General Surgery

MBBS Recap: high-yield notes for revision

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Revision notes for the MD/MS entrance (MEC PG paper): the facts an examiner asks in General Surgery, set out for quick revision. They follow the topics of the practice questions.

Trauma and ATLS

Primary survey: what changed in the ATLS 11th edition (2025)

- **ATLS 11th edition (American College of Surgeons, 2025) changed ABCDE to xABCDE**, its most fundamental change: **x is control of exsanguinating external haemorrhage** (direct pressure, wound packing, tourniquet), then **Airway with cervical spine protection, Breathing, Circulation, Disability, Exposure and environment**. Older books (10th edition, 2018) teach ABCDE with haemorrhage control under C; an exam may ask either, so read the stem.
- Airway obstruction kills in minutes, so once catastrophic bleeding is controlled the airway comes first, with the neck held in line.
- ATLS 11 airway points: **jaw thrust is the preferred manoeuvre (chin lift removed)**; every trauma airway is treated as potentially difficult; rapid sequence intubation is preferred, with **volume resuscitation started before RSI drugs** in shock and a bolus vasopressor allowed for RSI-induced hypotension; video laryngoscopy optimal; apnoeic oxygenation; change technique or operator after three attempts; tube position confirmed by **sustained end-tidal CO_2 (at least seven breaths)**. A surgical ("incisional") airway is for can't intubate, can't oxygenate; **needle cricothyroidotomy only for infants and young children**, in whom surgical cricothyroidotomy is avoided.
- Adjuncts to the primary survey: chest and pelvic X-ray, FAST/eFAST, ECG, blood gas and lactate (lactate is used to follow resuscitation in ATLS 11), urinary catheter and gastric tube (with caution).
- Sources of hidden blood loss: **"four and the floor"**: chest, abdomen, pelvis and retroperitoneum, long bones, plus the floor (external bleeding).
- Best clinical guide to organ perfusion: **urine output**.
- **Fluids. Exam answer (ATLS 10th): an initial 1 L of warm isotonic crystalloid in adults (20 mL/kg in children), then blood for non-responders. Current practice (ATLS 11th, 2025): blood and blood products, including whole blood, are the preferred primary resuscitation fluid for haemorrhagic shock**; crystalloid is limited. Children: blood products at 10 mL/kg.
- Secondary survey follows only when the primary survey is complete and the patient is responding: head-to-toe examination, AMPLE history. Transfer communication in ATLS 11: **S-xABCDE-BAR** (situation, xABCDE, background, assessment, recommendations).

Glasgow Coma Scale

Component	Range	Anchors
Eye	4 to 1	spontaneous 4, to voice 3, **to pain 2**, none 1
Verbal	5 to 1	orientated 5, confused 4, **inappropriate words 3**, incomprehensible sounds 2, none 1
Motor	6 to 1	obeys 6, **localises 5**, normal flexion (withdraws) 4, abnormal flexion 3, extension 2, none 1

- Minimum score **3**, maximum 15. Eye 2 + inappropriate words 3 + localising 5 = **10**.
- Record the best response; motor is the most useful single component for prognosis. **GCS of 8 or less: secure a definitive airway.** GCS-P subtracts the pupil reactivity score (0, 1 or 2 non-reacting pupils) from the GCS, range 1 to 15. An intubated patient's verbal score is recorded "T".
- Severity of head injury: 13 to 15 mild, 9 to 12 moderate, 3 to 8 severe.

Thoracic injuries

- **Tension pneumothorax**: a clinical diagnosis. Respiratory distress, hypotension, distended neck veins, absent breath sounds and hyperresonance on the injured side, tracheal deviation **away** from it (a late sign). Do not wait for X-ray: **decompress at once, then a chest drain**. Site in adults: ATLS 10th moved it to the **5th intercostal space, just anterior to the mid-axillary line** (the chest wall is thinner there); ATLS 11 adds further support for this axillary site. The classical site, still in many books and used in children, is the **2nd intercostal space in the midclavicular line**. Finger thoracostomy is an alternative in the ventilated patient.
- **Chest drain**: 5th intercostal space (nipple level) just anterior to the mid-axillary line, in the "triangle of safety" (lateral border of pectoralis major, lateral border of latissimus dorsi, the line of the 5th space), over the upper border of the rib below (the neurovascular bundle runs under each rib).
- **Massive haemothorax**: over 1,500 mL drained at once, or over 200 mL an hour for 2 to 4 hours, or need for repeated transfusion: **thoracotomy**.
- **Open pneumothorax (sucking chest wound)**: air follows the path of least resistance when the hole is over about two-thirds of the tracheal diameter; cover with a **dressing taped on three sides** (a flutter valve), then a chest drain away from the wound.
- **Cardiac tamponade**: **Beck's triad** is hypotension, muffled heart sounds and raised jugular venous pressure; pulsus paradoxus and Kussmaul's sign; FAST shows pericardial fluid. Pericardiocentesis only temporises; definitive treatment is **thoracotomy or sternotomy** by a surgeon. Cushing's triad

(hypertension, bradycardia, irregular breathing) belongs to raised intracranial pressure.

- **Flail chest**: **two or more adjacent ribs each broken in two or more places**, giving paradoxical movement, but the **main cause of hypoxia is the underlying pulmonary contusion**. Treatment: oxygen, good analgesia (regional blocks; ATLS 11 stresses pain control in chest wall injury), ventilation if needed; rib fixation in selected patients.
- **Blunt aortic injury**: deceleration tears the aorta at the **isthmus, just distal to the left subclavian artery** (at the ligamentum arteriosum); X-ray shows a widened mediastinum (over 8 cm), loss of the aortic knuckle, depressed left main bronchus, deviation of the nasogastric tube to the right; **CT angiography** confirms; most are now repaired by endovascular stent graft (TEVAR) after heart rate and blood pressure control.
- **Oesophageal rupture after vomiting (Boerhaave syndrome)**: chest pain, fever and surgical emphysema in the neck after a bout of vomiting; **Hamman's sign** (a crunch in time with the heartbeat) means mediastinal air; **confirm with a water-soluble contrast swallow or CT with oral contrast**, never barium (mediastinitis), and not endoscopy first. Details under Gastrointestinal surgery (Oesophagus).
- **Penetrating neck injury**: zones (exam answer): **I** thoracic inlet to the cricoid; **II cricoid to the angle of the mandible** (the commonest injured and the easiest to expose); **III** angle of the mandible to the skull base (I and III are hard to reach, so imaging and endovascular planning). Current practice (Western Trauma Association algorithm 2013, EAST): a **"no-zone" approach**: hard signs (expanding haematoma, active bleeding, airway compromise, bubbling wound) go straight to theatre; every stable patient, whatever the zone, gets **CT angiography**.
- Diaphragmatic rupture is commoner on the **left** (the liver protects the right). Commonest thoracic injury: rib fracture; commonest lung injury: contusion. Primary blast injury: the **ear drum is most often hurt; the lung ("blast lung") is the commonest fatal primary injury**.

