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General Surger

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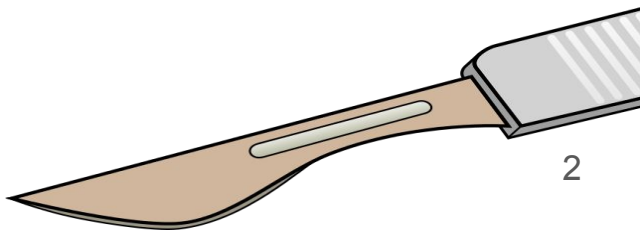
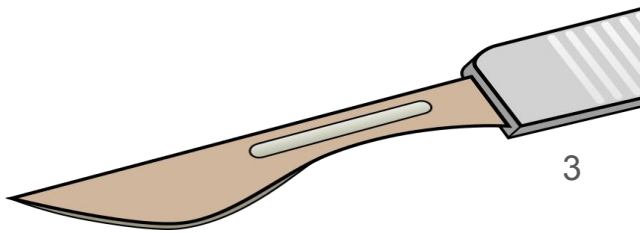
Learning Objectives

- Organise preoperative care and the operating list
- Understand preoperative preparation: surgical, medical, anaesthetic assessment
- Optimise the patient's condition
- Identify and optimise the higher-risk surgical patient
- Understand the importance of critical care in management
- Take consent properly
- Organise an operating list safely and efficiently



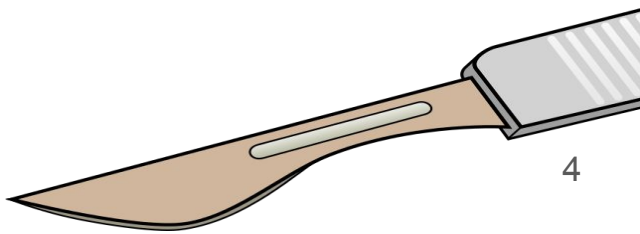
Introduction — Why Preoperative Care Matters

- Major surgery increases oxygen demand by about 40%
- Cytokine-related inflammation, endocrine responses, hypercoagulability, fluid shifts may last several postoperative days
- Careful preoperative planning minimises unwanted physiological effects
- Systematic history, examination and investigations assess functional reserve and guide optimisation
- GP records and hospital notes provide baseline information
- GPs help monitor chronic conditions, adjust medications, weight reduction, exercise, smoking cessation
- Simple questionnaire + agreed guidelines can identify high-risk patients needing specific tests and optimisation
- Severe comorbidity or high-risk surgery → specialist referral to quantify and reduce perioperative risk
- Discuss risks of surgery, anaesthesia and comorbidities so patient can make informed decision
- Advise on nil by mouth, regular medication and premedication
- Plan operating list and inform all involved
- WHO checklist starts just before induction and continues during and after surgery



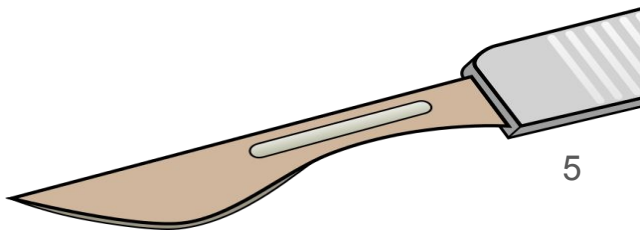
Summary Box 17.1 — Preoperative Plan for Best Outcomes

- Gather and record all relevant information
- Optimise patient condition
- Choose surgery that offers minimal risk and maximum benefit
- Anticipate and plan for adverse events
- Adequate hydration, nutrition and exercise are advised



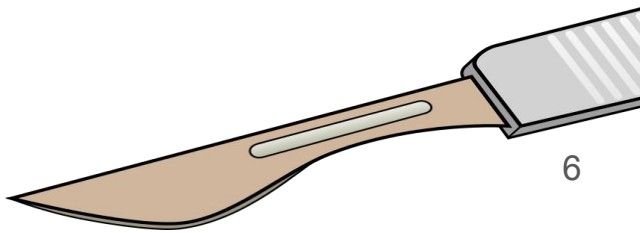
Patient Assessment — Overview

- Evidence: correction of anaemia, better diabetes control, preoperative exercises and better nutrition improve outcomes and reduce postoperative complications
- Estimate individual risk from population statistics, comorbidities and type of surgery
- Use tools and scores as risk predictors
- Focus on functional reserve and optimisation



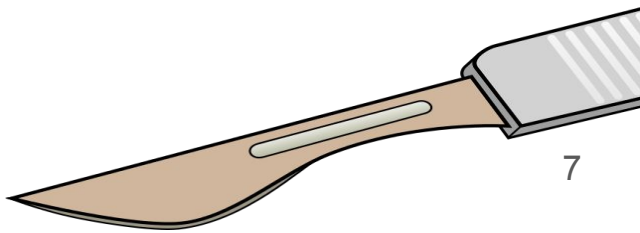
History Taking — Principles and Key Topics

- Summary Box 17.2 — Principles:
  - Listen: What is the problem? Open questions
  - Clarify: What does the patient expect? Closed questions
  - Narrow: Differential diagnosis; focused questions
  - Fitness: Comorbidities; fixed questions
- Each organ system problem: note dates, aetiology, treatment delivered
- Screening questions reveal fitness for surgery and anaesthesia
- Recent chest infection → assess anaesthetic risk and postoperative surgical infection
- Increasing symptom severity → worsening condition, possible medication change
- Inability to achieve 4 metabolic equivalents, e.g. climbing a flight of stairs, increases cardiac risk after major surgery
- Some factors treatable preoperatively: anaemia, angina, palpitations, obesity
- Past surgery/anaesthesia may reveal problems: intra-abdominal adhesions for laparoscopic surgery, apnoea syndromes
- Recreational drugs and alcohol → adverse outcomes
- Check allergies and DVT risk factors
- Social history, communication ability and mobility → plan rehabilitation
- Table 17.1 key topics:
  - Cardiovascular: ischaemic heart disease, angina, MI, hypertension, heart failure, dysrhythmia, peripheral vascular disease, DVT/PE
  - Respiratory: COPD, asthma, respiratory infections
  - Gastrointestinal: peptic ulcer disease, gastro-oesophageal reflux, liver disease
  - Genitourinary: UTI, renal dysfunction
  - Neurological: epilepsy, CVA/TIA
  - Psychiatric disorders, cognitive function
  - Endocrine/metabolic: diabetes, thyroid dysfunction, phaeochromocytoma, porphyria
  - Locomotor: osteoarthritis, inflammatory arthropathy such as rheumatoid arthritis
  - Other: HIV, hepatitis, TB, malignancy, allergy, previous surgery, problems encountered, family history of anaesthesia problems
- Entries in bold need to be recorded even when negative



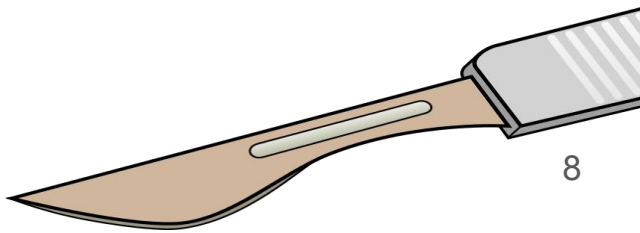
Examination — General Principles and Table 17.2

- Treat patients with respect and dignity
- Clear explanation of examination
- Keep patient as comfortable as possible
- Chaperone for intimate examinations; follow local policy
- Summary Box 17.3 — Examination:
  - General: positive findings even if unrelated to proposed procedure should be explored
  - Surgery related: type and site of surgery, complications from underlying pathology
  - Systemic: comorbidities and extent of limitation of each organ function
  - Specific: e.g. suitability for positioning during surgery
- Table 17.2 — Medical examination:
  - General: anaemia, jaundice, cyanosis, nutritional status, sources of infection (teeth, feet, leg ulcers)
  - Cardiovascular: pulse, blood pressure, heart sounds, bruits, peripheral oedema
  - Respiratory: respiratory rate and effort, chest expansion and percussion note, breath sounds, oxygen saturation
  - Gastrointestinal: abdominal masses, ascites, bowel sounds, hernia, genitalia
  - Neurological: consciousness level, cognitive function, sensation, muscle power, tone and reflexes
  - Airway assessment



