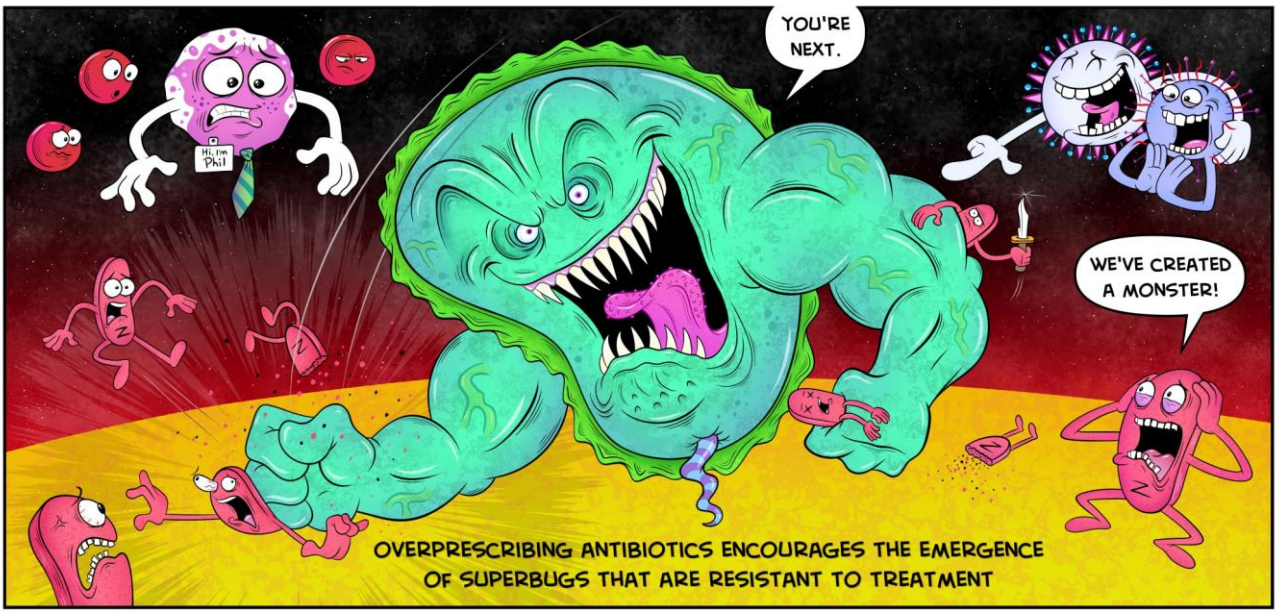

Acute Dystonic Reaction

The anti-dopaminergic drugs (such as antipsychotics) may result in extrapyramidal side effects. These may range from mild parkinsonian symptoms such as resting tremor and bradykinesia. Through to acute dystonic reactions which are characterised by abnormal and involuntary facial and bodily movements, such as spasmodic torticollis, oculogyric crisis and oromandibular dystonia.

Chronic cases are generally only encountered in psychiatric units. In surgical practice the administration of the anti-dopaminergic drug metoclopramide may be sufficient to precipitate an attack.

Treatment may be required if symptoms are sufficiently troublesome; **benzhexol and procyclidine** are two drugs which may be used.

Brain Death

Criteria for brain stem death testing

- Deep coma of known aetiology.
- Reversible causes excluded
- No sedation
- Normal electrolytes

Testing for brain death

- Fixed pupils which do not respond to sharp changes in the intensity of incident light
- No corneal reflex
- Absent oculo-vestibular reflexes - no eye movements following the slow injection of at least 50ml of ice-cold water into each ear in turn (the caloric test)
- No response to supraorbital pressure
- No cough reflex to bronchial stimulation or gagging response to pharyngeal stimulation
- No observed respiratory effort in response to disconnection of the ventilator for long enough (typically 5 minutes) to ensure elevation of the arterial partial pressure of carbon dioxide to at least 6.0 kPa (6.5 kPa in patients with chronic carbon dioxide retention). Adequate oxygenation is ensured by pre-oxygenation and diffusion oxygenation during the disconnection (so the brain stem respiratory centre is not challenged by the ultimate, anoxic, drive stimulus)

The test should be undertaken by two appropriately experienced doctors on two separate occasions. Both should be experienced in performing brain stem death testing and have at least 5 years post graduate experience. One of them must be a consultant. Neither can be a member of the transplant team (if organ donation contemplated).