Abdominal and pelvic trauma

- **FAST**: the first test for intraperitoneal blood in a **haemodynamically unstable** blunt trauma patient, at the bedside, four windows (pericardial, hepatorenal (Morison's pouch), splenorenal, pelvis); detects roughly 100 to 250 mL of fluid; the hepatorenal view is the most sensitive. eFAST adds the pleural spaces (loss of lung sliding; "barcode" or stratosphere sign on M-mode for pneumothorax). FAST does not show retroperitoneal or hollow-organ injury well.
- Unstable with a positive FAST: laparotomy. **Contrast CT is the best test but only in the stable patient**, because the scanner takes the patient away from resuscitation. Diagnostic peritoneal lavage is now rare (positive: 10 mL of frank blood, or over 100,000 red cells per mm^3).
- **Organs injured. Blunt: spleen commonest, then liver. Penetrating (ATLS): stab wounds hit the liver (about 40%), small bowel (30%), diaphragm (20%) and colon (15%); gunshot wounds hit the small bowel (about 50%), colon (40%), liver (30%) and vessels (25%).** A "contrast blush" on CT means active bleeding: stable with no blush, non-operative management; blush, angioembolisation; unstable, laparotomy. Splenic and liver injuries are graded by AAST (I to V).
- **Kehr's sign**: pain at the **left** shoulder tip from blood under the diaphragm (splenic rupture), referred through the **phrenic nerve (C3 to C5)**, which shares roots with the skin of the shoulder.
- Deceleration injures structures at points of fixation: duodenojejunal flexure, mesentery, renal pedicle, aortic isthmus. **A lap belt worn without a shoulder strap** acts as a fulcrum: a **Chance fracture** (flexion-distraction, thoracolumbar junction and upper lumbar spine) with **small-bowel and mesenteric injury** (sometimes pancreas or duodenum); an abdominal seat-belt sign calls for a search for hollow-viscus injury, which early CT can miss. Duodenal haematoma in children from handlebars.
- **Retroperitoneal haematoma found at laparotomy**: **zone 1** (central: pancreas, duodenum, great vessels) is explored after blunt or penetrating injury; **zone 2** (flank: kidney, colon) is explored if expanding, pulsatile or penetrating, and a stable blunt one is left; **zone 3** (pelvic) **after blunt injury is not opened** (the intact retroperitoneum tamponades venous bleeding from the fracture): pelvic binder or external fixation, preperitoneal packing, angioembolisation. Penetrating haematomas in any zone are generally explored.
- **Pelvic fracture with blood at the meatus**: do not pass a Foley catheter blindly; it can **turn a partial urethral tear into a complete one** and infect the pelvic haematoma. Do a **retrograde urethrogram** first; if torn, a suprapubic catheter. A high-riding prostate on rectal examination points to posterior (membranous) urethral injury. Bleeding pelvis: **pelvic binder centred on the greater trochanters**, then pre-peritoneal packing, angioembolisation or external fixation.
- **Why urine from a bulbar urethral rupture spares the thigh**: with Buck's fascia breached, urine fills the **superficial perineal pouch** deep to **Colles' fascia**, which is fused to the ischiopubic rami, the perineal membrane and the **fascia lata** just below the inguinal ligament; so it spreads to the scrotum, penis and, under Scarpa's fascia, up the lower abdominal wall, but **not into the thigh**. Posterior (membranous) injuries with pelvic fracture: suprapubic catheter, no instrumentation. Other urethral and bladder injury details: see Urology.

Head and spinal injury (ATLS 11: one chapter, "Disability")

- **Extradural haematoma**: temporal blow, fractured squamous temporal bone at the pterion tearing the **middle meningeal artery**, a **lucid interval**, then drowsiness and an ipsilateral dilated pupil (uncal herniation compressing the oculomotor nerve). CT: **biconvex (lens-shaped) hyperdense collection that does not cross sutures**. Urgent craniotomy and evacuation.
- **Acute subdural haematoma**: crescentic, crosses sutures (not the midline), torn **bridging veins**, elderly, alcoholics, anticoagulated; worse prognosis than extradural because of the brain injury beneath. Chronic subdural: hypodense, weeks later, burr-hole drainage.
- Diffuse axonal injury: punctate haemorrhages at the grey-white junction and corpus callosum, coma with a near-normal CT. Traumatic subarachnoid blood in the basal cisterns and sulci.
- **ATLS 11 targets**: adults **systolic BP of 100 mmHg or more in traumatic brain injury** and **mean arterial pressure over 90 mmHg in spinal cord injury**; hypotension and hypoxia together double the risk of death in TBI. **"Critical neuroworsening"** (fall in the motor score, new pupil

inequality or loss of reactivity, new focal deficit, Cushing's triad) is treated step by step: intubation and controlled ventilation, head up 30 to 45 degrees with the neck neutral, loosen a tight collar, **transient hyperventilation to $PaCO_2$ 30 to 35 mmHg only**, analgesia and sedation, a bolus of hypertonic saline or mannitol, normothermia. **Seizure prophylaxis after severe (GCS 8 or less) and penetrating TBI.**

- Raised ICP: Monro-Kellie doctrine; Cushing's triad is late. Early spinal decompression may improve recovery in partial cord injury.

Damage control and massive bleeding

- **Lethal triad: hypothermia, acidosis and coagulopathy** (some add hypocalcaemia as a "diamond"). Cold fluids worsen it. **Damage-control surgery**: stop bleeding and contamination, close temporarily, restore physiology in ICU, return for definitive repair in 24 to 48 hours.
- **Tranexamic acid 1 g over 10 minutes then 1 g over 8 hours, within 3 hours of injury** (CRASH-2, 2010; benefit falls with delay and it harms after 3 hours); ATLS 11 supports TXA in major haemorrhagic shock.
- **Permissive (hypotensive) resuscitation** until bleeding is controlled (systolic about 80 to 90 mmHg), **not in head injury**. **Balanced transfusion: plasma : platelets : red cells near 1:1:1** (PROPPR, 2015). Massive transfusion protocol activated by an **ABC score of 2 or more** (penetrating mechanism, systolic 90 or less, heart rate 120 or more, positive FAST), named in ATLS 11.
- Scores: **Injury Severity Score = sum of the squares of the highest AIS in the three most severely injured body regions** (range 0 to 75; over 15 is major trauma); Revised Trauma Score (GCS, systolic BP, respiratory rate); TRISS combines ISS, RTS, age and mechanism.
- **Triage**: red immediate, yellow delayed, green minor (walking wounded), black expectant or dead. In mass casualties, the aim is the greatest good for the greatest number, so the sickest unlikely to survive may wait. ATLS 11 field triage follows the US 2021 National Guideline (red and yellow criteria).
- **Trauma in pregnancy (ATLS 11)**: the uterus compresses the IVC from about 18 to 20 weeks, so displace it to the left; abruption can appear up to 24 hours after injury (contractions the most sensitive sign); anti-D within 72 hours for Rh-negative women; **resuscitative caesarean delivery** (the new name for perimortem caesarean) if the fundus is at or above the umbilicus and there is no return of circulation after 5 minutes.
- Open fractures: **Gustilo-Anderson** grading (type I clean wound under 1 cm, type III extensive soft tissue damage, contamination or vascular injury) guides antibiotics; X-ray the whole bone with the joints above and below.