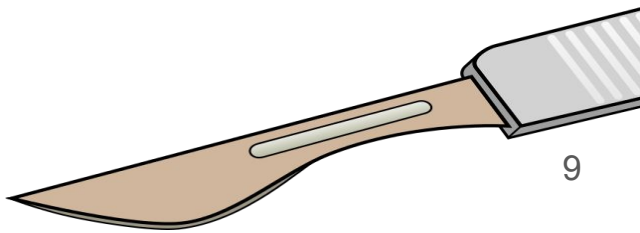
Examination Specific to Surgery

- Note clinical findings, site, side, specific imaging or investigation findings related to pathology
- Assess suitability of patient for proposed surgical option and vice versa
- Example: laparoscopic procedures are less invasive and preferred in most; not all tolerate pneumoperitoneum and positioning
- Type of surgery + comorbidities determine perioperative risks
- Example: perioperative mortality in UK open aortic aneurysm repair 3%; endovascular repair 1%
- Sources of potential bacteraemia can compromise surgical results, especially if artificial material implanted, e.g. joint replacement or arterial grafting
- Check and treat infections preoperatively: infected toes, pressure sores, teeth, urine
- Screen for methicillin-resistant Staphylococcus aureus colonisation



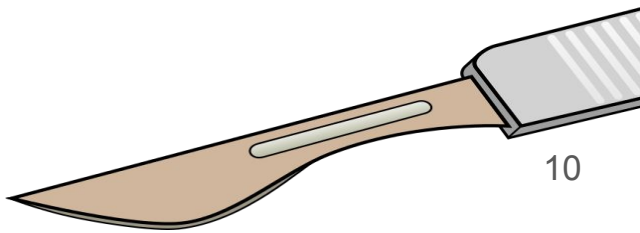
Investigations — NICE Guidelines and Summary Box 17.4

- NICE guidelines lay out investigations for various categories of surgery
- Summary Box 17.4 — Investigations needed:
  - Type of surgery: major surgery can lead to organ system dysfunction needing most investigations
  - Patient: e.g. sickle cell test for patients of Afro-Caribbean origin with family history of sickle cell disease
  - Comorbidities: e.g. peak flow rates for severe asthmatics
- Full blood count (FBC):
  - Needed for major operations, elderly, anaemia, pathology with ongoing blood loss, chronic disease
  - Sickle cell test if suspicion/history of sickle crisis in Afro-Caribbean and Indian subcontinent origin patients
- Urea and electrolytes (U&Es):
  - Before all major operations
  - Most patients over 65 years
  - Cardiovascular, renal and endocrine disease
  - Significant blood loss anticipated
  - Medications affecting electrolytes: steroids, diuretics, digoxin, NSAIDs, IV fluid/nutrition, endocrine problems



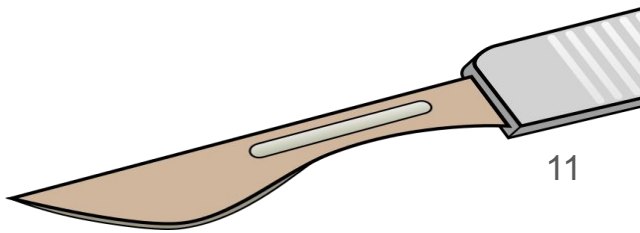
Investigations — ECG, CXR, Clotting, Urinalysis, Pregnancy

- Electrocardiography (ECG):
  - Over 65 years
  - Symptomatic patients with history of rheumatic fever, diabetes, cardiovascular, renal, cerebrovascular disease
  - With and without severe respiratory problems
  - Depends on minor/intermediate/major surgery
- Chest radiograph:
  - Restrict to specific patients due to cost-effectiveness and radiation risk
  - Cardiac failure, severe COPD, acute respiratory symptoms, pulmonary cancer, metastasis or effusions
  - Risk of active pulmonary tuberculosis
- Clotting screen:
  - History suggestive of bleeding diathesis, liver disease, eclampsia, cholestasis
  - Family history of bleeding disorder
  - On antithrombotic or anticoagulant agents
  - Routine tests cannot measure effects of antiplatelet agents, LMWH and newer factor Xa agents
- Urinalysis:
  - Dipstick testing on all patients
  - Detect urinary infection, biliruria, glycosuria, inappropriate osmolality
- β-human chorionic gonadotrophin:
  - Ask women of child-bearing age sensitively about pregnancy status
  - If doubt, laboratory test or reliable pregnancy kit after consent
  - Avoid danger of surgery and anaesthesia to foetus



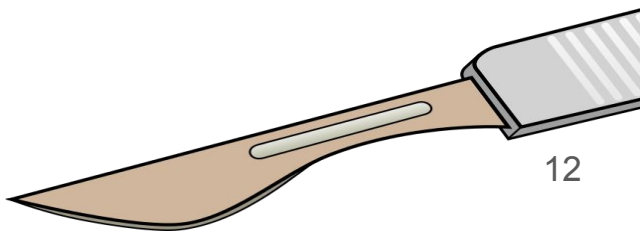
Investigations — Glucose, ABG, LFTs, Other

- Blood glucose and HbA1c:
  - Poor diabetes control → perioperative infection and slow recovery
  - HbA1c indicates longer-term control
  - Goals: early mobilisation, oral intake, return to routine medication
- Arterial blood gases:
  - Low-cost, quick, vital information
  - Acute or chronic severe respiratory conditions
  - Acid-base disturbances
  - Changing milieu, e.g. immediately before kidney transplant
- Liver function tests:
  - Indicated in jaundice, known/suspected hepatitis, cirrhosis, malignancy, poor nutritional status
- Other investigations:
  - Specialist radiological views and recent imaging sometimes required
  - If imaging needed during surgery, plan in advance



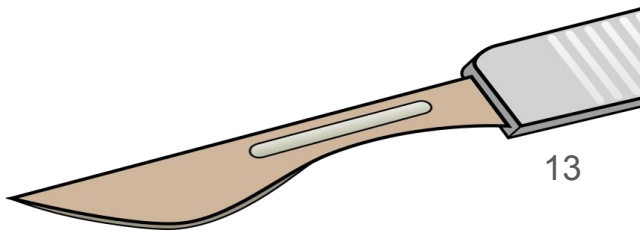
Specific Preoperative Problems — Overview and Summary Box 17.5

- Correct specific medical problems to best possible level
- Many patients with severe disease need specialist referral
- Referral letter should include history, examination and investigation results
- Summary Box 17.5 — Preoperative management of patients with systemic disease:
  - Capacity: baseline organ function capacity should be assessed
  - Optimisation: medication, lifestyle changes, specialist referral improve organ capacity
  - Alternative: minimally impacting procedure, appropriate postoperative care improve outcomes
  - Theatre preparations: timing, teamwork, special instruments and equipment



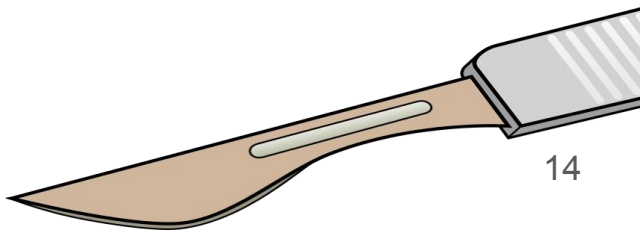
Cardiovascular Disease — Risk Assessment

- Perioperative cardiovascular complications are frequent
- Patients who can climb a flight of stairs without dyspnoea, chest pain or needing to stop likely tolerate many surgeries with acceptable risk
- Identify high perioperative risk of major adverse cardiovascular events (MACE), including MI
- High risk: ischaemic heart disease, congestive cardiac failure, arrhythmias, severe peripheral vascular disease, cerebrovascular disease, significant renal impairment
- Especially major intra-abdominal or intra-thoracic surgery
- Ischaemic heart disease: evaluate cardiac and coronary reserve with stress test (stress ECG, stress echocardiogram, myocardial scintigraphy)
  - High negative predictive value, relatively low positive predictive value
  - Negative → unlikely IHD
  - Positive → not necessarily very high chance, but need further investigation such as coronary angiography
- Fractional coronary flow reserve (FFR) during angiography using pressure wire identifies coronary lesions with largest impact on myocardial perfusion
- Echocardiogram if valvular heart disease or poor left ventricular function
  - Pressure gradients, chamber dimensions, contractility
  - Ejection fraction <30% associated with poor outcomes
- Cardiopulmonary exercise testing: non-invasive assessment of combined pulmonary, cardiac and circulatory function
- Refer to cardiologist if:
  - Murmur heard and patient symptomatic
  - Known poor left ventricular function or cardiomegaly
  - Ischaemic changes on ECG even if asymptomatic (silent ischaemia, silent MIs frequent)
  - Abnormal rhythm on ECG, e.g. tachy/bradycardia or heart block