Adult Respiratory Distress Syndrome (ARDS)

Defined as an acute condition characterized by bilateral pulmonary infiltrates and severe hypoxemia (PaO_2/FiO_2 ratio < 200) in the absence of evidence for cardiogenic pulmonary oedema (clinically or pulmonary capillary wedge pressure of less than 18 mm Hg).
It is subdivided into two stages. Early stages consist of an exudative phase of injury with associated oedema. The later stage is one of repair and consists of fibroproliferative changes. Subsequent scarring may result in poor lung function.

Causes

- Sepsis
- Direct lung injury
- Trauma
- Acute pancreatitis
- Long bone fracture or multiple fractures (through fat embolism)
- Head injury (causes sympathetic nervous stimulation which leads to acute pulmonary hypertension)

Clinical features

- Acute dyspnoea and hypoxaemia hours/days after event
- Multi organ failure
- Rising ventilatory pressures

Management

- Treat the underlying cause
- Antibiotics (if signs of sepsis)
- Negative fluid balance i.e. Diuretics
- Recruitment maneuvers such as prone ventilation, use of positive end expiratory pressure
- Mechanical ventilation strategy using low tidal volumes, as conventional tidal volumes may cause lung injury (only treatment found to improve survival rates)

Management of Pain

World Health Organisation (WHO) Analgesic Ladder

- Initially peripherally acting drugs such as paracetamol or non-steroidal anti-inflammatory drugs (NSAIDs) are given.
- If pain control is not achieved, the second part of the ladder is to introduce weak opioid drugs such as codeine or dextropropoxyphene together with appropriate agents to control and minimise side effects.
- The final rung of the ladder is to introduce strong opioid drugs such as morphine. Analgesia from peripherally acting drugs may be additive to that from centrally-acting opioids and thus, the two are given together.

Exam Scenarios

- COPD patient – *regional anesthesia preferred over general; open surgery preferred over laparoscopy*
- Distal radius # – *can be manipulated under a Bier's block*
- Episiotomy – *can be done under a pudendal block*
- Hemorrhoidectomy – *can be done under a caudal block*
- Thoracotomy / Lobectomy – *Epidural analgesia is commonly provided for analgesia after thoracotomy*
- Major open surgery – *consider PCA post-operatively*

Local anaesthetics

- Infiltration of a wound with a long-acting local anaesthetic such as Bupivacaine
- Analgesia for several hours
- Further pain relief can be obtained with repeat injections or by infusions via a thin catheter
- Blockade of plexuses or peripheral nerves will provide selective analgesia in those parts of the body supplied by the plexus or nerves
- Can either be used to provide anaesthesia for the surgery or specifically for postoperative pain relief
- Especially useful where a sympathetic block is needed to improve postoperative blood supply or where central blockade such as spinal or epidural blockade is contraindicated.

Spinal anaesthesia

Provides excellent analgesia for surgery in the lower half of the body and pain relief can last many hours after completion of the operation if long-acting drugs containing vasoconstrictors are used.

Side effects of spinal anaesthesia include: hypotension, sensory and motor block, nausea and urinary retention.

Epidural anaesthesia

An indwelling epidural catheter inserted. This can then be used to provide a continuous infusion of analgesic agents. It can provide excellent analgesia. They are still the preferred option following major open abdominal procedures and help prevent post-operative respiratory compromise resulting from pain.

Disadvantages of epidurals is that they usually confine patients to bed, especially if a motor block is present. In addition, an indwelling urinary catheter is required. Which may not only impair mobility but also serve as a conduit for infection. They are contraindicated in coagulopathies.

