any impact on subsequent morbidity. If a patient is unlikely to be able to eat for a significant period postoperatively this can be anticipated and alternative nutritional support must be planned.

Obesity Morbid obesity can be defined as BMI of more than 35 (other definitions exist) and is associated with an increased risk of postoperative complications. Patients should be made aware of the risks involved and advised on healthy eating and taking regular exercise. If possible, surgery should be delayed until the patient is more active and has lost weight. If this fails, prophylactic measures need to be taken, such as preventative measures for acid aspiration and deep vein thrombosis (DVT). OSA that is unrecognised has been shown to be associated with a higher incidence of MACE in comorbid patient groups. Identification of those at higher risk by using a clinical scoring system, such as the perioperative sleep apnoea prediction (P-SAP) score, can rationalise referral for formal sleep apnoea studies. Urgency of surgery may preclude full investigation and treatment preoperatively. Patients with severe OSA require 6 weeks of nocturnal continuous positive airway pressure (CPAP) use preoperatively to reduce their risks. Associated risks need to be explained prior to the surgery and an appropriate anaesthetic technique planned with postoperative monitoring.

Diabetes mellitus Diabetes and associated cardiovascular and renal complications should be controlled to as near a normal level as possible before embarking on elective surgery. Any history of hyper- and hypoglycaemic episodes and hospital admissions should be noted. For elective surgery, an HbA1c of <69 mmol/mol is recommended. Lipid-lowering medication should be started in patients who are in a high-risk group for cardiovascular complications of diabetes. Patients with diabetes should be first on the operating list and their antidiabetic medication adjusted as per local or national guidance, as they will miss a meal preoperatively. Although tight control of blood sugar is not needed, the patient's blood sugar levels should be checked hourly. Variable rate intravenous insulin infusion (VRII) should be started for patients with diabetes on insulin undergoing major surgery or if blood sugar is difficult to control for other reasons.

Adrenocortical suppression Patients receiving oral adrenocortical steroids should be asked about the dose and duration of the medication to determine the need for supplementation with extra doses of steroids perioperatively so as to avoid an Addisonian crisis. A patient taking >5 mg prednisolone equivalent within a month of surgery will require supplementation at induction and postoperatively.

Neuroendocrine tumours, including pheochromocytoma, carcinoid, gastrinoma, VIPomas and insulinoma, have specific treatments that must be started preoperatively in liaison with specialist endocrinology

physicians. Anaemia and blood transfusion Patients found to be newly anaemic (haemoglobin <130 g/L), with an expected operative blood loss of >500 mL, should be investigated for the cause of their anaemia. Any vitamin or iron deficiency should be corrected before proceeding for elective surgery. Chronic anaemia is well tolerated in the perioperative period where <500 mL blood loss is expected, but where possible should be corrected. Preoperative transfusion may be considered rarely for elective patients when guided by a haematologist. Local policy should agree which procedures require a preoperative 'group and save' or cross-matched blood sample. Some patients may refuse blood transfusion, for example a Jehovah's Witness. In such a case, during the consent process discussion should include which blood product and/or system (e.g. cell salvage, reinfusion from drains) is acceptable. The discussion should extend to other areas, for example whether refusal of transfusion would apply in life-threatening situations. As in all consent processes, the discussion and outcome should be clearly documented. Thrombophilia Factor V Leiden and deficiencies in antithrombin III and proteins C and S increase the patient's thrombosis risk. The patient will need special discussion with a haematologist to tailor their venous thromboembolism prophylaxis. For all other patients a DVT risk assessment should be made preoperatively and precautions planned as per local or national guidance. Risk factors are included in Table 21.4. The progesterone-only contraceptive pill should be continued; however, the risks of continuing the combined pill (slight increased risk of significant thrombosis) should be weighed against the risks of an unplanned pregnancy. Consider stopping oestrogen-containing oral contraceptives or hormone replacement therapy 4 weeks before surgery (NICE guidance; see Further reading). Bleeding disorders Bleeding disorders such as haemophilia, von Willebrand disease or thrombocytopenia are best discussed with haematology preoperatively.

Examination

Examination

Patients should be treated with respect and dignity , receive a clear explanation of the examination undertaken and be kept as comfortable as possible. A chaperone should be present, especially for intimate examinations. This should be part of a local guideline or policy .

James Parkinson , 1755–1824, general practitioner of Shoreditch, London, UK, published the original article suggesting that the size of the base of the tongue is an important factor in determining the degree of difficulty of direct laryngoscopy in the Canadian Anaesthetists' Society Journal in 1985. The original Mallampati classification was modified from a total of three to four classes by GLT Samsoon and JRB Young after reviewing a series of obstetric and general surgical patients who had had difficult intubations.

Examination is especially important in symptomatic individuals and at a minimum should include cardiorespiratory examination and airway assessment. Specifically , look for signs of heart failure, valvular heart disease, peripheral vascular disease and respiratory disease (Table 21.2).