Mass casualties, compartment syndrome, chest conditions and facial fractures

- **START triage** (simple triage and rapid treatment) sorts in about 30 seconds each, by **walking, respiration, perfusion and mental status (RPM)**: **anyone who can walk is green (minor)**; not breathing after airway opening is **black**; respiratory rate over 30, capillary refill over 2 seconds (or no radial pulse) or failure to obey commands is **red (immediate)**; the rest are **yellow (delayed)**. Only two interventions are allowed during triage: opening the airway and stopping a bleed. The group needing life-saving care first is **red**.
- **Compartment syndrome**: pressure inside a closed fascial space exceeds capillary perfusion pressure, after fracture (tibia, forearm), crush, reperfusion, tight casts or burns. **Earliest and most reliable sign: pain out of proportion that is increased by passive stretch of the muscles in the compartment**, with a tense swollen compartment; paraesthesia follows; **distal pulses and capillary refill are usually preserved** until very late, so pallor, pulselessness and paralysis are late signs. Measure pressure when the patient cannot report (unconscious, children): **delta pressure (diastolic minus compartment pressure) under 30 mmHg**, or an absolute pressure over 30 mmHg, supports the diagnosis. Treatment: remove tight dressings and casts, keep the limb at heart level, then **urgent fasciotomy** of all compartments (four in the leg, two incisions). Delay causes Volkmann's contracture and myoglobinuria.
- **Haemothorax**: blood in the pleural space (over 300 mL shows on a film); **large-bore chest drain** (28 to 32 Fr in ATLS 10, the exam answer) in the 5th intercostal space just anterior to the midaxillary line; in a stable patient a **14 Fr pigtail drains as well** (randomised trial, Kulvatunyou 2021); the 1,500 mL or 200 mL an hour thresholds above mean thoracotomy. A retained clotted haemothorax is treated by VATS washout (within about a week) to prevent empyema and fibrothorax.
- **Chylothorax**: lymph (milky, **triglycerides over 110 mg/dL**, chylomicrons) in the pleural space from thoracic duct injury (oesophagectomy, cardiothoracic surgery, trauma) or tumour (lymphoma); drain, **low-fat or medium-chain-triglyceride diet or parenteral nutrition**, octreotide, then thoracic duct ligation if it persists. **Hydrothorax** is a transudate (heart failure, cirrhosis, hypoalbuminaemia). **Empyema thoracis**: pus in the pleural space after pneumonia; exudative, fibrinopurulent and organising stages; intercostal drainage with antibiotics, fibrinolytics or VATS decortication when loculated. **Lung abscess**: aspiration (posterior segment of the upper lobe or apical segment of the lower lobe), antibiotics for weeks; surgery is rare. **Bronchiectasis**: irreversible bronchial dilatation (TB, childhood infection, cystic fibrosis); HRCT shows signet-ring signs; surgery only for localised disease or massive haemoptysis (bronchial artery embolisation first).
- **Mediastinal masses by compartment** (the usual 'four Ts' for the anterior one): **anterior: thymoma, teratoma and germ cell tumours, thyroid goitre, lymphoma; middle: lymph nodes, bronchogenic and pericardial cysts; posterior: neurogenic tumours** (schwannoma, neuroblastoma in children). **Thymoma** is associated with **myasthenia gravis**; the thymus is also removed (thymectomy) in myasthenia.
- **Cardiac surgery in brief**: **acquired** heart disease needing surgery: coronary bypass (left internal mammary artery to the LAD has the best patency), valve replacement (mechanical valves need lifelong warfarin; bioprosthetic valves do not but wear out; TAVI first for inoperable and high-risk aortic stenosis, now also for intermediate and low risk: ACC/AHA 2020 favours TAVI over 80 years and either over 65). **Congenital**: acyanotic (VSD commonest, ASD, PDA) versus cyanotic (**tetralogy of Fallot the commonest cyanotic lesion after infancy**; Blalock-Taussig shunt for palliation). **Pericardial tamponade** is the surgeon's emergency: Beck's triad (hypotension, raised venous pressure, muffled heart sounds). **Constrictive pericarditis** (often TB in South Asia):

pericardial calcification, Kussmaul's sign, treated by pericardiectomy.

- **Maxillofacial fractures**: **mandible is the second commonest facial fracture after the nasal bones**, usually at two sites (a body or angle fracture with the opposite condylar neck); malocclusion and sublingual haematoma suggest it; treat with fixation or intermaxillary fixation. **Zygomatic complex (tripod) fractures**: flattening of the cheek, **infraorbital nerve numbness**, diplopia and trismus (coronoid impingement). **Le Fort**: I horizontal (floating palate), II pyramidal (floating maxilla and nose), III craniofacial dysjunction (floating face); a **cerebrospinal fluid leak** is common with II and III; an **airway** and cervical spine come first. CT is the investigation.

Shock, fluids and burns

Haemorrhagic shock

Exam answer: the ATLS 10th edition classes (Bailey & Love and most question banks still use them):

Class	Blood loss	Heart rate	Systolic BP	Pulse pressure	Base deficit
I	up to 15% (up to 750 mL)	normal	normal	normal	0 to -2
II	15 to 30% (750 to 1,500 mL)	normal or raised (100 to 120)	normal	**narrow**	-2 to -6
III	**31 to 40%** (1,500 to 2,000 mL)	raised (120 to 140)	**falls**	narrow	-6 to -10
IV	over 40%	markedly raised (over 140)	very low	very narrow	below -10

- **Systolic pressure first falls in class III** (a book offering only 40% for the loss at which pressure falls means the top of class III). In class II the pulse pressure narrows because catecholamine vasoconstriction **raises the diastolic** pressure while stroke volume falls.
- **Current practice (ATLS 11th, 2025)**: the class I to IV table and its **blood-loss percentages are removed**, replaced by a table placing clinical signs on a spectrum from mild to major haemorrhage with response to resuscitation and need for operative control; "GCS" in the table becomes "level of consciousness". **Shock index (heart rate divided by systolic pressure; over 1 suggests significant bleeding)** and end-tidal CO_2 are discussed. Response to an initial fluid or blood challenge: rapid, transient or minimal/no response (the last two mean ongoing bleeding and need surgery or embolisation).
- Shock types: hypovolaemic; cardiogenic; obstructive (tension pneumothorax, tamponade, massive PE); distributive (septic, anaphylactic, neurogenic). **Hypovolaemic: low CVP, low cardiac output, high SVR.** Cardiogenic: high CVP, low output, high SVR. Septic (warm phase): low SVR, high output. **Neurogenic: low SVR with bradycardia and warm peripheries** (loss of sympathetic tone above T6); spinal shock is the loss of cord reflexes, a different thing.
- **Massive transfusion** (commonly 10 or more units in 24 hours, more than 4 units in 1 hour with ongoing need, or half the blood volume in 3 hours): **citrate binds ionised calcium, so hypocalcaemia** (worse with hypothermia and liver dysfunction, which slow citrate clearance); also hyperkalaemia, hypothermia, dilutional coagulopathy and thrombocytopenia, and later **metabolic alkalosis** (citrate is metabolised to bicarbonate). Give calcium and warm all products. The hypocalcaemia shows as **hypotension, a prolonged QT** and tetany; stored blood is also cold and potassium-rich. TRALI is the leading cause of transfusion-related death, with TACO.

Sepsis and aspiration pneumonitis

- **Sepsis-3 (JAMA 2016)**: sepsis is life-threatening organ dysfunction caused by a dysregulated host response to infection (a SOFA rise of 2 or more). **Septic shock**: vasopressors needed to keep MAP at 65 mmHg or more **and lactate over 2 mmol/L** despite adequate fluid.
- **qSOFA** (outside ICU): **respiratory rate 22 or more, altered mentation, systolic BP 100 mmHg or less**; two or more flag a high risk of death. **SIRS**: temperature over 38 or under 36 °C, heart rate over 90, respiratory rate over 20 or $PaCO_2$ under 32 mmHg, WBC over 12,000 or under 4,000 (or over 10% bands). **Surviving Sepsis Campaign 2021 recommends against qSOFA alone as a screening tool** compared with SIRS, NEWS or MEWS (qSOFA is specific but insensitive).
- **SSC 2021**: antibiotics **within 1 hour** for possible septic shock or probable sepsis (within 3 hours if sepsis is possible without shock); **30 mL/kg crystalloid in the first 3 hours** (a weak recommendation), **balanced crystalloids preferred** to saline; **noradrenaline first-line vasopressor**, add **vasopressin** when noradrenaline is 0.25 to 0.5 µg/kg/min, then adrenaline; **hydrocortisone 200 mg/day** if vasopressor need persists (noradrenaline 0.25 µg/kg/min or more for at least 4 hours); target MAP 65 mmHg; source control as soon as practical. Dopamine is not recommended.
- **Mendelson syndrome**: **chemical pneumonitis after aspiration of acid gastric contents** (pH below about 2.5, volume above about 25 mL), at induction or emergence from anaesthesia in obstetric and emergency patients; an immediate chemical burn of the lung, later bacterial infection and ARDS. Prevention: fasting, H2 blockers or antacids (sodium citrate), rapid sequence induction.