Transversus Abdominal Plane block (TAP)

In this technique an ultrasound is used to identify the correct muscle plane and local anaesthetic (usually bupivicaine) is injected. The agent diffuses in the plane and blocks many of the spinal nerves. It is an attractive technique as it provides a wide field of blockade but does not require the placement of any indwelling devices. There is no post-operative motor impairment. For this reason, it is the preferred technique when extensive laparoscopic abdominal procedures are performed. They will then provide analgesia immediately following surgery but as they do not confine the patient to bed, the focus on enhanced recovery can begin sooner.

The main disadvantage is that their duration of action is limited to the half-life of the local anaesthetic agent chosen. In addition some anaesthetists do not have the USS skills required to site the injections.

Patient Controlled Analgesia (PCA)

Patients administer their own intravenous analgesia and titrate the dose to their own end-point of pain relief using a small microprocessor - controlled pump. Morphine is the most popular drug used.

Strong Opioids

Severe pain arising from deep or visceral structures requires the use of strong opioids

Morphine

- Short half-life and poor bioavailability.
- Metabolised in the liver and clearance is reduced in patients with liver disease, in the elderly and the debilitated
- Side effects include nausea, vomiting, constipation and respiratory depression.
- Tolerance may occur with repeated dosage

Pethidine

- Synthetic opioid which is structurally different from morphine but which has similar actions. Has 10% potency of morphine.
- Short half-life and similar bioavailability and clearance to morphine.
- Short duration of action and may need to be given hourly.
- Pethidine has a toxic metabolite (norpethidine) which is cleared by the kidney, but which accumulates in renal failure or following frequent and prolonged doses and may lead to muscle twitching and convulsions. Extreme caution is advised if pethidine is used over a prolonged period or in patients with renal failure.

Weak opioids

Moderate pain

Codeine

- Markedly less active than morphine, has predictable effects when given orally and is effective against mild to moderate pain.

Non opioid analgesics

Mild to moderate pain.

Paracetamol

- Inhibits prostaglandin synthesis.
- Analgesic and antipyretic properties but little anti-inflammatory effect
- It is well absorbed orally and is metabolised almost entirely in the liver
- Side effects in normal dosage and is widely used for the treatment of minor pain. It causes hepatotoxicity in over dosage by overloading the normal metabolic pathways with the formation of a toxic metabolite.

NSAIDs

- Analgesic and anti-inflammatory actions
- Inhibition of prostaglandin synthesis by the enzyme Cyclooxygenase which catalyses the conversion of arachidonic acid to the various prostaglandins that are the chief mediators of inflammation. All NSAIDs work in the same way and thus there is no point in giving more than one at a time.
- NSAIDs are, in general, more useful for superficial pain arising from the skin, buccal mucosa, joint surfaces and bone.
- Relative contraindications: history of peptic ulceration, gastrointestinal bleeding or bleeding diathesis; operations associated with high blood loss, asthma, moderate to severe renal impairment, dehydration and any history of hypersensitivity to NSAIDs or aspirin.

Neuropathic Pain

Neuropathic pain may be defined as pain which arises following damage or disruption of the nervous system. It is often difficult to treat and responds poorly to standard analgesia. Examples include:

- Diabetic neuropathy
- Post-herpetic neuralgia
- Trigeminal neuralgia
- Prolapsed intervertebral disc

NICE issued guidance in 2010 on the management of neuropathic pain:

- First-line treatment*: oral amitriptyline or pregabalin
- If satisfactory pain reduction is obtained with amitriptyline but the person cannot tolerate the adverse effects, consider oral imipramine or nortriptyline as an alternative
- Second-line treatment: if first-line treatment was with amitriptyline, switch to or combine with pregabalin. If first-line treatment was with pregabalin, switch to or combine with amitriptyline
- Other options: pain management clinic, tramadol (not other strong opioids), topical lidocaine for localised pain if patients unable to take oral medication

**Please note that for some specific conditions the guidance may vary.*

*For example, **carbamazepine** is used first-line for trigeminal neuralgia, **duloxetine** for diabetic neuropathy*

Circulatory Support of the Critically Ill

Circulatory support

Impaired tissue oxygenation may occur as a result of circulatory shock. Shock is considered further under its own topic heading.