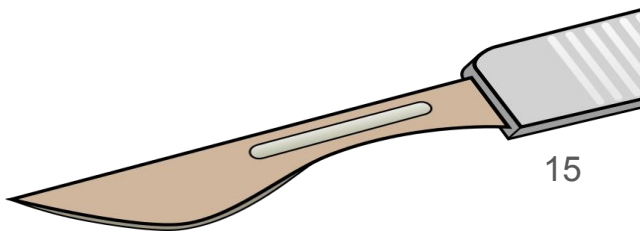
Hypertension, Ischaemic Heart Disease and Coronary Stents

- Elective surgery: control blood pressure to near 160/100 mmHg
- New antihypertensive agent → allow at least 2 weeks stabilisation
- Uncontrolled angina → further cardiology investigation
- Indications for coronary revascularisation before major surgery same as medical indications
- Pharmacological protection indicated
- β-blockers and statins should be maintained
- Consider initiating statins preoperatively
- Most long-term cardiac medications continued perioperatively
- ACE inhibitors and receptor blockers often omitted 24 hours prior to surgery and reintroduced gradually postoperatively



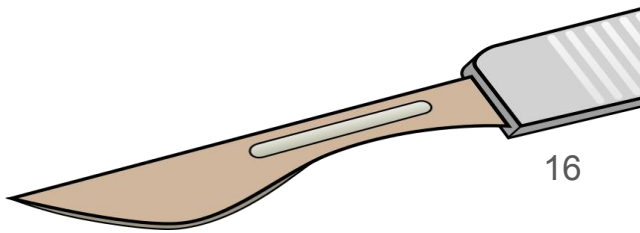
Myocardial Infarction, Stents and Antiplatelet Therapy

- After proven MI, postpone elective surgery 3–6 months to reduce perioperative reinfarction risk
- Primary percutaneous intervention is treatment of choice for acute coronary syndromes
- Many patients receive stents and dual antiplatelet therapy for 12 months
- If surgery absolutely necessary within dual antiplatelet therapy:
  - Joint decision by surgeon, cardiologist, anaesthetist and patient
  - Balance risk of continuing antiplatelets (bleeding) vs stopping them (stent thrombosis)
- Risk of stent thrombosis with MI and death reduced if elective surgery delayed until after dual antiplatelet therapy no longer needed:
  - About 6 weeks after bare metal stent
  - 12 months after drug-eluting stent
  - Newest drug-eluting stents: 6 months dual antiplatelet therapy may be enough
- If surgery cannot be postponed and risk of significant perioperative bleeding is low → dual antiplatelet therapy can be continued
- If benefits of surgery can be negated by bleeding in closed cavities (spinal, intracranial, cardiac, posterior chamber of eye, prostate surgery):
  - May have to stop clopidogrel or ticagrelor
  - Continue aspirin if possible
  - Seek cardiology opinion
- Figure 17.1: Preoperative ECG showing recent transmural anterior MI with Q waves and ST elevation



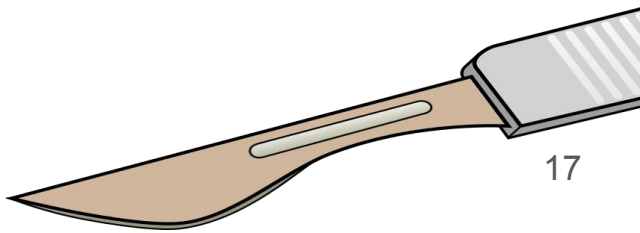
Dysrhythmias — Atrial Fibrillation and Anticoagulation

- Atrial fibrillation:
  - Start or continue β-blockers, digoxin or calcium channel blockers preoperatively
  - Control rate and possibly rhythm
  - Cardiac output can increase by 15% if sinus rhythm restored
- Warfarin in AF:
  - Stop 5 days preoperatively to achieve INR ≤1.5, safe for most surgery
- Newer anticoagulants:
  - Dabigatran (direct thrombin inhibitor)
  - Rivaroxaban, apixaban, edoxaban (direct factor Xa inhibitors)
  - No antagonists → must be stopped preoperatively
  - Generally 2–3 days in normal renal function; longer if renal impairment
- Alternative anticoagulation not required perioperatively unless stroke risk high (high CHA2DS2-VASc score)
- Bridging therapy with unfractionated heparin or LMWH recommended for AF + mechanical heart valve undergoing procedures requiring warfarin interruption
- Balance risks of stroke and bleeding



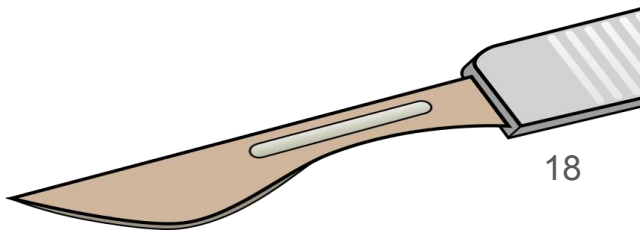
Pacemakers, ICDs and Heart Blocks

- Implanted pacemakers and cardiac defibrillators:
  - Checks and appropriate reprogramming preoperatively by specialists
  - Monopolar diathermy may be sensed as ventricular fibrillation
  - Turn off cardioversion and overpace modes (switch on after surgery) or convert to VOO mode ("ventricle paced, not sensed with no response to sensing")
  - Bipolar diathermy should be available at surgery
- Symptomatic heart blocks and asymptomatic second-degree (Mobitz II) and third-degree heart blocks:
  - If discovered at preoperative assessment clinic → cardiology consultation
  - Temporary or permanent pacemaker insertion
- Figure 17.2: Complete heart block with dissociated P waves and QRS complexes, requiring preoperative pacing
- Figure 17.3: Atrial flutter



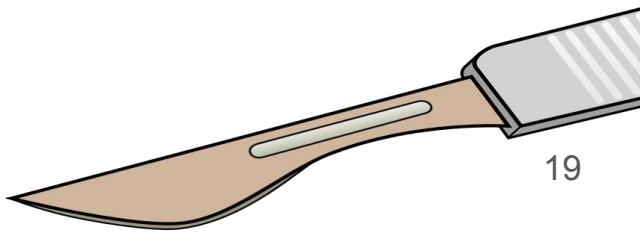
Valvular Heart Disease and Mechanical Valves

- Moderate valvular disease: anaesthetic management altered to achieve haemodynamic stability
- Severe aortic and mitral stenosis: may benefit from valvuloplasty before elective non-cardiac surgery
- Refer to anaesthetist and cardiologist
- Mechanical heart valves:
  - Stop warfarin 5 days before surgery
  - Start unfractionated heparin infusion when INR falls below 1.5
  - Monitor APTT to keep at 1.5 times normal
  - Stop infusion 2 hours before surgery
  - Start heparin and warfarin postoperatively
  - Stop heparin when full effect of warfarin takes effect
  - Thrombin inhibitors and factor Xa inhibitors are not licensed and should not be used in patients with mechanical valves



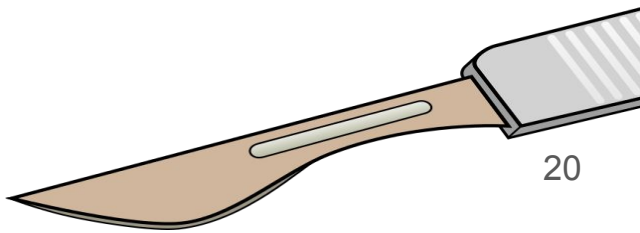
Anaemia and Blood Transfusion

- Investigate cause of anaemia at preoperative assessment
- Treat with iron and vitamin supplements
- Chronic anaemia well tolerated perioperatively
- If major procedure → consider preoperative transfusion
- If excessive bleeding expected → preoperative group and save and appropriate cross-match
- Jehovah's witness or refusal of blood transfusion:
  - During consent discuss which blood product and/or device system acceptable (cell salvage, reinfusion from drains)
  - Extend discussion to life-threatening situations
  - Document discussion and outcome clearly