Cardiovascular Valvular heart disease Ischaemic heart disease: angina, myocardial infarction, coronary stents Hypertension Heart failure Dysrhythmia Peripheral vascular disease Cardiac devices, i.e. permanent pacemaker Respiratory Chronic obstructive pulmonary disease Asthma Respiratory infections Obstructive sleep apnoea symptoms Gastrointestinal Peptic ulcer disease and gastro-oesophageal reflux Liver disease Genitourinary tract Urinary tract infection Renal dysfunction For females last menstrual period/pregnancy/breastfeeding status Neurological Epilepsy Cerebrovascular accidents and transient ischaemic attacks Parkinson's disease Multiple sclerosis Psychiatric disorders Cognitive function Anxiety or depression Endocrine/metabolic Diabetes Thyroid dysfunction Pheochromocytoma Porphyria Locomotor system Osteoarthritis Inflammatory arthropathy, i.e. rheumatoid arthritis Disorders of muscle, i.e. muscular dystrophy, myasthenia, myopathy Haematological Bleeding disorders Personal or family history of deep vein thrombosis and pulmonary embolism Objection to blood product transfusion Haemoglobinopathy, i.e. sickle cell disease Infection Human immunodeficiency virus/hepatitis/tuberculosis Other, i.e. MRSA/COVID-19/drug-resistant organisms Previous surgery and anaesthesia Problems encountered, i.e. difficult Airway Society Alert, suxamethonium apnoea Family history of problems with anaesthesia, i.e. malignant hyperpyrexia COVID-19, coronavirus disease 2019; MRSA, methicillin-resistant *Staphylococcus aureus* . General: positive findings, even if not related to the proposed procedure, should be explored further Surgery related: type and site of surgery, with reference to imaging and investigations Systemic: comorbidities and extent of limitation of each organ's function Specific: for example, suitability for positioning during surgery or to plan airway management

TABLE 21.2 Medical examination. General Anaemia, jaundice, cyanosis, frailty,

nutritional status, sources of infection (teeth, feet, leg ulcers), height, weight and BMI
Cardiovascular Pulse rate and rhythm, blood pressure, heart sounds, bruits, jugular venous pressure, peripheral oedema, exercise tolerance Respiratory Respiratory rate and effort, chest expansion and percussion note, breath sounds, oxygen saturation at rest and exertion, consider PEFR Gastrointestinal Abdominal masses, ascites, bowel sounds, hernia, genitalia Neurological Consciousness level, cognitive function, sensation, muscle power, tone and reflexes Airway Mouth opening, neck extension, Mallampati assessment score, thyromental distance, jaw protrusion, scarring to mouth or neck, dentition BMI, body mass index; PEFR, peak expiratory flow rate.

FURTHER READING

FURTHER READING

Bainbridge D, Martin J, Arango M, Cheng D; for the Evidence-based Peri-operative Clinical Outcomes Research (EPiCOR) Group. Perioperative and anaesthetic-related mortality in developed and developing countries: a systematic review and meta-analysis. *Lancet* 2012; 380 (9847): 1075–81.

Barker P, Creasey PE, Dhatariya K et al. Peri-operative management of the surgical patient with diabetes. *Anaesthesia* 2015; 70 (12): 1427–40.

Boyd O, Jackson N. How is risk defined in high-risk surgical patient management? *Crit Care* 2005; 9 : 390–6.

Chan MTV, Wang CY, Edwin S et al. Association of unrecognized obstructive sleep apnoea with postoperative cardiovascular events in patients undergoing major non cardiac surgery. *JAMA* 2019; 321 (18): 1788–98.

Department of Health. Mental Capacity Act (MCA). England and Wales. London: HMSO, 2005.

Duminda N, Wijesundera W, Beattie S et al. Integration of the Duke Activity Status Index into preoperative risk evaluation: a multicentre prospective cohort study. *Br J Anaesth* 2020; 124 (3): 261–70.

Fleisher L, Fleischmann K, Auerbach A et al. 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol* 2014; 64 (22): e77–e137. from <https://www.gmc-uk.org/ethical-guidance/ethical-guidance-for-doctors/decision-making-and-consent>.

Gri ffi ths R, Beech F, Brown A et al. Peri-operative care of the elderly 2014. *Anaesthesia*. 2014; 69 : 81–98.

Gri ffi ths R, Babu S, Dixon S et al. Guideline for the management of hip fractures 2020. *Anaesthesia* 2021; 76 : 225–37.

Hartle A, McCormack T, Carlisle J et al. The measurement of adult blood pressure and management of hypertension before elective surgery. *Anaesthesia* 2016; 71 (3): 326–37.

Jørgensen ME, Torp-Pedersen C, Gislason GH et al. Time elapsed after ischemic stroke and risk of adverse cardiovascular events and mortality following elective noncardiac surgery. *JAMA* 312 (3): 269–77.

Kristenson SD, Knuuti J, Saraste A et al. 2014 ESC/ESA Guidelines on non-cardiac surgery: cardiovascular assessment and management: The Joint Task Force on non-cardiac surgery: cardiovascular assessment and management of the European Society of Cardiology (ESC) and the European Society of Anaesthesiology (ESA). *Eur Heart J* 2014; 35 : 2383–431.

Lee TH, Marcantonio ER, Mangione CM et al. Derivation and prospective validation of a simple index for prediction of cardiac risk of major noncardiac surgery. *Circulation* 1999; 100 : 1043–9.

Minto G, Biccard B. Assessment of the high-risk perioperative patient. *BJA Educ* 2014; 14 (1): 12–17.

Munoz M, Acheson G, Auerbach M et al. International consensus statement on the perioperative management of anaemia and iron deficiency. *Anaesthesia* 2017; 72 (2): 233–47.