Burns: size, depth, fluids

- **Rule of nines (adult):** head and neck 9%, each arm 9%, **anterior trunk 18%**, posterior trunk 18%, each leg 18%, perineum 1%. The patient's palm with fingers is about 1% (palm alone about 0.5%), for scattered burns. Children have a larger head (18% in an infant) and smaller legs: the **Lund and Browder chart** is the most accurate. Erythema (superficial burn) is not counted.
- **Jackson's three zones**: central **coagulation** (dead); around it **stasis** (reduced perfusion, **salvageable**: hypotension, infection, drying or oedema convert it to necrosis, good resuscitation and wound care save it); outer **hyperaemia** (vasodilatation, recovers).
- **First aid**: stop the burning, remove clothing and jewellery, **cool under running tap water for 20 minutes, within 3 hours** of the burn; **no ice** (vasoconstriction deepens the burn), **no ghee, butter, oil or toothpaste** (they hold heat, hide the depth and carry infection; wipe them off); cover with cling film; keep the rest of the body, and small children above all, warm (ANZBA and ISBI first-aid guidance).

Depth	Appearance	Sensation	Healing
Superficial (epidermal)	red, dry, blanches	painful	3 to 7 days, no scar

Depth	Appearance	Sensation	Healing
Superficial partial thickness	**blisters**, moist, pink, blanches	**very painful**	about 2 weeks
Deep partial thickness	mottled red and white, slow or no blanching	reduced	over 3 weeks; graft
Full thickness	white, brown or black **leathery eschar**, no blanching	**painless** (nerve endings destroyed)	only from edges; graft

- **Parkland formula (exam answer)**: Ringer's lactate **4 mL × weight (kg) × %TBSA** in 24 hours, **half in the first 8 hours from the time of burn**, half over the next 16. Example: 70 kg, 40%: 4 × 70 × 40 = 11,200 mL; **5,600 mL in the first 8 hours**. Formal resuscitation from about 20% TBSA in adults (10 to 15% in children). Colloid (albumin) is added in the second 24 hours by many units.
- **Current practice (ATLS 10th and 11th editions, American Burn Association)**: **adults start at 2 mL/kg/%TBSA** (lower volume to avoid "fluid creep", oedema and compartment syndromes); **all electrical injuries 4 mL/kg/%TBSA**; children 3 mL/kg/%TBSA plus glucose-containing maintenance fluid in small children. ATLS 11 (2025) states that the calculations are made "over 16 hours, not 8", that they are **not adjusted for time since injury or fluid already given**, and that the rate is changed **hourly by urine output**; boluses are avoided (hypotension in a burn patient means another injury until proved otherwise). Before TBSA is calculated, start Ringer's lactate at **500 mL/h for age 13 and over, 250 mL/h for 6 to 12 years, 125 mL/h for 5 years and under**.
- **Urine output target: 0.5 mL/kg/h in adults (30 to 50 mL/h); 1 mL/kg/h in children of 30 kg or less; 1 to 1.5 mL/kg/h in electrical injury with myoglobinuria** until the urine clears.

Burns: airway, complications and wound care

- **Inhalation injury**: burns in a closed space, facial burns, singed nasal hair, **carbonaceous sputum or soot**, hoarseness, stridor. **Early endotracheal intubation** (a large tube) before oedema closes the airway; steroids have no role. Bronchoscopy confirms lower-airway injury.
- **Carbon monoxide**: pulse oximetry reads falsely normal (use co-oximetry for carboxyhaemoglobin); treat with **high-flow 100% oxygen**, which cuts the carboxyhaemoglobin half-life from about 4 to 5 hours on air to about 1 hour (about 20 to 30 minutes with hyperbaric oxygen, for severe cases). **Cyanide** (burning plastics; unexplained lactic acidosis): **hydroxocobalamin**.
- **Curling's ulcer**: acute stress ulcer of the stomach or duodenum after major burns from **reduced splanchnic perfusion** (Cushing's ulcer follows head injury, with acid hypersecretion from vagal stimulation). Prophylaxis: early enteral feeding, PPI.
- **Escharotomy** for circumferential full-thickness burns of a limb (compartment pressure) or chest (ventilation). **Early excision and grafting** within the first days reduces sepsis. Electrical burns: small entry and exit wounds hide deep muscle damage; ECG monitoring, myoglobinuria, compartment syndrome. Chemical burns: copious water irrigation (alkalis burn deeper); hydrofluoric acid needs calcium gluconate.
- **Commonest cause of death**: early, inhalation injury and burn shock; **late (beyond about 48 hours), sepsis** (with multi-organ failure). Organisms: early Gram-positive (S. aureus); after about 5 days Gram-negative, **Pseudomonas the classic burn-wound organism**, then Candida. Wound infection is confirmed by quantitative biopsy (over 10^5 organisms per gram).
- **Nutrition**: hypermetabolism; **Curreri formula: 25 kcal/kg + 40 kcal per %TBSA** a day; early enteral feeding.

Topical agent	Notes
Silver sulfadiazine 1%	commonest; broad spectrum, poor eschar penetration; transient **leucopenia**
Mafenide acetate	**penetrates eschar** (burned ears, cartilage); painful; **carbonic anhydrase inhibition: hyperchloraemic metabolic acidosis**
0.5% silver nitrate	hypotonic: leaches sodium, chloride, potassium and calcium: **hyponatraemia, hypochloraemia**; **stains skin and linen black**; methaemoglobinaemia (nitrate reduction)
Silver sulfadiazine with cerium nitrate	firm, sterile eschar for delayed excision

- Wound healing problems after burns: hypertrophic scars and contractures (pressure garments, early splinting); Marjolin's ulcer in an old burn scar (see Perioperative care).