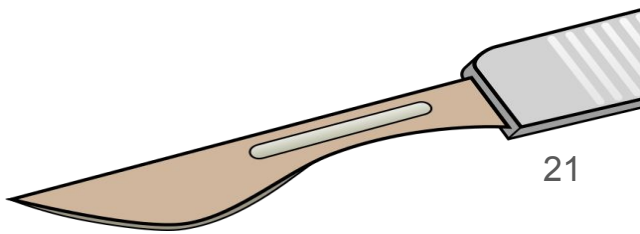
Respiratory Disease — Assessment and Referral

- Postoperative respiratory complications, e.g. pneumonia, major cause of morbidity and mortality, especially after major abdominal and thoracic surgery
- Compare current respiratory status with “normal state”
- Note severity of asthma and COPD:
  - Past hospital admissions
  - Pulmonary function tests
  - Oral steroids
  - Home oxygen
  - Non-invasive ventilation support
  - Evidence of right heart failure
- Preoperative chest radiograph or scan useful in emphysematous bullae, pulmonary cancer, metastasis or effusions
- Severe disease if:
  - FEV1 <30% predicted
  - $PaCO_2$ >6 kPa
  - On oral steroids or oxygen therapy
  - At risk of pneumonia and respiratory failure postoperatively
- Continue regular inhalers until start of anaesthesia
- Brittle asthmatics may need extra steroid cover
- Encourage medication compliance, balanced diet, stop smoking
- Provide information on perioperative risks of smoking
- Stopping smoking reduces carbon monoxide and improves sputum clearance
- Preoperative inspiratory muscle training significantly improves respiratory muscle function early postoperatively and reduces pulmonary complications
- Consider regional anaesthetic techniques and less invasive surgical options in severe cases
- Postpone elective surgery until acute exacerbations treated
- Refer to respiratory physician if:
  - Severe disease or significant deterioration
  - Major surgery planned with significant respiratory comorbidities
  - Right heart failure present: dyspnoea, fatigue, tricuspid regurgitation, hepatomegaly, oedematous feet
  - Young patient with severe respiratory problems (indicates rare condition)



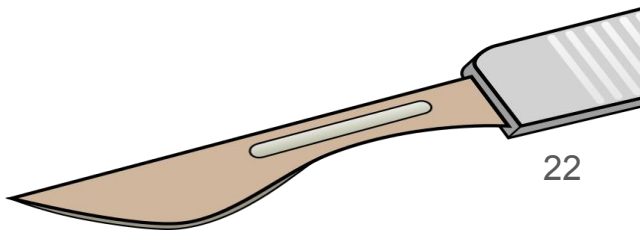
Respiratory Failure and Optimisation

- Definition: PaO_2 <8 kPa in air, PaO_2/FiO_2 <40 kPa, or inability to extubate 48 hours after surgery
- Mortality 27–40%
- Around 1.5% develop lower respiratory tract infection after surgery; 30-day mortality over 20%
- Surgery, especially open abdominal under general anaesthesia, reduces functional residual capacity
- Residual anaesthetic agents, limited mobility and pain cause atelectasis and predispose to postoperative respiratory infection
- Other complications: bronchospasm, pneumothorax, ARDS
- Preoperatively:
  - Bronchodilator therapy for reversible obstructive airway disease
  - Start or increase steroids if needed
  - Optimise nutrition and correct albumin
  - Physiotherapy for postural drainage, deep breathing exercises or incentive spirometry
- Consider regional techniques where possible
- Delay extubation until analgesia, hydration and acid-base status corrected
- Plan ITU admission if needed
- Non-invasive respiratory support may allow earlier extubation
- Figure 17.8: Non-invasive ventilation



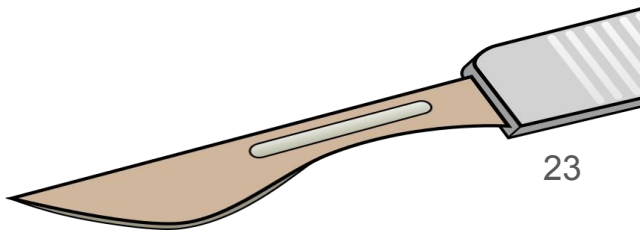
Gastrointestinal Disease — NBM and Regurgitation Risk

- Nil by mouth:
  - No solids within 6 hours before anaesthesia
  - Clear fluids (isotonic drinks and water) within 2 hours before anaesthesia
  - Avoid acid aspiration syndrome
  - Restrictions further reduced in infants; hydration reduces discomfort and improves postoperative outcomes
- If surgery delayed:
  - Allow oral clear fluids until 2 hours before surgery or start IV fluids
  - Especially children, elderly, diabetics
- Patients can continue specified routine medications with sips of water during NBM period
- Regurgitation risk:
  - Hiatus hernia, obesity, pregnancy, diabetes
  - High risk of pulmonary aspiration even if NBM
  - Clear antacids, H2-receptor blockers (e.g. ranitidine) or proton pump inhibitors (e.g. omeprazole) may be given at appropriate time preoperatively



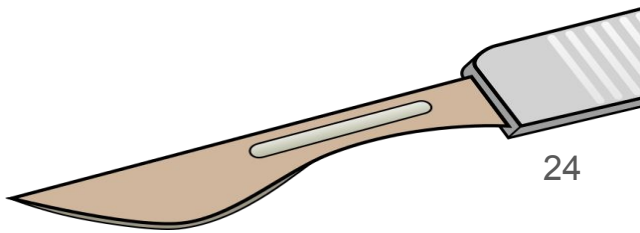
Liver Disease

- Know cause of liver disease
- Look for clotting problems, renal involvement, encephalopathy
- Postpone elective surgery until acute episode settled, e.g. cholangitis
- Blood tests: liver function tests, coagulation, blood glucose, U&Es
- Note ascites, oesophageal varices, hypoalbuminaemia, sodium and water retention
- All influence choice and outcome of anaesthesia and surgery



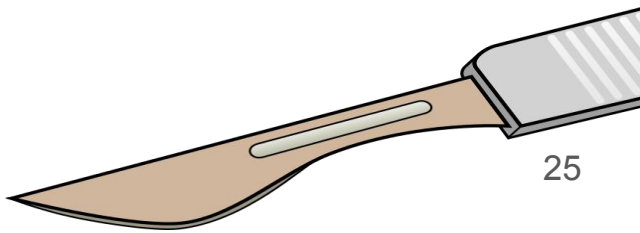
Genitourinary Disease — Renal Disease and UTI

- Renal disease:
  - Stabilise underlying conditions: diabetes mellitus, hypertension, ischaemic heart disease
  - Treat acidosis, hypocalcaemia, hyperkalaemia >6 mmol/L
  - Continue peritoneal or haemodialysis until a few hours before surgery
  - After final dialysis before surgery: send FBC and U&Es
  - Chronic renal failure patients often have chronic microcytic anaemia that is well tolerated; preoperative transfusion often not necessary
  - Acute kidney injury can present with acute surgical problem, e.g. bowel obstruction needing emergency surgery
  - Start medical treatment earliest, continue through surgery and into critical care
- Urinary tract infection:
  - Uncomplicated urinary infections common in women
  - Outflow uropathy with chronically infected urine common in men
  - Treat before elective surgery where infection carries dire consequences, e.g. joint replacement
  - Emergency procedures: start antibiotics and ensure good urine output before, during and after surgery



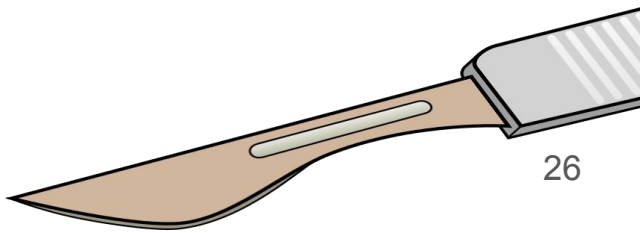
Malnutrition and Obesity

- Malnutrition:
  - BMI = weight (kg) / height (m^2)
  - BMI <18.5 indicates nutritional impairment
  - BMI <15 associated with significant hospital mortality
  - Nutritional support for minimum 2 weeks before surgery required to impact subsequent morbidity
  - If unlikely to eat for significant period, preoperative assessment team should arrange nutritional support in immediate postoperative phase
- Obesity:
  - Morbid obesity: BMI >35 (other definitions exist)
  - Increased risk of postoperative complications
  - Make patient aware of risks; advise healthy eating and regular exercise
  - Associated sleep apnoea predicted by P-SAP score or sleep apnoea studies
  - Evidence: outcomes improve with >6 weeks preoperative CPAP and cholesterol-reducing agents perioperatively
  - Delay surgery until more active and lost weight if possible
  - If fails, prophylactic measures for acid aspiration and DVT; explain associated risks before surgery