Patients requiring circulatory support require haemodynamic monitoring. At its simplest level this may simply be in the form of regular urine output measurements and blood pressure monitoring. In addition, ECG monitoring will allow the identification of cardiac arrhythmias. Pulse oximeter measurements will allow quick estimation haemoglobin oxygen saturation in arterial blood.

Invasive arterial blood pressure monitoring is undertaken by the use of an indwelling arterial line. Most arterial sites can be used although the radial artery is the commonest. It is important not to cannulate end arteries. The arterial trace can be tracked to ventilation phases and those patients whose systolic pressure varies with changes in intrathoracic pressure may benefit from further intravenous fluids.

Central venous pressure is measured using a CVP line that is usually sited in the superior vena cava via the internal jugular route. The CVP will demonstrate right atrial filling pressure and volume status. When adequate intra vascular volume is present a fluid challenge will typically cause a prolonged rise in CVP (usually greater than 6-8mmHg).

To monitor the cardiac output a Swan-Ganz catheter is traditionally inserted (other devices may be used and are less invasive). Inflation of the distal balloon will provide the pulmonary artery occlusion pressure and the pressure distal to the balloon will equate to the left atrial pressure. This gives a measure of left ventricular preload. Because the Swan-Ganz catheter can measure several variables it can be used to calculate:

- Stroke volume
- Systemic vascular resistance
- Pulmonary artery resistance
- Oxygen delivery (and consumption)

Inotropes

In patients with an adequate circulating volume but on-going circulatory compromise a vasoactive drug may be considered. These should usually be administered via the central venous route. Commonly used inotropes include:

Agent	Mode of action	Effect
Noradrenaline	α agonist	Vasopressor action, minimal effect on cardiac output
Adrenaline	α and β receptor agonist	Increases cardiac output and peripheral vascular resistance
Dopamine	β1 agonist	Increases contractility and rate
Dobutamine	β1 and β2 agonist	Increases cardiac output and decreases SVR
Milrinone	Phosphodiesterase inhibitor	Elevation of cAMP levels improves muscular contractility, short half life and acts as vasodilator

Cryoprecipitate

- Blood product made from plasma
- Usually transfused as 6 unit pool
- Indications include massive haemorrhage and uncontrolled bleeding due to haemophilia

Composition

Agent	Quantity
Factor VIII	100IU
Fibrinogen	250mg
von Willebrand factor	Variable
Factor XIII	Variable

Massive Haemorrhage

Definition

This is the loss of one blood volume in a 24 hour period or the loss of 50% of the circulating blood volume in 3 hours. A blood loss of 150ml/ minute is also included. The normal adult blood volume is 7% of total adult body weight. The blood volume equates to between 8 and 9% of a child's body weight.

Complications of massive transfusion

Complication	Key points
Hypothermia	Blood is refrigerated Hypothermic blood impairs homeostasis Shifts Bohr curve to the left
Hypocalcaemia	Both FFP and platelets contain citrate anticoagulant, this may chelate calcium
Hyperkalaemia	Plasma of red cells stored for 4-5 weeks contains 5-10 mmol K^+
Delayed type transfusion reactions	Due to minor incompatibility issues especially if urgent or non cross matched blood used
Transfusion related lung injury	Acute onset non cardiogenic pulmonary oedema Leading cause of transfusion related deaths Greatest risk posed with plasma components Occurs as a result of leucocyte antibodies in transfused plasma Aggregation and degranulation of leucocytes in lung tissue accounts for lung injury
Coagulopathy	Anticipate once circulating blood volume transfused 1 blood volume usually drops platelet count to 100 or less 1 blood volume will both dilute and not replace clotting factors Fibrinogen concentration halves per 0.75 blood volume transfused

Hypovolaemia and the Surgical Patient

Hypovolaemia often represents the end point of multiple pathological processes. It may be divided into the following categories; overt compensated hypovolaemia, covert compensated hypovolaemia and decompensated hypovolaemia. Of these three categories the covert compensated subtype of hypovolaemia remains the commonest and is accounted for by the fact that class I shock will often produce no overtly discernible clinical signs. This is due, in most cases, to a degree of splanchnic autotransfusion. The most useful diagnostic test for detection of covert compensated hypovolaemia remains urinanalysis. This often shows increased urinary osmolality and decreased sodium concentration.