Murray P, Whiting P, Hutchinson S et al. Preoperative shuttle walking testing and outcome after oesophagogastrrectomy. *Br J Anaesth* 2007; 99 (6): 809–11.

National Confidential Enquiry into Patient Outcome and Death (NCEPOD). An age-old problem: a review of the care received by elderly patients undergoing surgery, 2010. Available from https://www.ncepod.org.uk/2010report3/downloads/EESE_fullReport.pdf.

National Confidential Enquiry into Patient Outcome and Death (NCEPOD). Knowing the risk. A review of the perioperative care of surgical patients, 2011. Available from <https://www.ncepod.org>.

uk/2011report2/downloads/POC_fullreport.pdf. National Emergency Laparotomy Audit (NELA) Project Team. patient report of the National Emergency Laparotomy Audit , 2020. Available from <https://www.nela.org.uk/reports>. tests for elective surgery . NICE Guideline 45. London: NICE, 2016. Available from <https://www.nice.org.uk/guidance/ng45>. National Institute for Health and Care Excellence. Decision-making and mental capacity . NICE Guideline 108. London: NICE, 2018. Available from <https://www.nice.org.uk/guidance/ng108>. National Institute for Health and Care Excellence. Venous thromboembolism in over 16s: reducing the risk of hospital-acquired deep vein thrombosis or pulmonary embolism . NICE Guideline 89. London: NICE, 2019. Available from <https://www.nice.org.uk/guidance/ng89>. National Institute for Health and Care Excellence. Perioperative care in adults 2014; . NICE Guideline 180. London: NICE, 2020. Available from <https://www.nice.org.uk/guidance/ng180>. Noordzij PG, Poldermans D, Schouten O et al . Postoperative mortality in The Netherlands: a population based analysis of surgery-specific risk in adults. *Anesthesiology* 2010; 112 (5): 1105–15. Practice guidelines for the perioperative management of patients with obstructive sleep apnea: a report by the American Society of Anesthesiologists Task Force on Perioperative Management of Patients with Obstructive Sleep Apnea. *Anesthesiology* 2006; 104 : 1081–93. Royal College of Surgeons. Caring for patients who refuse blood: a guide to good practice for the surgical management of Jehovah's Witnesses and other patients who decline transfusion , 2016. Available from <https://www.rcseng.ac.uk/-/media/files/rcs/library-and-publications/non-journal-publications/caring-for-patients-who-refuse-blood--a-guide-to-good-practice.pdf>. Royal College of Surgeons. Consent: supported decision making: a guide to good practice , 2018. Available from <https://www.rcseng.ac.uk/standards-and-research/standards-and-guidance/good-practice-guides/consent/>. Shoemaker WC, Appel PL, Kram HB et al . Hemodynamic and oxygen transport responses in survivors and non survivors of high risk surgery . *Crit Care Med* 1993; 21 (7): 977–90. Woodcock T , Barker P , Daniel S et al . Guidelines for the management of glucocorticoids during the perioperative period for patients with adrenal insufficiency . *Anaesthesia* 2020; 75 (5): 654–63. Sixth

Factors contributing to risk

Factors contributing to risk

Risk is a complex interaction of multiple factors that can be classified into patient and surgical factors. Patient factors are listed in Table 21.6. The elderly, although not independently at higher risk, not only have more cardiac, pulmonary and renal disease but also require surgery four times as often as the rest of the population. Around 10% of the population over 65 are frail, with increasing incidence associated with age. Multiple body systems lose their in-built reserves in the elderly. The type of surgery contributes independently and is listed in Table 21.7. This risk increases if the surgery is performed as an emergency. Often, the underlying condition requiring surgery itself may be associated with an increased risk of complications. For example, a patient with severe peripheral vascular disease resulting from heavy smoking may need a femoral-popliteal bypass graft and can be expected also to have significant COPD and IHD. Moreover, when mortality by type of surgery is adjusted for patient risk factors, the apparent hierarchy of surgical risk may change. The average mortality risk for an individual patient undergoing thoracic surgery, for example, is likely to be higher than the average risk for that same patient undergoing vascular surgery. Complications associated with the latter are greater medical risk factors (Table 21.8).

et al.

TABLE 21.6 Patient factors that predispose to high risk of morbidity and mortality. Previous severe cardiorespiratory illness, e.g. acute myocardial infarction, COPD or stroke Late-stage vascular disease involving the aorta Age >70 years with limited physiological reserve in one or more vital organs Extensive surgery for carcinoma Acute abdominal catastrophe with haemodynamic instability (e.g. peritonitis) Acute massive blood loss >8 units Septicaemia Positive blood culture or septic focus Respiratory failure: $\text{PaO}_2 < 8 \text{ kPa}$ or FIO_2

“ 0.4 or mechanical FiO_2 ventilation >48 hours Acute renal failure: urea >20 mmol/L or creatinine >260 $\mu\text{mol/L}$ COPD, chronic obstructive pulmonary disease; FIO_2 , fraction of O_2 inspired oxygen; PaO_2 , arterial oxygen partial pressure. 2 Based on clinical criteria used by Shoemaker and colleagues, modi

defined by Boyd. TABLE 21.7 Surgery-specific estimates of risk. High risk (cardiac risk Intermediate risk Low risk (cardiac