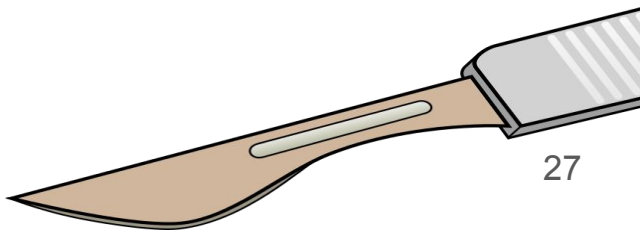
Diabetes Mellitus and Adrenocortical Suppression

- Diabetes mellitus:
  - Control diabetes and associated cardiovascular and renal complications as near normal as possible before elective surgery
  - Note history of hyper- and hypoglycaemic episodes and hospital admissions
  - Check HbA1c; for elective surgery HbA1c <69 mmol/mol recommended
  - Start lipid-lowering medication in high-risk cardiovascular groups
  - Patients with diabetes should be first on operating list
  - Morning operation: omit morning dose of medication and breakfast
  - Tight control not needed; check blood sugar 2-hourly
  - Afternoon list: breakfast with half regular dose of intermediate-acting insulin or full dose oral antidiabetic agents; regular blood sugar checks
  - Intravenous insulin sliding scale for insulin-dependent diabetes mellitus patients undergoing major surgery or if blood sugar difficult to control
- Adrenocortical suppression:
  - Ask patients on oral adrenocortical steroids about dose and duration
  - Supplement with extra doses of steroids perioperatively
  - Avoid Addisonian crisis



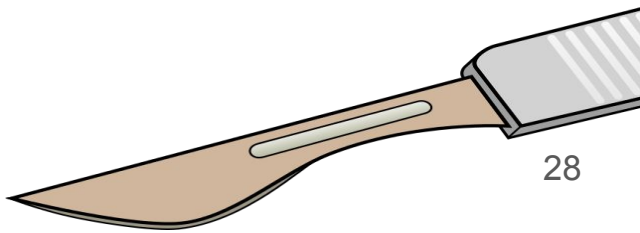
Coagulation Disorders and Thrombophilia

- Identify patients with strong family history or previous personal history of thrombosis
- They need thromboprophylaxis perioperatively
- Progesterone-only contraceptive pill should be continued
- Risks of continuing combined pill (slight increase risk of significant thrombosis) vs risks of unplanned pregnancy
- Consider stopping oestrogen-containing oral contraceptives or HRT 4 weeks before surgery (NICE guidance)
- Low risk of thromboembolism: thromboembolism-deterrent stockings during perioperative period
- High risk with history of recurrent DVT, PE, arterial thrombosis: usually on warfarin
  - Stop warfarin before surgery
  - Replace with LMWH or factor Xa inhibitors
- Follow local or national guidelines for DVT prophylaxis for each type of surgery
- Table 17.3 — Risk factors for thrombosis:
  - Age >60 years
  - Obesity BMI >30 kg/m²
  - Trauma or surgery, especially abdomen, pelvis, lower limbs; anaesthesia >90 minutes
  - Reduced mobility >3 days
  - Pregnancy/puerperium
  - Varicose veins with phlebitis
  - Drugs: oestrogen contraceptive, HRT, smoking
  - Known active cancer or on treatment, significant medical comorbidities, critical care admission
  - Family/personal history of thrombosis, e.g. antithrombin III, protein S and C deficiencies



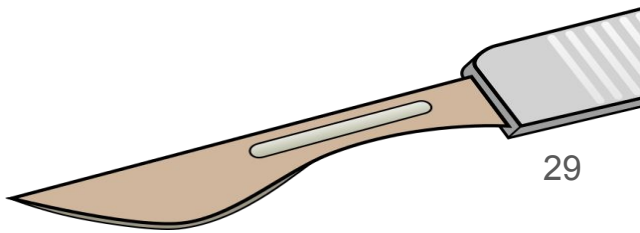
Neurological and Psychiatric Disorders

- Stroke history: record pre-existing neurological deficit
- May be on antiplatelet agents or anticoagulants
- If neurological and cardiovascular thrombotic risks low: withdraw antiplatelet agents (aspirin 7 days, clopidogrel 10 days)
- If thrombotic risks high and surgery high risk of bleeding: continue aspirin alone
- Anticonvulsants and anti-Parkinson medication continued perioperatively to help early mobilisation
- Lithium: stop 24 hours prior to surgery; measure blood levels to exclude toxicity
- Inform anaesthetist if on psychiatric medications such as tricyclic antidepressants or monoamine oxidase inhibitors; may interact with anaesthetic drugs



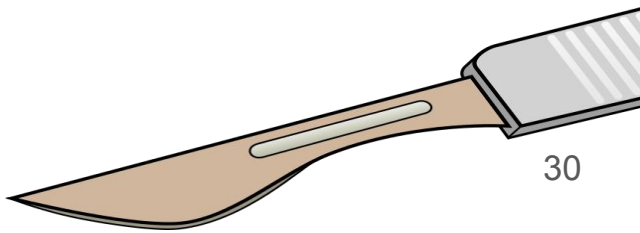
Musculoskeletal Disorders

- Rheumatoid arthritis:
  - Can lead to unstable cervical spine with possibility of spinal cord injury during intubation
  - Obtain flexion and extension lateral cervical spine radiographs in symptomatic patients
  - Assess severity of renal, cardiac valvular and pericardial involvement and restrictive lung disease
  - Rheumatologists advise on steroids and disease-modifying drugs; balance immunosuppression (infection risk) against need to stabilise disease perioperatively (stopping DMARDs can cause flare-up)
- Ankylosing spondylitis:
  - Spinal or epidural anaesthesia often challenging
- Systemic lupus erythematosus:
  - May exhibit hypercoagulable state and airway difficulties
- Joint replacement:
  - Antibiotic prophylaxis required, usually follows local or national guidelines
- Figure 17.4: Extension view of cervical spine in rheumatoid arthritis
- Figure 17.5: Flexion view in same patient; large increase in atlantodens interval, significant instability



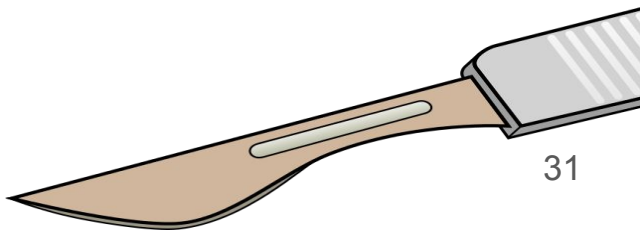
Airway Assessment

- Ability to intubate trachea and oxygenate patient are basic and crucial anaesthetic skills
- Predict difficulty by simple examination:
  - Full mouth opening (modified Mallampati class)
  - Jaw protrusion
  - Neck movement
  - Thyromental distance
- Look for loose teeth, obvious tumours, scars, infections, obesity, thickness of neck
- More than one positive test → greater chance of difficulty obtaining and securing airway
- Modified Mallampati class: anaesthetist sits in front of patient, asks to open mouth and protrude tongue
- Higher grade = higher risk
- Table 17.4 — Airway assessment (Samsoon and Young modified Mallampati test):
  - 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 17.6: Normal mouth opening view



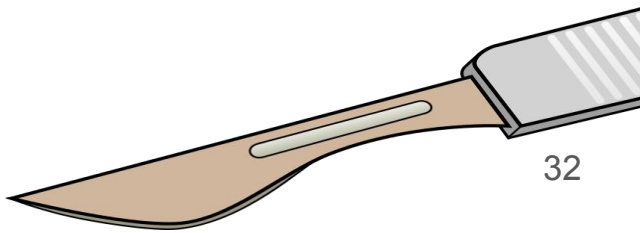
Preoperative Assessment in Emergency Surgery

- Principles same as elective surgery
- Opportunity to optimise limited by time constraints
- Start medical assessment and treatments, e.g. Advanced Trauma Life Support guidelines, even if no time to complete before surgery
- Some risks may be reduced; some may persist
- Whenever possible, explain persistent risks to patient
- Summary Box 17.6 — Preoperative assessment for emergency surgery:
  - Start: similar principles to elective surgery
  - Constraints: time, facilities available
  - Consent: may not be possible in life-saving emergencies
  - Organisational efforts: local/national algorithms for multiple injuries