In overt compensated hypovolaemia the blood pressure is maintained although other haemodynamic parameters may be affected. This correlates to class II shock. In most cases assessment can be determined clinically. Where underlying cardiopulmonary disease may be present the placement of a CVP line may guide fluid resuscitation. Severe pulmonary disease may produce discrepancies between right and left atrial filling pressures. This problem was traditionally overcome through the use of Swann-Ganz catheters.

Untreated, hypovolaemia may ultimately become uncompensated with resultant end organ dysfunction. Microvascular hypoperfusion may result in acidosis with a subsequent myocardial depressive effect, thereby producing a vicious circle.

The treatment of hypovolaemia is with intravenous fluids. In the first instance a fluid challenge such as the rapid infusion of 250ml of crystalloid will often serve as both a diagnostic and resuscitative measure. In the event that this fails to produce the desired response the patient will need to be re-evaluated clinically. More fluid may be needed. However, it is important not to overlook mechanical ureteric obstruction in the anuric, normotensive patient.

Nutrition Monitoring - NICE Guidelines

- Weight: daily if fluid balance concerns, otherwise weekly reducing to monthly
- BMI: at start of feeding and then monthly
- If weight cannot be obtained: monthly mid arm circumference or triceps skin fold thickness
- Daily electrolytes until levels stable. Then once or twice a week.
- Weekly glucose, phosphate, magnesium, LFTs, Ca, albumin, FBC, MCV levels if stable, 2-4 weekly Zn, Folate, B12 and Cu levels if stable
- 3-6 monthly iron and ferritin levels, manganese (if on home parenteral regime)
- 6 monthly vitamin D
- Bone densitometry initially on starting home parenteral nutrition then every 2 years

Nutrition Screening - NICE Guidelines

NICE Screening for malnutrition: A summary

- To be performed by an appropriate professional.
- All new hospital admissions, new GP patients, new care home patients and patients attending their first clinic should be screened. Afterwards hospital in patients should be screened weekly.
- The favored screening tool in the UK is the Malnutrition Universal Screening Tool (MUST).

Nutritional support i.e. oral, enteral or parenteral

- Given to patients identified as being malnourished *(see box…)*
- Considered in people identified as being AT RISK of malnutrition *(see box…)*

$$BMI = \frac{kg}{m^2}$$

NB if considering feed withdrawal refer to GMC guidance 'withholding and withdrawing life prolonging treatment'.

Patients identified as being malnourished

- BMI < 18.5 kg/m^2
- Unintentional weight loss of > 10% over 3-6/12
- BMI < 20 kg/m^2 and unintentional weight loss of > 5% over 3-6/12

AT RISK of malnutrition

- Eaten nothing or little > 5 days, who are likely to eat little for a further 5 days
- Poor absorptive capacity
- High nutrient losses
- High metabolism

Refeeding Syndrome

Refeeding syndrome describes the metabolic abnormalities which occur on feeding a person following a period of starvation. The metabolic consequences include:

- Hypophosphataemia
- Hypokalaemia
- Hypomagnesaemia
- Abnormal fluid balance

These abnormalities can lead to organ failure.

Re-feeding problems

If patient not eaten for > 5 days, aim to re-feed at < 50% energy and protein levels

High risk for re-feeding problems

If one or more of the following:

- BMI < 16 kg/m^2
- Unintentional weight loss >15% over 3-6 months
- Little nutritional intake > 10 days
- Hypokalaemia, Hypophosphataemia or hypomagnesaemia prior to feeding (unless high)

If two or more of the following:

- BMI < 18.5 kg/m^2
- Unintentional weight loss > 10% over 3-6 months
- Little nutritional intake > 5 days
- History of: alcohol abuse, drug therapy including insulin, chemotherapy, diuretics and antacids

Nutrition Prescriptions

National institute of clinical excellence (NICE) guidelines

For people not severely ill and not at risk of refeeding syndrome aim to give

- 25-35 kcal/kg/day (lower if BMI > 25)
- 0.8-1.5g protein /kg/day
- 30-35 ml fluid/kg/day
- Adequate electrolytes, minerals, vitamins
- Severely ill patients aim to give < 50% of the energy and protein levels over the first 24-48h.