5%) (cardiac risk 1–5%) risk <1%) Open aortic Elective abdominal Breast Major vascular Carotid Dental Peripheral vascular Endovascular Thyroid Urgent body cavity Aneurysm Ophthalmic Head and neck Gynaecological Major neurosurgery Reconstructive Arthroplasty Minor orthopaedic Elective pulmonary Minor urology Major urology From Eagle KA, Berger PB, Calkins H et al .; American College of Cardiology; American Heart Association. ACC/AHA guideline update for perioperative cardiovascular evaluation for noncardiac surgery: executive summary: a report of the American College of Cardiology/ American Heart Association evaluation for noncardiac surgery. J Am Coll Cardiol 2002; 39 (3): 542–53. TABLE 21.8 The effect of adjustment for patient factors on surgery-specific operative mortality. Type of surgery Unadjusted 30-day Adjusted 30-day mortality (% (rank)) mortality (%(rank)) 0.98 (5) 5.97 (1) Vascular 2.28 (1) 3.40 (2) Thoracic 1.83 (2) 2.73 (3) Abdominal 1.13 (4) 2.70 (4) Cardiac 1.60 (3) 1.74 (5) Neurosurgery 0.49 (7) 1.25 (6) Orthopaedic 0.68 (6) 0.85 (7) Ear-nose-throat 0.38 (8) 0.81 (8) Urology 0.17 (9) 0.13 (9) Gynaecology 0.08 (10) 0.07 (10) Breast Modi /f_i ed from Noordzij et al . (2010).

Scores predicting mortality Scores not requiring ASA operative information APACHE-II Hardman index Glasgow aneurysm score Surgical Outcome Risk Tool (SORT) Boey score Hacetteppe score Physiological POSSUM ACS NSQIP surgical risk score Scores requiring operative Mannheim peritonitis index information NELA score Reiss index Fitness score POSSUM P-POSSUM Cleveland colorectal model Surgical risk scale ACS NSQIP , American College of Surgeons National Surgical Quality Improvement Programme; APACHE-II, Acute Physiology and Chronic Health Evaluation II; ASA, American Society of Anesthesiologists; NELA, National Emergency Laparotomy Audit; POSSUM, Physiologic and Operative Severity Score for the enUmeration of Mortality and Morbidity; P-POSSUM, Portsmouth-POSSUM; VA, Veterans Affairs. Modi /f_i ed from Rix TE, Bates T. Pre-operative risk scores for the prediction of outcome in elderly people who require emergency surgery. J Emerg Surg 2007; 2 : 16.

Gastrointestinal disease

Gastrointestinal disease

Regurgitation risk Patients undergoing general anaesthesia or sedation have - a risk of regurgitation of stomach contents and aspiration pneumonia. To reduce this risk patients should fast preoperatively . This should be clearly explained to the patient: 6 hours for solids or non-clear fluids (e.g. milk), 2 hours for clear fluids and 4 /uni00A0 hours for infants consuming breast milk. encouraged. Patients with hiatus hernia, obesity , pregnancy or diabetes are at higher risk of pulmonary aspiration, even if they have been fasted appropriately before elective surgery . Clear antacids, H -receptor blockers, e.g. ranitidine, or proton pump 2 inhibitors, e.g. omeprazole, may be given at an appropriate time in the preoperative period to reduce stomach acidity .

Liver disease In patients with liver disease, the cause of the disease needs to be known, as well as any evidence of clotting problems, renal involvement and encephalopathy . Elective surgery should be postponed until any acute episode has settled, e.g. cholangitis. The presence of ascites, oesophageal varices, hypoalbuminaemia or sodium and water retention should be noted, as all can influence the choice and outcome of anaesthesia and surgery . Patients with cirrhosis undergoing major surgery have a very high mortality; the Model for End-stage Liver Disease (MELD) can be used to predict mortality of cirrhotic patients undergoing non-transplant surgery . If alcohol addiction is the aetiology then reduction of alcohol intake should be encouraged but abstinence must be medically supervised to prevent delirium tremens.

Genitourinary disease

Genitourinary disease

Renal failure Underlying conditions leading to chronic renal failure such as diabetes mellitus, hypertension and IHD should be stabilised before elective surgery . Appropriate measures should be taken to treat acidosis, hypocalcaemia and hyperkalaemia of greater than 6 mmol/L. Arrangements should be made to continue peritoneal dialysis or haemodialysis until a few hours before surgery . After the final dialysis before surgery , a blood sample should be sent for FBC and U&Es. Patients with chronic renal failure often have chronic anaemia that is well tolerated; therefore, preoperative blood transfusion is often not necessary . Optimisation of the haemoglobin is best guided by the renal team. **Urinary tract infection** Uncomplicated urinary tract infections are common in women, while outflow uropathy with chronically infected urine is common in men. These infections should be treated before embarking on elective surgery where infection carries dire consequences, e.g. joint replacement. For emergency procedures, antibiotics should be started and care taken to ensure that the patient maintains a good urine output before, during and after surgery .