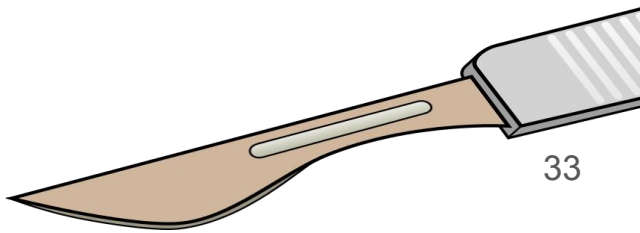
Assessment of the High-Risk Patient — Definition and Epidemiology

- Perioperative mortality has decreased significantly over last half-century, especially in resource-rich countries
- Lancet systematic review: mortality declined from 10,603 per million in 1970s to 1,176 per million in 1990s–2000s ($p < 0.0001$)
- Still a subgroup at higher risk of morbidity and mortality
- Identifying high-risk patients preoperatively and planning management reduces morbidity and mortality
- Predicted mortality ≥5% → consider “high risk”
- High-risk group <15% of all surgical procedures but >80% of all perioperative deaths in UK



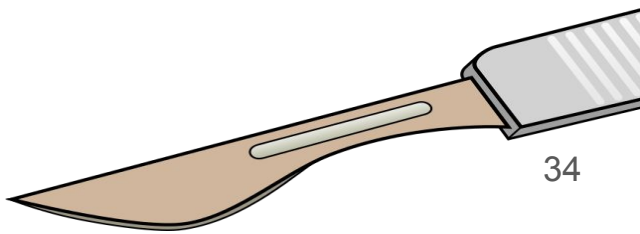
Pathophysiology of High Risk

- After surgery: tissue destruction, blood loss, fluid shifts, temperature changes, pain and anxiety increase oxygen delivery demands
- Oxygen demand increases from average 110 mL/min/m² at rest to 170 mL/min/m² postoperatively
- Most patients meet demand by increasing cardiac output and tissue oxygen extraction
- Patients unable to meet demands due to limited cardiorespiratory reserve → risk of oxygen debt
- Occult hypovolaemia from fluid shift or blood loss further impairs oxygen delivery
- Splanchnic vasoconstriction may cause gut ischaemia
- Coronary or cerebrovascular disease → higher risk of myocardial ischaemia or stroke



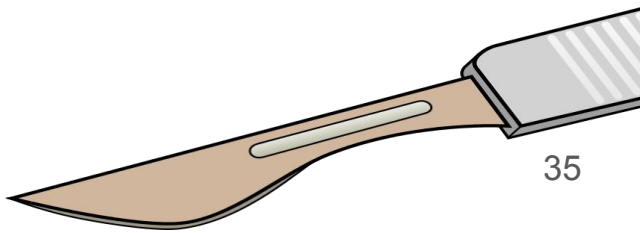
Factors Contributing to Risk

- Risk = complex interaction of patient and surgical factors
- Patient factors (Table 17.5):
  - Previous severe cardiorespiratory illness, e.g. acute MI, COPD or stroke
  - Late-stage vascular disease involving 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: PaO_2 <8 kPa or FiO_2 >0.4 or mechanical ventilation >48 h
  - Acute renal failure: urea >20 mmol or creatinine >260 mmol/L
- Elderly: not independently higher risk, but more cardiac, pulmonary and renal disease; require surgery four times as often
- Around 10% over 65 have frailty; increasing incidence with age; multiple body systems lose reserves
- Surgery-specific risk (Table 17.6):
  - High risk (cardiac risk >5%): open aortic, major vascular, peripheral vascular, urgent body cavity
  - Intermediate risk (1–5%): elective abdominal, carotid, endovascular aneurysm, head and neck, major neurosurgery, arthroplasty, elective pulmonary, major urology
  - Low risk (<1%): breast, dental, thyroid, ophthalmic, gynaecological, reconstructive, minor orthopaedic, minor urology
- Risk increases if surgery performed as emergency
- Underlying condition may increase risk, e.g. severe peripheral vascular disease from heavy smoking may also have significant COPD and IHD
- Adjusted mortality by type of surgery (Table 17.7):
  - Vascular: unadjusted 5.97% (rank 1), adjusted 0.98% (rank 5)
  - Thoracic: 3.40% (2), adjusted 2.28% (1)
  - Abdominal: 2.73% (3), adjusted 1.83% (2)
  - Cardiac: 2.70% (4), adjusted 1.13% (4)
  - Neurosurgery: 1.74% (5), adjusted 1.60% (3)
  - Orthopaedic: 1.25% (6), adjusted 0.49% (7)
  - ENT: 0.85% (7), adjusted 0.68% (6)
  - Urology: 0.81% (8), adjusted 0.38% (8)
  - Gynaecology: 0.13% (9), adjusted 0.17% (9)
  - Breast: 0.07% (10), adjusted 0.08% (10)
- Typical high-risk patient: elderly with coexisting conditions such as IHD and/or COPD undergoing major surgery; risk increases if emergency



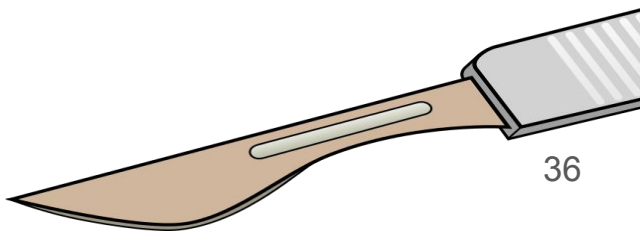
Management of Risk

- Key: identification and accurate quantification of risk, then measures to minimise it
- Realistic estimates of risk are cornerstone of informed consent and shared decision making
- Patient and surgeon may choose less extensive or non-surgical option if risks too high or unacceptable
- RCS England recommendation:
    - Predicted mortality >5% → active consultant input in all stages of management
    - Predicted mortality >10% → conducted under direct supervision of consultant surgeon or anaesthetist, unless consultants satisfied with seniority and competence of staff managing these patients
    - Mortality >10% → managed in critical care facility
- Optimise medical therapy for comorbidities
- Additional physiological optimisation:
    - Minimise myocardial ischaemia
    - Improve oxygen delivery to major organs
- Optimisation before surgery can be more effective in critical care environment
- Patients may need preoperative HDU or ITU admission
- Plan likelihood of postoperative critical care preoperatively; discuss with duty critical care physician
- Identify patients who benefit most from interventions for outcomes and effective resource allocation
- Emergency surgery associated with higher risks due to less time and opportunity to organise additional care
- Summary Box 17.7 — Practical approach to care for high-risk patient:
    - Identify the high-risk patient
    - Assess the level of risk
    - Detailed preoperative assessment
    - Adequate resuscitation
    - Optimise medical management
    - Investigation to define underlying surgical problem
    - Immediate and definitive treatment of underlying problems
    - Consider admission to critical care facility postoperatively



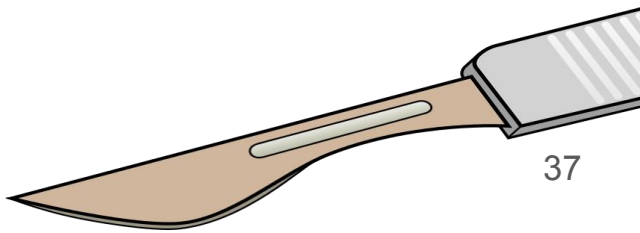
Identification of High-Risk Patient — ASA and MET