For people at high risk of refeeding syndrome:

- Start at up to **10 kcal/kg/day** increasing to full needs over 4-7 days
- Start immediately before and during feeding: oral thiamine 200-300mg/day, vitamin B co strong 1 tds and supplements
- Give K^+ (2-4 mmol/kg/day), phosphate (0.3-0.6 mmol/kg/day), magnesium (0.2-0.4 mmol/kg/day)

Oral, Enteral and Parenteral Feeding - NICE Guidelines Summary

Oral nutrition

- Identify patients who are or at risk of being malnourished ***(see box…)***
- Check for dysphagia
- If safe swallow, provide food and fluid in adequate quantity and quality
- Give a balanced diet
- Offer multivitamins and minerals

Surgical patients: If malnourished and safe swallow and post-op caesarean/gynecological/abdominal surgery, aim for oral intake within 24h

Identify unsafe / inadequate oral intake OR a non-functional GI tract / perforation / inaccessible

Consider parenteral nutrition:

- For feeding < 14 days consider feeding via a peripheral venous catheter
- For feeding > 30 days use a tunneled subclavian line
- Continuous administration in severely unwell patients
- If feed needed > 2 weeks consider changing from continuous to cyclical feeding
- Don't give > 50% of daily regime to unwell patients in first 24-48 hours

Surgical patients: if malnourished with unsafe swallow OR a non-functional GI tract/perforation/inaccessible then consider peri-operative parenteral feeding.

Total parenteral nutrition (TPN)

- Commonly used in nutritionally compromised surgical patients.
- Bags contain combinations of glucose, lipids and essential electrolytes, the exact composition is determined by the patient's nutritional requirements.
- Although it may be infused peripherally, this may result in thrombophlebitis.
- Longer term infusions should be administered into a central vein (preferably via a PICC line).
- Complications are related to sepsis, re-feeding syndromes and hepatic dysfunction.

Enteral Feeding

- Identify patients as malnourished or at risk ***(see box…)***
- Identify unsafe or inadequate oral intake with functional GI tract
- Consider for enteral feeding
- Gastric feeding unless upper GI dysfunction (then for duodenal or jejunal tube)
- Check NG placement using aspiration and pH (check post pyloric tubes with AXR)
- Gastric feeding > 4 weeks consider long-term gastrostomy
- Consider bolus or continuous feeding into the stomach
- ITU patients should have continuous feeding for 16-24h (24h if on insulin)
- Consider motility agent in ITU or acute patients for delayed gastric emptying. If this doesn't work then try post pyloric feeding or parenteral feeding.
- PEG can be used 4 hours after insertion, but should not be removed until >2 weeks after insertion.

Surgical patients due to have major abdominal surgery: if malnourished, unsafe swallow/inadequate oral intake and functional GI tract then consider pre-operative enteral feeding.

Post-Operative Fluid Management

Composition of commonly used intravenous fluids $mmol^{-1}$

	Na	K	Cl	Bicarbonate	Lactate
Plasma	137-147	4-5.5	95-105	22-25	-
0.9% Saline	153	-	153	-	-
Dextrose / saline	30.6	-	30.6	-	-
Hartmans	130	4	110	-	28

Post-operative fluid management

In the UK the GIFTASUP and NICE (CG174 2013) guidelines (see reference below) were devised to try and provide some consensus guidance as to how intravenous fluids should be administered. A decade ago it was a commonly held belief that little harm would occur as a result of excessive administration of normal saline and many oliguric post operative patients received enormous quantities of IV fluids. As a result they developed hyperchloraemic acidosis. With greater understanding of this potential complication, the use of electrolyte balanced solutions (Ringers lactate/ Hartmans) is now favored over normal saline.