Heart failure

Heart failure

Left ventricular failure is the end result of several conditions, including IHD, hypertension, cardiomyopathies and valve dysfunction. Decompensated heart failure puts the patient at risk of multiorgan failure. Those with ejection fractions of less than 35%, and in whom the failure is undiagnosed or its severity underestimated, are at highest risk. The patient's functional capacity needs to be assessed and surgery may have to be delayed for investigations such as an echo and/or for optimisation of medical therapy. B-type natriuretic peptide is a useful marker and can be prognostic. Drugs used in chronic heart failure can have significant implications for perioperative care, including intraoperative hypotension. β -blockers and probably ACE inhibitors (unless renal perfusion is to be significantly affected) should be discussed with a cardiologist and optimised. Cardiac resynchronisation therapy devices may be considered, depending on the QRS duration.

Hypertension

Hypertension

Prior to elective surgery blood pressure should be controlled to $<160/100$ mmHg. If a new antihypertensive agent is introduced, a stabilisation period of at least 2 weeks should be allowed.

Implanted pacemakers and cardiac defibrillators

Implanted pacemakers and cardiac defibrillators

Checks and appropriate reprogramming should be done preoperatively by specialists and advice followed. Monopolar diathermy activity during surgery may be sensed by the pace maker as ventricular fibrillation or a paced beat. Therefore, cardioversion and over-pace modes must be turned off (and switched back on after surgery) or converted to 'ventricle paced, not sensed with no response to sensing' (VOO) mode. Bipolar diathermy should be made available at surgery .

Introduction

INTRODUCTION

The stress of major surgery can lead to increased oxygen demand by up to 40%. Inflammatory changes due to cytokine release, endocrine responses, hypercoagulability and redistribution of fluid between compartments may last several postoperative days. The purpose of careful preoperative planning is to minimise the unwanted effects of these physiological changes. Systematic history taking, examination and investigation at the preoperative clinic should include not only an assessment of functional reserve but also the formulation of advice on optimisation, to best cope with the anticipated operative stress. Primary care physician records and hospital notes are useful sources of baseline information. Ideally a multidisciplinary team approach, including the primary care physician, specialist nurses, physiotherapist, dietician and perioperative physician, is utilised. This allows optimisation of chronic conditions, facilitates weight reduction and smoking cessation, and allows coordination of prehabilitation and postoperative rehabilitation needs. The anaesthetist and surgeon must plan the safest anaesthetic technique and operation for the patient. A simple questionnaire can identify risk factors for patients undergoing surgery that will require specific tests or optimisation. Patients with severe comorbidities or undergoing high-risk surgery should be referred to specialists to quantify and reduce perioperative risks. The risks of surgery and Summary box 21.1 Preoperative plan for the best patient outcomes /uni25CF /uni25CF /uni25CF /uni25CF anaesthesia and the effects of comorbid conditions should be discussed so that the patient can make an informed decision. Patients should be given advice on preoperative fasting times, adjustments to regular medication and specific premedication at the preoperative visit. To enable the list to run smoothly on the day, key personnel involved in the list (surgeon, anaesthetist and senior theatre staff) should be involved in planning the list order. The National Patient Safety Agency's adaptation of the World Health Organization's checklist recommends a 'team brief' before the start of each list, which is also a valuable opportunity to share information with the theatre team and improve the safety of anaesthesia and surgery.

Gather and record all relevant information Optimise patient condition Choose surgery that offers minimal risk and maximum benefit /f_i t Informed consent of the patient (see Chapter 14) Anticipate and plan for adverse events Adequate hydration, nutrition and exercise are advised Importance of critical care in management • Emergency cases • To be able to organise preoperative care and the operating list

Investigations

Investigations

Guidelines produced by the UK's National Institute for Health and Care Excellence (NICE) set out the investigations needed for various categories of elective surgery and American Society of Anesthesiologists (ASA) score of the patient. The following are some of the tests done preoperatively, although not all are done routinely or are recommended by NICE. /uni25CF Full blood count (FBC) . An FBC is needed for major operations, in the elderly and in those with anaemia or pathology with ongoing blood loss and chronic disease.

Figure 21.2 Ability to protrude jaw.

Figure 21.3 Normal head extension.

measured in patients with diabetes who have not had it measured in the last 3 months. /uni25CF Sick cell test . Not routinely offered, but in cases of suspicion of a sickle crisis or a family history of sickle cell disease a sickle cell test is needed. /uni25CF Urea and electrolytes (U&Es) . U&Es are needed before all major operations, in patients over 65 years of age, in patients with cardiovascular, renal or endocrine disease or if significant blood loss is anticipated. They are also needed in those on medications that affect electrolyte levels, e.g. steroids, diuretics, digoxin, non-steroidal anti-inflammatory drugs, intravenous fluid or nutrition therapy, and in those with endocrine problems. /uni25CF Liver function tests . These are indicated in patients with jaundice, known or suspected hepatitis, malignancy, alcohol excess or poor nutritional status. /uni25CF Clotting/coagulation screen . This is needed if a patient has a history suggestive of a bleeding diathesis, liver disease, eclampsia or cholestasis, is on antithrombotic or anticoagulant agents or has a family history of a bleeding disorder. It should be noted that the effects of antiplatelet agents, low-molecular-weight heparins (LMWHs) and newer agents affecting factor Xa cannot be measured by routine laboratory tests. /uni25CF Electrocardiogram (ECG) . This is required for patients over 65 years of age or symptomatic patients with a history of rheumatic fever, diabetes or cardiovascular, renal or cerebrovascular disease, with or without severe respiratory problems. It will also depend on whether the surgery is minor/intermediate or major, as described in NICE guidance. /uni25CF Chest radiograph . Not routinely offered unless there is concern on clinical examination. /uni25CF Echocardiogram (echo) . Consider in those with heart murmurs who are symptomatic or in those with signs of heart failure. /uni25CF Urine tests . Only consider microscopy and culture of midstream urine if infection would influence the decision to operate. /uni25CF β -Human chorionic gonadotrophin (pregnancy test) . Women of childbearing age should be asked sensitively about their pregnancy status as this will affect the surgical plan and consent. Pregnant patients must be consented for the risk to a fetus that surgery and anaesthetic pose, and obstetric advice sought. In addition, on the day of surgery the woman should be