- Many scoring systems developed to identify high-risk patients (Table 17.8)
- American Society of Anaesthesiologists (ASA) system:
  - Widely used
  - Not designed as risk prediction score but quantitative association with predicted postoperative mortality
  - Does not account for age or nature of surgery
  - “Systemic disease” introduces subjectivity
  - Table 17.9 — Operative mortality by ASA grade:
    - I Healthy: 0.1%
    - II Mild systemic disease, no functional limitation: 0.7%
    - III Severe systemic disease, definite functional limitation: 3.5%
    - IV Severe systemic disease, constant threat to life: 18.3%
    - V Moribund patient unlikely to survive 24 hours with or without operation: 93.3%
    - E Emergency operation: —
- Metabolic equivalent (MET):
  - Overall functional physical fitness judged by ability to tolerate METs
  - 1 MET = oxygen consumption of adult at rest (~3.5 mL/kg/min)
  - 1 MET = eating and dressing
  - 4 MET = climbing 2 flights of stairs
  - 6 MET = short run
  - >10 MET = able to participate in strenuous sport
  - Patients who can exercise at 4 METs or above have lower risk of perioperative mortality
  - If able to perform >4 METs, e.g. climbing at least one flight of stairs, considered suitable candidate for major surgery
  - Depends on subjective assessment; may be overestimated by patient
- Objective indices based on weighted scores for surgery and comorbidity created to stratify cardiac risk:
  - Goldman cardiac risk index
  - Revised cardiac risk index (RCRI) of Lee (Table 17.11)
  - Predict risk of cardiac complications, not designed to predict mortality



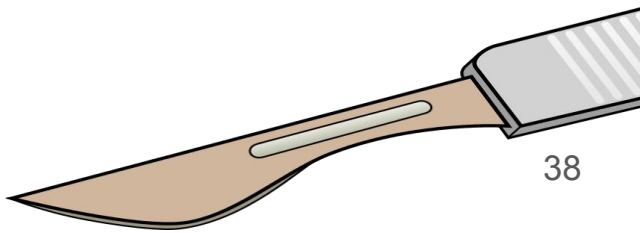
Identification — RCRI, POSSUM, ACS NSQIP

- Revised Cardiac Risk Index (RCRI) of Lee:
  - Risk factors: history of ischaemic heart disease, history of compensated or prior heart failure, history of cerebrovascular disease, diabetes mellitus, renal insufficiency (creatinine >177 μmol/L), high-risk surgery
  - Risk of major cardiac complications:
    - 0 factors = 0.4%
    - 1 factor = 0.9%
    - 2 factors = 7.0%
    - 3+ factors = 11.0%
- POSSUM score:
  - Physiologic and Operative Severity Score for the enUmeration of Mortality and Morbidity
  - Modifications: P-POSSUM, CR-POSSUM
  - Used to predict all-cause mortality in postoperative critical care patients and non-cardiac morbidity
- ACS NSQIP score:
  - American College of Surgeons National Surgical Quality Improvement Programme
  - Estimates chance of complication or death after surgery for more than a thousand different surgical procedures
  - Compares patient's risk with average person's risk
  - Web-based tool done preoperatively
  - Calculated from surgical procedure and 19 patient-specific preoperative risk factors
- Table 17.8 — Surgical risk scores classified by outcome measures and need for intraoperative information:
  - Scores predicting mortality: ASA, APACHE-II, Donati score, Hardman index, Glasgow aneurysm score, Sickness assessment, Boey score, Hacetteppe score, Physiological POSSUM, ACS NSQIP surgical risk score
  - Scores predicting morbidity: ASA, APACHE-II, Goldman cardiac risk index, Veltkamp score, VA respiratory failure score, VA pneumonia prediction index, ACS NSQIP surgical risk score
  - Scores requiring operative information: Mannheim peritonitis index, Reiss index, Fitness score, POSSUM, P-POSSUM, Cleveland colorectal model, Surgical risk scale
  - Scores predicting morbidity requiring operative information: POSSUM, P-POSSUM



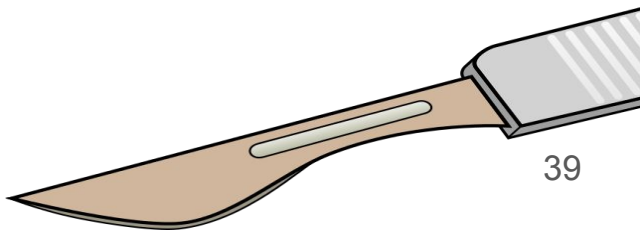
Cardiopulmonary Exercise Testing and Walk Tests

- Cardiopulmonary exercise testing (CPET):
  - Screening tool to identify high-risk patients
  - Measures O2 consumption and CO2 production during 10 minutes of incrementally demanding exercise, usually cycle ergometer, up to maximally tolerated level
  - Principle: when O2 delivery to active tissues inadequate, anaerobic metabolism begins; lactate buffered by bicarbonate; CO2 increases disproportionately
  - Anaerobic threshold (AT): O2 consumption in mL/kg/min above which this occurs
  - Peak oxygen consumption (VO2) also measured
  - End product of combined respiratory, cardiac, vascular and musculoskeletal fitness
  - Higher risk if AT <11 mL/kg/min and VO2 <15 mL/kg/min
- When CPET not available:
  - Simple walk tests: 6-minute walk test (6MWT)
  - Incremental shuttle walk test (ISWT)
  - Depend on ability to walk for fixed 6-minute period or at increasing speed over flat surface
- Figure 17.7: Cardiopulmonary exercise testing (CPET)



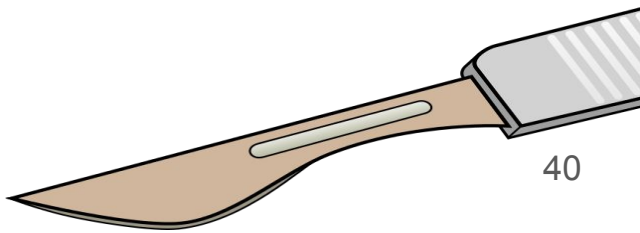
Optimisation of the High-Risk Patient — General and IHD

- Review and optimise all coexisting disease processes
- Simple measures:
  - Stop smoking (maximal benefit if stopped 8 weeks before surgery)
  - Reduce alcohol intake
  - Lose weight
  - Improve nutrition and/or haemoglobin levels
- High-risk group may need complex investigations, medication review or further surgery
- Example: AAA repair frequently requires carotid duplex scans; if significant blockage and high perioperative stroke risk, carotid endarterectomy may be indicated before AAA repair
- All high-risk patients benefit from multidisciplinary team care and experienced physicians perioperatively
- Ischaemic heart disease:
  - Perioperative MI associated with high mortality (15–25%)
  - Ischaemia/MI occurs when myocardial oxygen supply exceeded by demand
  - Precipitated by hypotension, tachycardia, procoagulant states, e.g. inflammatory response to surgery
  - Preparation aims to optimise myocardial oxygen supply/demand ratio and minimise ischaemia
  - May involve further investigations or postponing non-cardiac surgery 3–6 months after MI
  - Some patients require preoperative revascularisation: CABG or PCI with stent/angioplasty
  - Minimising myocardial ischaemia:
    - Anaesthesia techniques dampen stress response, especially minimise pain, provide cardiac stability
    - Avoid tachycardia, systolic hypertension, diastolic hypotension
    - Invasive arterial blood pressure monitoring may help
    - Monitor blood loss accurately; maintain haemoglobin suitable for cardiac risk factors
    - Perioperative β-blockers may be considered but controversial
    - Troponin testing allows early diagnosis of perioperative MI; limited reperfusion options due to bleeding risk from surgical site
    - Consider HDU admission for IHD; continue supplemental oxygen 3–4 days



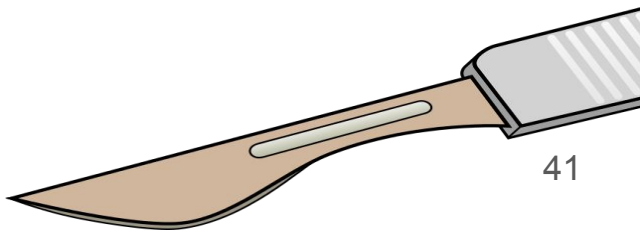
Optimisation — Cardiac Failure

- Left ventricular failure is end result of several conditions: IHD, hypertension, cardiomyopathies, valve dysfunction
- Decompensated heart failure → risk of multiorgan failure
- Highest risk: ejection fraction <35%, undiagnosed failure or underestimated severity
- Assess functional capacity
- May need to delay surgery for investigations such as echocardiogram and/or optimisation of medical therapy
- Drugs used in chronic heart failure have significant perioperative implications
- Continue β-blockers and probably ACE inhibitors, unless renal perfusion significantly affected
- Anaesthesia should ensure minimal myocardial depression and change in afterload
- Rapidly control arrhythmias, particularly AF
- Correct electrolyte imbalance crucial
- Invasive monitoring of trends in central venous and arterial pressure may help, especially with large fluid shifts