Blood transfusion and fluid and electrolyte balance

- **Blood grouping**: ABO antigens on red cells, anti-A and anti-B (naturally occurring IgM) in plasma; **group O red cells are the emergency universal donor, group AB plasma the universal donor plasma**; **group O Rh-negative blood in extreme emergency** (women of childbearing age especially). Crossmatch (type and screen, then compatibility testing) takes about 45 minutes; electronic or immediate-spin crossmatch less.
- **Transfusion reactions** (the common questions):

Reaction	Cause	Features and action
Febrile non-haemolytic (the commonest)	recipient antibodies against donor leucocytes, or cytokines in stored platelets and red cells	fever and chills within hours; slow or stop, **paracetamol**; prevented by leucodepletion
Acute haemolytic	**ABO incompatibility** (clerical error), IgM complement activation	fever, loin pain, hypotension, **haemoglobinuria, oozing (DIC)**, even under anaesthesia; **stop the transfusion, keep the line with saline, recheck the unit and patient, send samples**, treat shock and renal output
Mild allergic	donor plasma proteins	urticaria and itching; antihistamine, may continue
Anaphylaxis	**IgA deficiency with anti-IgA**, or other allergens	bronchospasm, hypotension; stop, **adrenaline**; give washed or IgA-deficient products afterwards
TRALI	donor anti-HLA or anti-neutrophil antibodies	within 6 hours; hypoxia, bilateral infiltrates, **normal or low filling pressures**, fever, hypotension; supportive; **classically the leading cause of transfusion death** (the exam answer)

Reaction	Cause	Features and action
TACO	volume overload	hypertension, **raised JVP**, responds to diuretics; **now the leading cause of reported transfusion deaths** (FDA fatality reports 2017 to 2021: TACO 32%, TRALI 21%), since plasma from women donors was restricted
Delayed haemolytic	anamnestic antibody (Rh, Kidd)	days 3 to 14; falling haemoglobin, jaundice, positive direct antiglobulin test
Bacterial contamination	**platelets** (stored at room temperature)	rigors, septic shock during or just after infusion; culture the unit
Graft-versus-host disease	donor T cells in immunocompromised recipients, or blood from a relative (a shared HLA haplotype)	rash, diarrhoea, pancytopenia at 1 to 2 weeks; prevented by **irradiated** products

- **Storage**: red cells at **2 to 6 °C**: **CPD or ACD 21 days, CPDA-1 35 days** (adenine regenerates ATP), **additive solutions (SAGM) 42 days**; **platelets at 20 to 24 °C with continuous agitation, about 5 days** (up to 7 with bacterial screening or pathogen reduction; refrigerated platelets clump and are cleared fast); FFP and cryoprecipitate frozen (FFP at −25 °C or colder for up to 36 months, UK Handbook of Transfusion Medicine). **Storage lesion**: falling pH, ATP and **2,3-DPG** (left shift of the oxygen curve) and rising extracellular **potassium**. Standard giving-set filter 170 to 200 micrometres. **One unit of red cells raises haemoglobin by about 1 g/dL** in an adult. Platelet thresholds: 10,000/µL prophylactic, 50,000 for most surgery and invasive procedures, 100,000 for neurosurgery and posterior eye surgery. Warfarin reversal in bleeding: prothrombin complex concentrate plus intravenous vitamin K.
- **Other hazards**: transmitted infection (HIV, hepatitis B and C, syphilis, malaria, CMV; the risk is now very small with screening, with CMV-negative and irradiated products for the immunosuppressed), **hyperkalaemia and hypocalcaemia (citrate) in massive transfusion**, iron overload in chronic transfusion, hypothermia (warm blood through a warmer). **Platelets can be given across ABO groups** but best matched; **cryoprecipitate** contains fibrinogen, factor VIII, von Willebrand factor and factor XIII; **fresh frozen plasma** has all clotting factors.
- **Body fluid compartments**: **total body water 60% of body weight in an adult man** (50% in women, about 75% in infants); **intracellular two thirds (40% of weight), extracellular one third (20%)**, of which **plasma 5% and interstitial 15%**. Main extracellular ions: sodium, chloride, bicarbonate; intracellular: **potassium**, magnesium, phosphate and proteins.
- **Daily adult maintenance**: about **25 to 30 mL/kg of water, 1 mmol/kg of sodium, 1 mmol/kg of potassium**. The 4-2-1 rule gives an hourly rate for children (4 mL/kg for the first 10 kg, 2 for the next 10, 1 thereafter). **Isotonic crystalloids** (0.9% saline, **Ringer's lactate or balanced solutions** such as Plasma-Lyte) replace extracellular losses; **5% dextrose is free water** (distributes in all compartments, only a twelfth stays intravascular) and is not a resuscitation fluid. Balanced crystalloids are now preferred to saline in most patients (SMART 2018; large saline loads cause **hyperchloraemic metabolic acidosis**). **Colloids** (albumin, gelatins, starches) have no survival benefit and starches carry renal risk. **Dextran** holds about 20 to 25 mL of water per gram, **causes rouleaux that interfere with cross-matching** (take the sample first) and impairs platelet function; dextran 40 acts for a shorter time than dextran 70. Among the classical crystalloids **Darrow's solution has the most potassium**; Hartmann's is slightly hypotonic to plasma, 0.9% saline slightly hypertonic. **Hypotonic fluids (5% dextrose) are avoided in head injury** (cerebral oedema); isotonic crystalloid is used.
- **Hyponatraemia**: commonest electrolyte disorder; the **cause is judged by volume status and urine sodium** (hypovolaemic, euvolaemic such as SIADH, hypervolaemic). Correct a chronic case at **no more than 8 to 10 mmol/L in 24 hours** (osmotic demyelination); symptomatic severe cases get 100 to 150 mL of 3% saline. **Hypernatraemia**: water deficit, correct slowly. **Hyperkalaemia**: tall tented T waves, then a wide QRS and sine wave; **10 mL of 10% calcium gluconate IV first (membrane protection)**, repeated if the ECG is unchanged (UK Kidney Association 2020 gives 30 mL), then insulin with glucose, nebulised salbutamol, and removal by resin, diuretic or dialysis. **Hypokalaemia**: U waves, flat T waves; replace carefully (no faster than 10 mmol/h peripherally).
- **Acid-base**: vomiting gives hypochloraemic metabolic alkalosis; diarrhoea, fistulas and ileostomy, renal failure and shock give metabolic acidosis; pyloric stenosis gives paradoxical aciduria (see Stomach).

Perioperative care and wounds

Wound classes and surgical site infection

Class	Definition	Infection rate (approx.)
Clean	no tract entered, no inflammation (hernia repair, thyroidectomy)	1 to 2%
Clean-contaminated	respiratory, alimentary, biliary or urinary tract entered under control, no unusual spillage (**elective cholecystectomy, laparoscopic or open**, elective bowel resection)	up to 10%
Contaminated	gross spillage, acute non-purulent inflammation, open fresh traumatic wounds, major break in asepsis	about 15 to 20%
Dirty	pus, perforated viscus, old traumatic wounds with devitalised tissue (classically over 4 hours)	30 to 40%

- **Prophylactic antibiotic: a single dose within 60 minutes before skin incision** (120 minutes for vancomycin or fluoroquinolones); **cefazolin 2 g** (3 g at 120 kg or more) is the usual choice, with metronidazole for bowel; **repeat if the operation outlasts two half-lives (about 4 hours for cefazolin) or blood loss exceeds 1.5 L**; **do not continue after closure** (WHO 2016/2018 SSI guidelines). Other measures: no hair removal, or clipping (never razors); **chlorhexidine-alcohol** skin preparation; normothermia; glucose control; no routine antibiotic continuation for drains.
- SSI grading: **Southampton scale 0 to V** (I erythema with bruising; II erythema plus inflammation; III clear or serous discharge; **IV pus**; V deep or severe infection with or without tissue breakdown, or a haematoma needing aspiration); the ASEPSIS score is an alternative. Commonest SSI organism: S. aureus.
- **Tetanus prophylaxis** (principles; give the vaccine course by Nepal's national schedule):

Immunisation history	Clean minor wound	Tetanus-prone (dirty) wound
Unknown, or fewer than 3 doses	vaccine (toxoid), complete the course	**vaccine plus human tetanus immunoglobulin (250 IU IM) at a separate site**, complete the course
3 or more doses	vaccine only if last dose over 10 years ago	vaccine only if last dose over 5 years ago

- Debridement of a tetanus-prone wound is essential; antibiotics (metronidazole) do not replace immunisation.