consented for a urine/ serum pregnancy test. Others : Venous bicarbonate . For patients who have screened as being at high risk for obstructive sleep apnoea (OSA). Followed by formal sleep studies if significant OSA is a concern. Arterial blood gases . A low-cost tool that can give quick and vital information in acute or chronic severe respiratory conditions, acid-base disturbances and conditions where there is a changing milieu, e.g. immediately before kidney transplant. loss >500 mL. Methicillin-resistant Staphylococcus aureus (MRSA) swabs. Coronavirus 2019 (COVID-19) polymerase chain reaction (PCR) swabs. Spirometry . Cardiopulmonary exercise testing to assess fitness for high-risk surgery . Specialist radiological views are sometimes required. If imaging is going to be needed during surgery , this needs to be planned in advance.

Ischaemic heart disease

Ischaemic heart disease

Patients with angina that is not well controlled should be investigated further by a cardiologist. The indications for coronary revascularisation in patients awaiting surgery are the same as at any other time. Pharmacological protection is indicated. - Patients established on β -blockers and statins should have their medication continued perioperatively. Initiating statins preoperatively should be considered if not already prescribed. Most long-term cardiac medications should be continued over the perioperative period. Angiotensin-converting enzyme (ACE) inhibitors and receptor blockers are often omitted 24 hours prior to surgery to prevent intraoperative hypotension, and restarted the next day for most surgery. - In patients with IHD the cardiac and coronary reserve can be evaluated using a stress test (stress ECG, stress echo, myocardial scintigraphy). The tests have a high negative predictive value but a relatively low positive predictive value. If the test is negative, the patient is unlikely to have IHD; conversely, if it is positive the chances of the patient actually having IHD are not necessarily very high, but there is a need for further investigation such as coronary angiography or cardiac computed tomography. Recently, measurement of the coronary fractional flow reserve during coronary angiography using a pressure wire has made it possible to identify coronary lesions that have the largest impact on myocardial perfusion. After a proven myocardial infarction (MI) (Figure 21.4) elective surgery should be postponed for 3–6 months to reduce the risk of perioperative reinfarction. Ischaemic changes can be seen on ECG even if the patient is not symptomatic (silent ischaemia/silent MI). These merit discussion with a cardiologist.

V4 V1 V5 V2 V6 V3 Figure 21.4 Preoperative electrocardiogram of a patient who complained of chest pain the previous day, showing recent transmural anterior myocardial infarction with Q waves and ST elevation.

Learning objectives

Learning objectives

To understand preoperative preparation for surgery: Surgical, medical and anaesthetic aspects of assessment • How to optimise patients and identify those at • higher risk

Musculoskeletal disorders

Musculoskeletal disorders

Muscular disorders have serious implications and require a tailored anaesthetic approach. They include muscular dystrophies, myotonic dystrophy and myasthenia gravis and a personal or family history of malignant hyperpyrexia. Rheumatoid arthritis can lead to an unstable cervical spine with the possibility of spinal cord injury during intubation. Therefore, flexion and extension lateral cervical spine radiographs should be obtained in symptomatic patients (Figures 21.7 and 21.8). Assessment of the severity of renal, - cardiac, valvular and pericardial involvement as well as restrictive lung disease should be carried out. Rheumatologists will advise on steroids and disease-modifying drugs so as to - balance immunosuppression (chance of infections) against the need to stabilise the disease perioperatively (stopping disease- modifying drugs can lead to flare-up of the disease). In patients with ankylosing spondylitis, in addition to the problems discussed above, techniques of spinal or epidural anaesthesia are often challenging. Patients with systemic lupus erythematosus may exhibit a hypercoagulable state along with - airway difficulties.

Neurological and psychiatric disorders

Neurological and psychiatric disorders

Anticonvulsants and anti-Parkinson's medication must be continued perioperatively to help early mobilisation of the patient, and patients should be planned early on a theatre list to reduce starvation times. Parenteral medication plans can be set in place preoperatively if there is potential for a prolonged 'nil by mouth' period postoperatively. Lithium should be stopped 24 hours prior to major surgery but can be continued for minor surgery with careful fluid management and U&Es monitoring. The anaesthetist should be informed if patients are on psychiatric medications, such as Erik Adolf von Willebrand, 1870–1949, physician, Diakonissanstaltens Hospital, Helsinki, (Helsingfors), Finland, described hereditary pseudohaemophilia in 1926. /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF as tricyclic antidepressants or monoamine oxidase inhibitors (MAOIs), as these may interact with anaesthetic drugs. Case-by-case decisions with a psychiatrist must be undertaken as stopping irreversible MAOIs safely may take many weeks of planning under psychiatric supervision. -

Age >60 years 2 Obesity (BMI >30 kg/m²) Trauma or surgery (especially of the abdomen, pelvis and lower limbs) Total anaesthesia time >90 minutes Reduced mobility for more than 3 days Pregnancy/puerperium Varicose veins with phlebitis Drugs, e.g. oestrogen contraceptive, HRT, smoking Known active cancer or on treatment, significant medical comorbidities, critical care admission Family/personal history of thrombosis, e.g. deficiencies in antithrombin III, protein S or C BMI, body mass index; HRT, hormone replacement therapy.