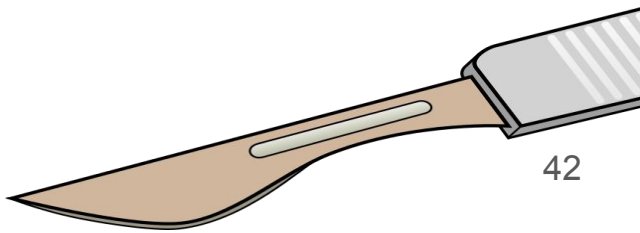
Optimisation — Respiratory Failure and Other Comorbidities

- Respiratory failure:
  - Around 1.5% develop lower respiratory tract infection after surgery; 30-day mortality over 20%
  - Surgery, especially open abdominal under general anaesthesia, changes respiratory physiology
  - Functional residual capacity reduced
  - Residual anaesthetic agents, limited mobility, pain → atelectasis and postoperative respiratory infection
  - Other complications: bronchospasm, pneumothorax, ARDS
  - Respiratory failure definition: PaO2 <8 kPa in air, PaO2/FiO2 <40 kPa, or inability to extubate 48 hours after surgery
  - Mortality 27–40%
  - Preoperatively: bronchodilators, steroids, optimise nutrition and albumin, physiotherapy, deep breathing exercises or incentive spirometry
  - Consider regional techniques where possible
  - Delay extubation until analgesia, hydration and acid-base status corrected
  - ITU admission may benefit; plan
  - Non-invasive respiratory support may allow earlier extubation
- Other comorbidities contributing to risk:
  - Acute kidney injury
  - Chronic kidney disease
  - Diabetes
  - Peripheral vascular disease
  - Liver dysfunction
  - All need optimisation
- Sepsis:
  - Urgent identification and treatment
  - If not treated early → prolonged critical care admission or death
  - Early resuscitative measures: broad-spectrum antibiotics, treat hypotension, hypovolaemia and elevated lactate with appropriate IV fluids
  - Deal with source of sepsis as early as possible



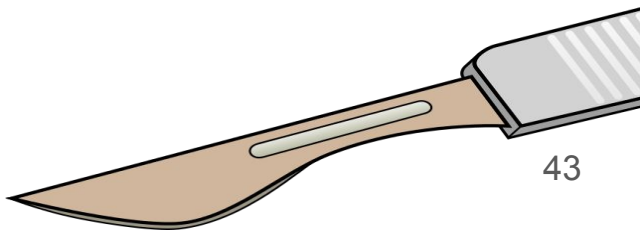
Minimising the Impact of Surgery in the High-Risk Patient

- Surgical technique choice may be influenced by patient risk factors
- Some procedures not primarily high-risk but become so in unsuitable patients
- Laparoscopic surgery:
  - Preferred technique for patients predisposed to postoperative respiratory complications
  - Effect on cardiac physiology means same may not apply to patients at risk of cardiac complications
- Expanding demand and indications for minimal access surgery push boundaries of intraoperative physiological tolerance
- Robotic prostatectomy and some laparoscopic colorectal procedures:
  - Require pneumoperitoneum with steep Trendelenburg (head down) positioning for several hours
  - Can be associated with adverse cardiovascular and neurological complications, e.g. myocardial ischaemia and increased intracranial pressure in high-risk group
  - Risk minimised by attention to patient selection
- Figure 17.9: Robotic surgery



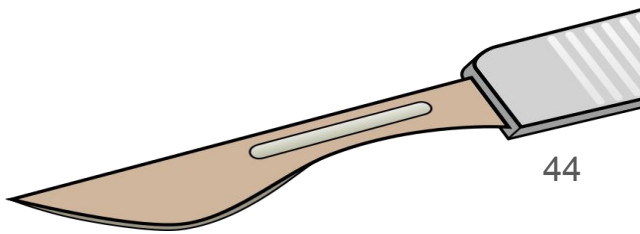
Role of Critical Care and Outreach Services

- Optimal care in high-risk group should extend to postoperative support
- Majority of these patients need admission to a critical care bed
- NCEPOD reports: majority of postoperative deaths in UK occur more than 5 days after surgery
- Admission to critical care unit allows early intervention and level of care difficult to deliver on ward during this crucial period
- High-risk surgical population accounts for 80% of postoperative deaths
- Only about 15–30% of high-risk surgical patients are admitted to critical care unit at any time after surgery
- One study: observed mortality UK 9.95% vs USA 2.1%
- Suggested difference related to critical care services: UK 8.6 critical care beds per 100,000 population vs USA 30.5
- Last decade: “critical care without walls”
- Intensive care outreach services (ICORS):
  - Grew from recognition that many hospital patients at risk of being critically ill
  - Early identification using “early warning scores” allows early intervention
  - Outreach team bridges gap between critical care unit and ward
- Figure 17.10: High-risk patient admitted to intensive care unit postoperatively



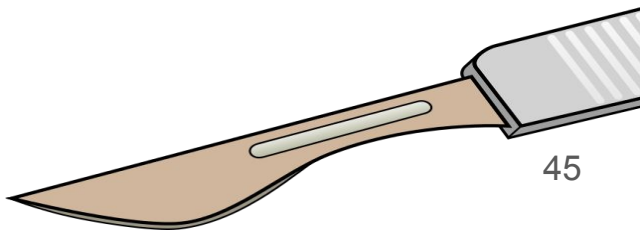
Consent

- Consent should be both voluntary and informed
- Process evolved; in UK, new guidance after recent legal judgement (RCS)
- Importance of supported decision-making concerning treatment or operation
- Key principles — discussion should:
    - Give patient information required to make a decision
    - Be tailored to individual patient
    - Explain all reasonable treatment options
    - Discuss all material risks
- Material risk: “whether, in the circumstances of the particular case, a reasonable person in the patient’s position would be likely to attach significance to the risk, or the doctor is or should reasonably be aware that the particular patient would likely attach significance to it” (RCS 2016)
- Consent should be written and recorded on a form
- Key points of discussion should be recorded in case notes
- Emergency situations: may not be possible to follow all key principles
- For consent, patient must have capacity:
    - Ability to understand information provided
    - Retain and use information to make decision
    - Indicate what that decision is
- Surgeon should presume patient has capacity for consent (Mental Capacity Act 2005) unless demonstrated otherwise
- Generally children presumed to have capacity at 16; under that age, capacity can be assessed (GMC guidance 2007)
- Person obtaining consent must be appropriately experienced
- Summary Box 17.8 — Consent:
    - Consent should be voluntary and informed
    - Supported decision-making is considered good practice
    - Explain all treatment options and material risks
    - Capacity is needed for a patient to give their consent



Arranging Theatre List

- Date, place and time of operation matched with availability of personnel
- Appropriate equipment and instruments available
- Operating list distributed as early as possible to all staff involved in making list run smoothly
- If electronic, familiarity with computer system required
- Prioritise patients:
  - Children and diabetic patients at beginning of list
  - Life- and limb-threatening surgery takes priority
  - Cancer patients need to be treated early
- Table 17.12 — Perioperative teams:
  - Ward, theatre and specialist nursing staff
  - Anaesthetic and surgical teams
  - Radiology, pathology involvement
  - Rehabilitation and social care workers
  - Specific personnel in individual cases



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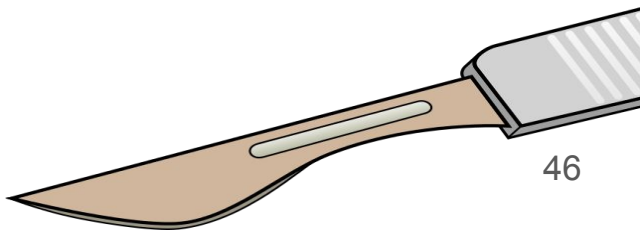

Take-Home Messages

- Preoperative care begins long before the theatre doors
- Systematic history, examination and investigation identify risk and guide optimisation
- Correct anaemia, diabetes, nutrition, smoking, alcohol and exercise where possible
- Know the high-risk patient: predicted mortality ≥5%, elderly, IHD/COPD, major/emergency surgery
- Use scores and CPET to quantify risk and guide critical care planning
- Optimise cardiac, respiratory, renal, hepatic, endocrine and coagulation status
- Respect NBM rules and regurgitation risk
- Consent must be voluntary, informed, capacity-based and documented
- Organise the list early, prioritise wisely, and communicate with the whole team
- Critical care and outreach save lives in the high-risk surgical patient