Wound healing and scars

- Phases: **haemostasis, inflammation (neutrophils, then macrophages, the key cell), proliferation (fibroblasts, angiogenesis, granulation tissue, epithelialisation), remodelling** (from about 3 weeks for up to 1 to 2 years). Early granulation tissue has **type III collagen**, replaced by **type I**; a scar reaches about **70 to 80% of normal tensile strength at 3 months** and never 100%. Myofibroblasts cause wound contraction.
- **Vitamin C is needed for hydroxylation of proline and lysine** (prolyl and lysyl hydroxylases) in procollagen; deficiency (scurvy) gives weak collagen, dehiscence and breakdown of old scars. **Lysyl oxidase** (cross-linking outside the cell) needs **copper**. Zinc, protein, vitamin A (counters steroid effect) also matter; steroids, diabetes, ischaemia, smoking, infection, radiation, malnutrition and uraemia impair healing.
- Healing by primary intention (clean incision closed), secondary intention (left open, heals by granulation and contraction), delayed primary (tertiary) closure of a contaminated wound after 3 to 5 days.

Feature	Keloid	Hypertrophic scar
Extent	**grows beyond the original wound margin**	stays within the wound
Onset	months later, may follow minor trauma	within weeks of injury
Natural course	does not regress; **recurs after simple excision**	often settles over 1 to 2 years
Contracture	rare	common, across joints
Predisposition	dark skin, familial, young	tension, delayed healing
Sites	**sternum, ear lobes, shoulders, deltoid**	any, esp. flexor surfaces

- Keloid treatment: **intralesional triamcinolone** first, silicone sheets, pressure; excision only with adjuvant steroid or radiotherapy.
- **Incision lines**: incisions along the **relaxed skin tension lines** (Borges; close to Kraissl's wrinkle lines) heal with the least scar; **Langer's lines**, mapped in cadavers, differ from them in places.
- **Marjolin's ulcer**: a **squamous cell carcinoma** (rarely BCC) arising in a long-standing scar, burn scar, chronic venous ulcer, sinus or osteomyelitis tract, often after decades; slow growing, painless, and **slow to spread to nodes because scar has few lymphatics**, though aggressive once it reaches normal tissue. Wide excision.
- **Ulcer edges**: **sloping: healing ulcer** (and venous ulcer); **undermined: tuberculous** (and pressure); **punched out: syphilitic (gummatous) and trophic (neuropathic)**, also ischaemic; **raised, beaded, pearly: basal cell carcinoma (rodent ulcer)**; **rolled, everted: squamous cell carcinoma**. A healing ulcer has a sloping edge with red granulation tissue on the floor.
- **Pressure injuries (NPIAP 2016)**: stage 1 intact skin with **non-blanchable erythema**; stage 2 partial thickness with exposed dermis (shallow open ulcer or intact blister); stage 3 full-thickness skin loss (fat visible, no bone or tendon); stage 4 full-thickness with muscle, tendon or bone; unstageable (base covered by slough or eschar); deep tissue injury (persistent maroon or purple discolouration). **Commonest site: sacrum**, then heel, ischium, trochanter. Prevention: turning every 2 hours, pressure-relieving mattress, nutrition; Braden scale for risk.

Sutures, closure, grafts and flaps

- **Jenkins' rule (1976)**: for midline laparotomy, a continuous mass closure with a suture **at least four times the wound length** (a 2 cm wound needs 8 cm). Classic bites 1 cm from the edge and 1 cm apart; **current practice: the small-bite technique, 5 mm from the edge and 5 mm apart, with a slowly absorbable monofilament (PDS)**, cuts incisional hernia (STITCH trial 2015; European Hernia Society 2015 guideline), and prophylactic mesh is considered in high-risk patients (PRIMA trial).
- **Polypropylene** (non-absorbable monofilament, inert) for vascular anastomosis and hernia mesh. **Polyglactin 910 (Vicryl)**: braided, absorbable, about 60 to 90 days; PDS: monofilament, about 6 months. Silk is braided and reactive. Catgut is withdrawn in Europe and largely obsolete.
- **Split-thickness graft**: epidermis plus part of the dermis; takes well even on less ideal beds, covers large areas (can be meshed), donor site heals by re-epithelialisation from adnexa, but **greater secondary contraction**. **Full-thickness graft**: whole dermis; **more primary contraction but little secondary contraction**, better colour and texture (face, eyelids, fingers), donor site closed primarily, size limited, **needs a well-vascularised bed**. Grafts take by plasmatic imbibition (first 48 hours), then inosculation and revascularisation. Grafts fail from haematoma (commonest), seroma, infection (Streptococcus pyogenes destroys grafts) and shearing. Grafts will not take on bare bone, tendon or cartilage without periosteum, paratenon or perichondrium: use a **flap**, which carries its own blood supply (random, axial, free).

Perioperative medicine

- **ASA physical status**: I healthy; II mild systemic disease; III severe systemic disease; IV severe disease that is a constant threat to life; V moribund, not expected to survive without the operation; VI brain-dead organ donor; "E" for emergency.
- **ERAS**: preoperative counselling, **no routine mechanical bowel preparation for colonic surgery** (ERAS Society 2018; for rectal and left-sided resections US guidance (ASCRS 2019) favours mechanical preparation with oral antibiotics), **clear fluids until 2 hours and solids until 6 hours before anaesthesia**, carbohydrate loading, no routine nasogastric tubes or drains, goal-directed fluids, opioid-sparing analgesia, **early oral feeding and mobilisation within 24 hours**, early catheter removal. Pain is called the fifth vital sign.
- **Anticoagulants and other drugs before elective surgery** (ACCP 2022): **warfarin stopped 5 days before, so the INR falls below about 1.5** (checked the day before; older books said 3 days, which leaves many patients above target); **bridging with heparin only at high thrombotic risk**

(mechanical mitral valve, recent VTE; BRIDGE trial 2015); urgent surgery: vitamin K or prothrombin complex concentrate. Clopidogrel stopped about 5 days before, ticagrelor 3 to 5, prasugrel 7; **low-dose aspirin for secondary prevention is usually continued**; the combined oral contraceptive pill is stopped 4 weeks before major surgery.

- **WHO Surgical Safety Checklist (2009)**: three pauses: **sign in (before induction), time out (before incision), sign out (before the patient leaves theatre)**.
- **Postoperative fever (the "5 Ws", a teaching aid rather than a rule)**: days 1 to 2 often the inflammatory response to surgery or atelectasis ("wind"); **days 3 to 5 urinary tract infection** ("water") and line infection; days 5 to 7 wound infection and **anastomotic leak**, deep collection; **DVT from day 5 onward** ("walking"); drug fever and transfusion any time ("wonder drugs").
- **VTE prophylaxis**: risk by Caprini score; mechanical (stockings, intermittent pneumatic compression) and low molecular weight heparin, extended to 28 days after major abdominal or pelvic cancer surgery.
- **Nutrition**: screen with **MUST** (BMI, unplanned weight loss, acute disease effect: no food for over 5 days; protein intake is not a component). **Enteral feeding is preferred** ("if the gut works, use it"); parenteral nutrition when the gut cannot be used. Energy values: **carbohydrate 4 kcal/g (intravenous dextrose monohydrate 3.4), protein 4, fat 9**; so 200 g glucose, 50 g protein and 30 g fat give 800 + 200 + 270 = 1,270 kcal at 4/4/9. Needs about 25 to 30 kcal/kg/day and 1 to 1.5 g protein/kg. **Refeeding syndrome**: the hallmark is **hypophosphataemia** (with low potassium and magnesium, thiamine deficiency); start slowly (NICE: 10 kcal/kg/day in high risk) with thiamine.
- **Laparoscopy**: CO_2 pneumoperitoneum at 12 to 15 mmHg (rises in end-tidal CO_2, reduced venous return, raised airway pressure); entry by Veress needle or open (Hasson) technique; **Palmer's point** (left upper quadrant, 3 cm below the costal margin in the midclavicular line) after previous surgery. **If the Veress needle enters a major vessel, leave it in place (it plugs the hole) and open the abdomen at once.** Port ergonomics: the **manipulation angle** between the two working instruments is ideally about 60 degrees (45 to 75), with the camera between them (baseball diamond arrangement). Shoulder-tip pain afterwards is diaphragmatic irritation by CO_2.