PATIENT ASSESSMENT

History taking

PATIENT ASSESSMENT History taking

A thorough past medical history , surgical history and systemic enquiry should be documented, including important negatives (Table 21.1). The history of past surgery and anaesthetic events can reveal the problems one may face during future procedures e.g. intra-abdominal adhesions for planned lapa - roscopic surgery , a di ffi cult airway or suxamethonium apnoea. The use of recreational drugs and alcohol consumption should be noted as they are known to be associated with adverse outcomes. A full drug history and list of allergies should be documented. Social history , ability to communicate and mobil - ity are important in planning admission, discharge route and rehabilitation after surgery .

PHYSICAL FITNESS

PHYSICAL FITNESS

Functional physical fitness can be judged by the ability to tolerate metabolic equivalent tasks (METs) (Table 21.5). One MET is equivalent to the oxygen consumption of an adult at rest (~ 3.5 mL/kg/min). Different tasks are assigned a number of METs. If the patient is able to perform >4 METs (e.g. climbing at least one flight of stairs) they are accepted to proceed for low-risk surgery in the USA and Europe. However this depends on a subjective assessment of the ability of a patient and may be overestimated by them. The Duke Activity Status Index (DASI) is a less subjective patient questionnaire. An estimate of the patient's peak oxygen consumption (VO_2 peak) can be calculated from their point score. Although it correlates with cardiopulmonary exercise testing (CPET), some patients who score poorly on DASI go on to score well on CPET. An objective measure of fitness is required for high-risk surgery.

Figure 21.7 Extension view of the cervical spine in a patient with rheumatoid arthritis. Arrow indicates the atlantodens interval. Figure 21.8 Flexion view in the same patient as in Figure 21.7 the large increase in the atlantodens interval (arrow), implying significant instability at this level.

Respiratory disease

Respiratory disease

Postoperative respiratory complications, such as pneumonia, are a major cause of morbidity and mortality, especially after major abdominal and thoracic surgery. A patient's current respiratory status should be compared with their 'normal state'. Patients with severe disease are at risk of pneumonia and respiratory failure in the postoperative period. Severe disease would include patients with a forced expiratory volume in the first second (FEV₁) of less than 30% of predicted value, dependence on oral steroid treatment, home ventilation or oxygen therapy or a PaCO₂ level of greater than 6 kPa. 2 Patients should continue to use their regular inhalers until the start of anaesthesia. Brittle asthmatics may also need extra steroid cover. Encourage the patients to be compliant with the medications and stop smoking. Information should be provided to indicate perioperative risks associated with smoking. Stopping smoking reduces carbon monoxide levels and offers the patient a better ability to clear sputum. Evidence suggests that preoperative inspiratory muscle training significantly improves respiratory (muscle) function in the early postoperative period, reducing the risk of pulmonary complications. Regional anaesthetic techniques and less invasive surgical options should be considered in severe cases. Elective surgery should be postponed until acute exacerbations are treated. The patient should be referred to a respiratory physician if:

- there is a severe disease or significant deterioration;
- major surgery is planned in a patient with significant respiratory comorbidities;
- right heart failure is present – dyspnoea, fatigue, tricuspid regurgitation, hepatomegaly and oedematous feet;
- the patient is young and has severe respiratory problems (may indicate a rare condition).

Risk prediction

Risk prediction

The key to managing patients effectively is the identification and accurate quantification of the risk, and subsequent measures taken to minimise it. Realistic estimates of risk are the cornerstone of informed patient consent and shared decision making. The patient and the surgeon may choose a less extensive or even a non-surgical option when the risks of the definitive procedure are deemed to be too high or unacceptable. The Royal College of Surgeons of England has recommended that patients who are predicted to have >5% mortality risk should have active consultant input in all stages of their management. Surgical procedures in those with predicted mortality of >10% should be conducted under the direct supervision of a consultant surgeon or anaesthetist, unless the consultants are satisfied with the seniority and competence of the staff managing these patients. Moreover, those with a mortality >10% should be managed in the critical care facility postoperatively. The identification of patients who will benefit the most from these interventions is important, not only for the improvement of outcomes but also for the effective allocation of resources. A number of scoring systems have been developed over the years with the aim of identifying high-risk patients (Table 21.9 American Society of Anesthesiologists system). The ASA scoring system is widely used. Although not designed to be used as a risk prediction score, it has a quantitative association with the predicted percentage of postoperative mortality (Table 21.10). Lee Goldman, b. 1948, Dean of Health Sciences and Medicine, Columbia University, New York, NY, USA, since 2006. He developed his index in 1977. mortality (Table 21.10). However, it does not account for the patient's age or the nature of the surgery and the term 'systemic disease' in ASA grading introduces an element of 'subjectivity'. Examples of each physical status added in 2015 aim to reduce this. The POSSUM score (Physiologic and Operative Severity Score for the Enumeration of Mortality and Morbidity) and its modifications (P-POSSUM, CR-POSSUM) are used to predict all-cause mortality in postoperative critical care patients as well as non-cardiac morbidity (Table 21.11).