The other guidance includes:

- Fluids given should be documented clearly and easily available
- Assess the patient's fluid status when they leave theatre
- If a patient is haemodynamically stable and euvolaemic, aim to restart oral fluid intake as soon as possible
- Review patients whose urinary sodium is < 20
- If a patient is oedematous, hypovolaemia if present should be treated first. This should then be followed by a negative balance of sodium and water, monitored using urine Na excretion levels
- Solutions such as Dextran 70 should be used in caution in patients with sepsis as there is a risk of developing acute renal injury

Postoperative Cognitive Dysfunction (POCD) Management

Definition

- Deterioration in performance in a battery of neuropsychological tests that would be expected in < 3.5% of controls

Or

- Long term, possibly permanent disabling deterioration in cognitive function following surgery

Early POCD

- Increasing age
- GA rather than regional
- Duration of anaesthesia
- Reoperation
- Postoperative infection

Late POCD

- Increasing age
- Emboli
- Biochemical disturbances

Anaesthetic technique and Post-operative cognitive impairment:

- Use of benzodiazepines preoperatively reduces long-term POCD (9.9% vs. 5%)
- Do not stop drugs for cognitive function
- Regional techniques reduce POCD in first week, but no difference at 3 months

Pulmonary Embolism: Investigation

See Emergency Medicine

Pulmonary Function Tests

Pulmonary function tests can be used to determine whether a respiratory disease is obstructive or restrictive. The table below summarises the main findings and gives some example conditions:

Obstructive lung disease	Restrictive lung disease
FEV1 - significantly reduced FVC - reduced or normal FEV1% (FEV1/FVC) - **reduced (less than approx. 70%)**	FEV1 - reduced FVC - significantly reduced FEV1% (FEV1/FVC) - **normal or increased (over approx. 70%)**
Asthma COPD Bronchiectasis Bronchiolitis obliterans	Pulmonary fibrosis Asbestosis Sarcoidosis Acute respiratory distress syndrome Infant respiratory distress syndrome Kyphoscoliosis Neuromuscular disorders

Surgical Complications

Anatomical principles

Understanding the anatomy of a surgical field will allow appreciation of local and systemic complications that may occur. For example, nerve injuries may occur following surgery in specific regions. The table below lists some of the more important nerves to consider and mechanisms of injury

Nerve	Mechanism
Accessory	Posterior triangle lymph node biopsy
Sciatic	Posterior approach to hip
Common peroneal	Legs in Lloyd Davies position
Long thoracic	Axillary node clearance
Pelvic autonomic nerves	Pelvic cancer surgery
Recurrent laryngeal nerves	During thyroid surgery
Hypoglossal nerve	During carotid endarterectomy
Ulnar and median nerves	During upper limb fracture repairs

These are just a few. The detailed functional sequelae are particularly important and will often be tested.

In addition to nerve injuries certain procedures carry risks of visceral or structural injury. Again some particular favorites are given below:

Structure	Mechanism
Thoracic duct	During thoracic surgery e.g. Pneumonectomy, oesphagectomy
Parathyroid glands	During difficult thyroid surgery
Ureters	During colonic resections/ gynaecological surgery
Bowel perforation	Use of Verres Needle to establish pneumoperitoneum
Bile duct injury	Failure to delineate Calots triangle carefully and careless use of diathermy
Facial nerve	Always at risk during Parotidectomy
Tail of pancreas	When ligating splenic hilum
Testicular vessels	During re-do open hernia surgery
Hepatic veins	During liver mobilization

Again many could be predicted from the anatomy of the procedure.

Physiological derangements

A very common complication is bleeding and this is covered under the section of haemorrhagic shock. Another variant is infection either superficial or deep seated. The organisms are covered under microbiology and the features of sepsis covered under shock. Do not forget that immunocompromised and elderly patients may present will atypical physiological parameters.