Transplantation essentials

- **Kidney**: placed **extraperitoneally in the iliac fossa** (usually the right); the **native kidneys are left in place** (unless infected, very large or causing hypertension); the donor renal artery is joined to the external (or internal) iliac artery, with a **Carrel patch** of aorta from a deceased donor, the vein to the external iliac vein, and the ureter to the bladder by an **extravesical (Lich-Gregoir) ureteroneocystostomy** over a stent. Cold storage up to about 24 to 36 hours (University of Wisconsin solution); delayed graft function rises with longer cold ischaemia.
- **Rejection**: hyperacute (minutes, preformed antibodies to ABO or HLA; prevented by cross-match), acute cellular (T cell, weeks to months, treated with steroid pulses), antibody-mediated (C4d staining), chronic (vascular, months to years, the main cause of late graft loss). Immunosuppression: tacrolimus, mycophenolate, steroids, with induction (basiliximab or antithymocyte globulin).
- Liver transplant priority by **MELD** (bilirubin, INR, creatinine, sodium); in hepatocellular carcinoma, the Milan criteria (see Hepatobiliary).

Sterilisation, sutures, ulcers, sinuses and inflammation

- **Sterilisation methods**: **steam under pressure (autoclave) is the standard for instruments**: **121 °C at 15 psi for 15 minutes** (the gravity cycle; a faster **134 °C at about 30 psi for 3 minutes** in the prevacuum cycle). Moist heat kills by denaturing protein and is more effective than dry heat. **Dry heat** (hot-air oven): **160 °C for 1 hour holding time** (2 hours in some texts and in WHO guidance; 170 °C for 1 hour, 180 °C for 30 minutes) for glassware, powders, oils. **Boiling at 100 °C kills vegetative bacteria but not spores**, so it is disinfection, not sterilisation. **Ethylene oxide gas** for heat-sensitive plastics and scopes (toxic, needs aeration); **low-temperature hydrogen peroxide plasma**; **gamma radiation** for disposable syringes and sutures; **glutaraldehyde 2%** (cold sterilisation: 10 hours for sporicidal action, 20 minutes for high-level disinfection of endoscopes). **Biological indicator: Geobacillus (Bacillus) stearothermophilus for steam and Bacillus atrophaeus for dry heat and ethylene oxide**; chemical indicators (autoclave tape) show exposure only.
- **Suture materials**: **absorbable** versus **non-absorbable**; **monofilament** (less infection, more knot slip) versus **braided** (easy handling, harbours bacteria). **Plain catgut** (sheep intestine collagen) loses strength in 7 to 10 days and is absorbed by **proteolytic enzymes and the inflammatory cell reaction**, so it is unpredictable and reactive; **chromic catgut** (chromium salts) lasts 2 to 3 weeks. **Synthetic absorbables** (polyglactin/Vicryl, polyglycolic acid/Dexon, polydioxanone/PDS, poliglecaprone/Monocryl) are **absorbed by hydrolysis**, slowly and predictably with little reaction. Non-absorbable: **nylon, polypropylene (inert, does not dissolve in vessels), silk (the most reactive, lost over about 2 years), stainless steel wire (sternum, tendon repair; least reactive in tissue)**. **Inverting bowel suture patterns**: **Lembert** (interrupted seromuscular), **Connell** (continuous full-thickness), Cushing (continuous seromuscular). **Triclosan-coated** sutures reduce wound infection (WHO and NICE recommend). **Anastomosis**: a single-layer continuous or interrupted technique is as safe as two layers; the **submucosa gives the bowel's strength**; the ends need good blood supply, no tension and no distal obstruction.
- **Definitions**: an **ulcer** is a break in the continuity of an epithelial surface; a **sinus** is a **blind track lined by granulation tissue** that opens on one surface (pilonidal sinus, a chronic osteomyelitis sinus), usually kept open by a **foreign body, dead bone, a persistent infection (TB, actinomycosis) or an epithelialised lining**; a **fistula** is an **abnormal communication between two epithelial-lined surfaces** (enterocutaneous, vesicovaginal, anal). Causes of persistent fistula (**"FRIENDS"**: foreign body, radiation, infection or inflammation (Crohn's), epithelialisation, neoplasm, distal obstruction, steroids). Contrast studies (fistulogram, sinogram) show the track; fistulas from the bowel need **sepsis control, fluids and electrolytes, nutrition, then surgery after 6 weeks or more**.
- **Inflammation and infection**: the cardinal signs (**rubor, calor, tumor, dolor, functio laesa**) and the course through resolution, suppuration, organisation or chronicity. **Abscess**: a localised collection of pus; **incision and drainage is the treatment**; antibiotics alone do not penetrate the cavity. **Cellulitis**: spreading infection of the deep dermis and subcutis

(group A streptococcus, staphylococcus) with an **ill-defined margin**, treated with antibiotics. **Erysipelas** (Streptococcus pyogenes) is confined to the superficial dermis and its lymphatics, so the plaque has a **raised, sharply demarcated, shiny edge** (face, leg); fever is common to both. **Cold abscess**: tuberculous; **lacks heat, redness and pain**; aspirate through **healthy, uninvolved skin** with a wide needle, not incise (a sinus forms).

- **Necrotising soft-tissue infection**: **type I polymicrobial** (aerobes and anaerobes; diabetes, perineum, after surgery), **type II monomicrobial: group A streptococcus with or without Staphylococcus aureus** (healthy people, limbs), type III marine Vibrio or clostridial; **pain out of proportion**, dusky skin, bullae, crepitus, systemic toxicity; LRINEC score helps but cannot exclude it; **resuscitation, broad-spectrum antibiotics with clindamycin, and urgent radical debridement**, repeated. **Fournier gangrene**: necrotising fasciitis of the perineum, scrotum and penis, polymicrobial, **diabetes the commonest risk factor**; imaging must not delay theatre, and the **testes are usually spared** (their blood supply comes from the testicular arteries). **Meleney's** progressive bacterial synergistic gangrene follows abdominal or chest surgery. **Gas gangrene (clostridial myonecrosis)**: *Clostridium perfringens* in devitalised muscle; **alpha toxin (a lecithinase, phospholipase C)** causes necrosis, haemolysis and gas; crepitus, brown sweet-smelling discharge, shock; radical debridement, high-dose penicillin with clindamycin, hyperbaric oxygen where available (it must not delay surgery). Beta toxin causes necrotising enteritis (pigbel) and the enterotoxin food poisoning.
- **Hand infections**: **paronychia (nail fold, usually S. aureus) is the commonest**; drained by lifting the nail fold. **Felon (pulp space)**: drain early, or pressure in its septa causes osteomyelitis of the distal phalanx. **Flexor sheath infection: Kanavel's four signs** (finger held flexed, fusiform swelling, tenderness along the sheath, pain on passive extension, the earliest). The **thumb's sheath (radial bursa) and the little finger's (ulnar bursa) can communicate through Parona's space** (a horseshoe abscess); infection of the index finger spreads to the **thenar space**, of the middle and ring fingers to the **midpalmar space**. Bunnell's "no man's land" is flexor zone II.
- **Surgical nutrition**: enteral feeding is better than parenteral (see Perioperative medicine); **refeeding syndrome is a fall in phosphate, potassium and magnesium** when carbohydrate is restarted after prolonged starvation, with **thiamine deficiency** (Wernicke's) and fluid overload; start at 10 to 20 kcal/kg a day, give **thiamine before feeding**, and monitor electrolytes daily for the first week (NICE CG32). **Parenteral nutrition complications**: catheter sepsis (the commonest and most important), cholestasis and gallstones (gut disuse), hyperglycaemia, hypophosphataemia.