Scores predicting morbidity
ASA
APACHE-II
Revised Cardiac Risk Index (RCRI)
Veltkamp score
VA
respiratory failure score
VA pneumonia prediction index
ACS NSQIP surgical risk score
POSSUM
P-POSSUM
World
TABLE 21.10 Operative mortality by American Society of Anesthesiologists (ASA) grade.

ASA Description	30-day grade mortality (%)
0.1 Healthy	0.1
I 0.7 Mild systemic disease, no functional limitation	0.7
II 3.5 Severe systemic disease, definite functional limitation	3.5
III 18.3 Severe systemic disease, constant functional limitation	18.3
IV 93.3 Severe systemic disease, constant threat to life	93.3

Moribund patient unlikely to survive 24 hours with or without operation – Emergency operation
E From Boyd and Jackson (2005).

Lee's Revised Cardiac Risk index (RCRI) uses objective indices based on weighted scores pertaining to surgery and comorbidity. This stratifies cardiac risk but is not designed to predict mortality (Table 21.11). ACS NSQIP score The American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP) surgical risk score estimates the chance of a complication or death after surgery for more than a thousand different surgical procedures. It compares the patient's

risk with an average person's risk. It is a Web-based tool done preoperatively . The risk is calculated based on surgical procedure and 19 patient-specific preoperative risk factors.

Role of critical care and outreach services

Role of critical care and outreach services

Reports from the National Confidential Enquiry into Patient Outcome and Death (NCEPOD) show that the majority of postoperative deaths in the UK occur more than 5 days after surgery . Admission to a critical care unit allows for early treatment of complications and a level of care that is difficult to deliver in the ward environment during this crucial period. Common complications include myocardial ischaemia, cardiac, respiratory or renal failure and sepsis. Perioperative MI is associated with a high mortality (15–25%). Critical care uses invasive cardiac monitoring and vasoactive drugs to help provide cardiac stability postoperatively to minimise ischaemia and guide fluid management to prevent cardiac failure. Thomas H Lee , Professor of Medicine, Harvard Medical School, Professor of Health Policy and Management, Harvard School of Public Health, Boston, MA, USA. Friedrich Trendelenburg , 1844–1924, successively Professor of Surgery at Rostock (1875–1882), Bonn (1822–1895) and Leipzig, (1895–1911), Germany . The Trendelenburg position was first described in 1885. - - - Postoperatively , 1.5% of patients develop lower respiratory tract infection after surgery , with a 30-day mortality of >20%. Respiratory failure, which is defined as $\text{PaO}_2 < 8 \text{ kPa}$ in air, $\text{PaO}_2 / \text{FIO}_2$ (the ratio of arterial oxygen partial pressure to the FiO_2 fraction of inspired oxygen) $< 40 \text{ kPa}$ or the inability to extubate a patient 48 hours after surgery , is by far the most significant of these and is associated with a mortality of 27–40%. Elective non-invasive ventilation, chest physiotherapy and incentive spirometry should be considered for patients at increased risk of respiratory complications. These are commonly delivered on the critical care unit (Figure 21.11). The high-risk surgical population accounts for 80% of postoperative deaths, but only about 15–30% of high-risk surgical patients are admitted to a critical care unit at any time following surgery . Work by the National Emergency Laparotomy Audit in the UK is seeking to standardise treatment of this high-risk group with many recommendations, including admission to critical care where predicted mortality is >5%. In the last decade, the role of critical care has been expanded - to the concept of ‘critical care without walls’. The intensive care outreach services (ICORS) grew from a recognition that

Risk factors	Risk of major cardiac complications (%)	Number of factors	History of ischaemic heart disease
0	0.4	History of compensated or prior heart failure	1 = 0.9
History of cerebrovascular disease	2 = 7.0	Diabetes mellitus	3+ = 11.0
Renal insufficiency (creatinine >177 $\mu\text{mol/L}$)		High-risk surgery	

Figure 21.10 Robotic surgery

there were many patients in hospital who are at risk of being critically ill and that early identification of these patients using ‘early warning scores’ could allow for early intervention. The outreach team functions to bridge the gap between the critical care unit and ward.

Figure 21.11 A high-risk patient admitted to critical care postoperatively.

Valvular heart disease

Valvular heart disease

While anaesthetic management is altered to achieve haemodynamic stability in moderate valvular diseases, patients with severe aortic and mitral stenosis may benefit from valvuloplasty before elective non-cardiac surgery. Appropriate referral to an anaesthetist and cardiologist should be made. An echo is required in symptomatic patients with a new murmur. Patients with known significant valve pathology may benefit from a recent echo, especially if their clinical status has changed (standard intervals for surveillance echo can be guided by local cardiology policy). Patients with prosthetic valves are normally monitored with surveillance echo at intervals. In patients with mechanical heart valves, warfarin needs to be stopped preoperatively and bridging anticoagulation given to prevent valve thrombosis. Bridging options include unfractionated heparin infusions or LMWHs and should be done under guidance agreed with haematology. Bridging therapy should continue postoperatively until the patient is re-established on warfarin with a therapeutic INR but must be balanced with factor Xa inhibitors are not licensed and should not be used in patients with mechanical valves.