Selected physiological and biochemical issues are given below:

Complication	Physiological/ Biochemical Problem
Arrhythmias following cardiac surgery	Susceptibility to hypokalaemia (K^+ <4.0 in cardiac patients)
Neurosurgical electrolyte disturbance	SIADH following cranial surgery causing hyponatraemia
Ileus following gastrointestinal surgery	Fluid sequestration and loss of electrolytes
Pulmonary oedema following pneumonectomy	Loss of lung volume makes these patients very sensitive to fluid overload
Anastamotic leak	Generalised sepsis causing mediastinitis or peritonitis depending on site of leak
Myocardial infarct	May follow any type of surgery and in addition to direct cardiac effects the decreased cardiac output may well compromise grafts etc.

Diagnostic modalities: Depends largely on the suspected complication. In the acutely unwell surgical patient the following baseline investigations are often helpful:

- Full blood count, urea and electrolytes, C- reactive protein (trend rather than absolute value), serum calcium, liver function tests, clotting (don't forget to repeat if on-going bleeding)
- Arterial blood gases
- ECG (+cardiac enzymes if MI suspected)
- Chest x-ray to identify collapse/ consolidation
- Urine analysis for UTI

These will often identify the most common complications.

Special tests

- CT scanning for identification of intra-abdominal abscesses
- Doppler USS of leg veins- for identification of DVT
- CTPA for PE
- Sending peritoneal fluid for U+E (if ureteric injury suspected) or amylase (if pancreatic injury suspected)
- Echocardiogram if pericardial effusion suspected post cardiac surgery and no pleural window made.

Management of complications

The guiding principal should be safe and timely intervention. Patients should be stabilised and if an operation needs to occur in tandem with resuscitation then generally this should be of a damage limitation type procedure rather than definitive surgery (which can be more safely undertaken in a stable patient the following day).

Remember that recent surgery is a contra indication to thrombolysis and that in some patients IV heparin may be preferable to a low molecular weight heparin (easier to reverse).

As a general rule laparotomies for bleeding should follow the core principle of quadrant packing and then subsequent pack removal rather than plunging large clamps into pools of blood. The latter approach invariable worsens the situation is often accompanied by significant visceral injury particularly when done by the inexperienced. If packing controls a situation it is entirely acceptable practice to leave packs in situ and return the patient to ITU for pack removal the subsequent day.

Surgical Site Infection

- Surgical site infections may occur following a breach in tissue surfaces and allow normal commensals and other pathogens to initiate infection. They are a major cause of morbidity and mortality.
- Surgical site infections (SSI) comprise up to 20% of all healthcare associated infections and at least 5% of patients undergoing surgery will develop an SSI as a result.
- In many cases the organisms are derived from the patient's own body.
- Measures that may increase the risk of SSI include:
    - Shaving the wound using a razor (disposable clipper preferred)
    - Using a non-iodine impregnated **incise drape** if one is deemed to be necessary
    - Tissue hypoxia
    - Delayed administration of prophylactic antibiotics in tourniquet surgery

Preoperatively

- Don't remove body hair routinely
- If hair needs removal, use electrical clippers with single use head (razors increase infection risk)
- Antibiotic prophylaxis if:
    - Placement of prosthesis or valve
    - Clean-contaminated surgery
    - Contaminated surgery
- Use local formulary
- Aim to give single dose IV antibiotic on anaesthesia
- If a tourniquet is to be used, give prophylactic antibiotics earlier

Intraoperatively

- Prepare the skin with alcoholic chlorhexidine (Lowest incidence of SSI)
- Cover surgical site with dressing
- A recent meta-analysis has confirmed that administration of supplementary oxygen does not reduce the risk of wound infection. In contrast to previous individual RCTs
- Wound edge protectors do not appear to confer benefit

Post operatively

Tissue viability advice for management of surgical wounds healing by secondary intention

Use of diathermy for skin incisions

In the NICE guidelines the use of diathermy for skin incisions is not advocated(3). Several randomised controlled trials have been undertaken and demonstrated no increase in risk of SSI when diathermy is used.