Gastrointestinal surgery

Oesophagus

- **Achalasia**: loss of inhibitory (nitric oxide, VIP) neurons of the myenteric (Auerbach's) plexus, so the **lower sphincter fails to relax and peristalsis is absent**. Dysphagia to **solids and liquids from the start**, regurgitation, weight loss. Barium swallow: **bird's beak** with a dilated oesophagus, no gastric air bubble. **High-resolution manometry is the gold standard** (Chicago classification v4.0, 2021: **type II, pan-oesophageal pressurisation, responds best; type III, spastic, worst**). **Endoscopy is mandatory to exclude pseudoachalasia** from a cardia tumour (classically, amyl nitrite relaxes the sphincter in achalasia but not in cancer). Treatment: **laparoscopic Heller myotomy with partial fundoplication (Dor or Toupet)**, or **POEM** (peroral endoscopic myotomy; more reflux afterwards), or pneumatic dilatation; botulinum toxin for the frail. Long-term risk of squamous cell carcinoma. Chagas disease (Trypanosoma cruzi) mimics it. **Allgrove (triple A) syndrome: achalasia, alacrima, adrenal insufficiency (AAAS gene).**
- **Boerhaave syndrome**: spontaneous full-thickness rupture, usually the **left posterolateral wall of the lower oesophagus**, after forceful vomiting. **Mackler's triad: vomiting, lower chest pain, subcutaneous (cervical) emphysema. Hamman's sign**: a mediastinal crunch in time with the heartbeat. Chest X-ray: left pleural effusion (a tear of the middle third, less common, gives a right effusion) or hydropneumothorax, pneumomediastinum (V sign of Naclerio). **Water-soluble contrast swallow or CT** with oral contrast; repair and drainage (stent in selected cases); mortality rises steeply after 24 hours. **Mallory-Weiss tear**: mucosal (partial) tear at the gastro-oesophageal junction, haematemesis after retching, usually settles. Commonest cause of oesophageal perforation overall: **instrumentation (iatrogenic)**.
- **Plummer-Vinson (Paterson-Kelly) syndrome**: iron-deficiency anaemia, glossitis, koilonychia and dysphagia from an **upper oesophageal (post-cricoid) web**, mostly in middle-aged women; predisposes to **post-cricoid squamous cell carcinoma**, so follow up after iron and dilatation. Goitre is not part of it. Not the same as Plummer's disease (toxic nodular goitre).
- **Pharyngeal pouch (Zenker's diverticulum)**: a pulsion diverticulum through **Killian's dehiscence**, between thyropharyngeus and cricopharyngeus (the two parts of the inferior constrictor), usually left-sided, in the elderly: regurgitation of undigested food, halitosis, gurgling. Barium swallow (not endoscopy first: perforation risk); endoscopic stapling or open myotomy with excision.
- **GORD**: LA classification (A to D) of oesophagitis; pH and impedance monitoring (DeMeester score; Lyon consensus 2.0, 2023); PPIs first; **laparoscopic Nissen (360 degree) fundoplication** for refractory disease; **Toupet (270 degree posterior partial wrap)** when manometry shows weak oesophageal body peristalsis (less dysphagia); **Dor (180 degree anterior)** after Heller myotomy; Belsey Mark IV is a transthoracic 240 to 270 degree anterior wrap; Collis gastroplasty lengthens a short oesophagus. **Barrett's oesophagus**: **intestinal metaplasia (goblet cells)** of the lower oesophagus, Prague C and M criteria, the precursor of **adenocarcinoma**; surveillance; endoscopic resection and **radiofrequency ablation for dysplasia**.
- **Oesophageal cancer**: **squamous cell carcinoma is commonest worldwide and in South Asia** (tobacco, alcohol, hot drinks, achalasia, Plummer-Vinson, caustic stricture), mostly middle third; **adenocarcinoma is commonest in the West** (GORD, Barrett's, obesity), lower third. Progressive dysphagia, solids then liquids. Staging by endoscopic ultrasound (T and N), CT, PET-CT. Treatment of locally advanced disease: **neoadjuvant chemoradiotherapy (CROSS, 2012) or perioperative chemotherapy (FLOT) then oesophagectomy** (Ivor Lewis, McKeown three-stage, transhiatal); **adjuvant nivolumab** for residual disease (CheckMate 577, 2021). Gastro-oesophageal junction

tumours by **Siewert**: type I distal oesophagus (centre 1 to 5 cm above the junction), type II true cardia (1 cm above to 2 cm below), type III subcardial (2 to 5 cm below).

- **Leiomyoma** is the commonest benign tumour of the oesophagus (smooth filling defect; enucleation, never biopsy through the mucosa if surgery is planned).
- Dysphagia patterns: intermittent, solids only, non-progressive suggests Schatzki ring; progressive solids then liquids suggests stricture or cancer; solids and liquids from the start suggests a motility disorder.
- Narrowest part of the oesophagus: its beginning at the cricopharyngeus, **15 cm from the incisors (C6)**; other constrictions at 25 cm (aortic arch and left main bronchus) and 40 cm (diaphragm, gastro-oesophageal junction). **Ryle's tube markings**, in order: the first at the cardia (about 40 cm), the second at the body of the stomach, **the third at the pylorus**, the fourth at the duodenum; the centimetre values differ between makers and texts.

Stomach and duodenum

- **Peptic ulcer**: **duodenal ulcers** lie in the first part; **anterior ulcers perforate, posterior ulcers bleed** from the **gastroduodenal artery**. Pain relieved by food, nocturnal; most are H. pylori (about 90% classically; NSAIDs are a growing share). **Gastric ulcers**: lesser curve at the incisura; pain worse with food; may be malignant, so always biopsy and re-scope (Johnson types I to V).
- **Perforated peptic ulcer**: sudden severe pain, board-like rigidity, **free gas under the diaphragm on an erect chest X-ray** (absent in up to a quarter; CT is more sensitive). Treatment: resuscitation, **omental patch repair (Graham patch, laparoscopic or open)**, H. pylori eradication; Boey score predicts mortality. Conservative (Taylor's) management only in selected sealed perforations.
- **Bleeding peptic ulcer**: Glasgow-Blatchford score (before endoscopy; 0 or 1 can be managed as an outpatient) and Rockall score; **Forrest classification** (Ia spurting, Ib oozing, IIa visible vessel, IIb adherent clot, IIc flat spot, III clean base); endoscopic therapy for Ia to IIa (two methods, e.g. adrenaline plus clips or thermal), high-dose PPI; embolisation or surgery if it fails. Restrictive transfusion (haemoglobin 7 g/dL).
- **Dumping after gastric surgery**: **early (within about 30 minutes)**: hyperosmolar chyme draws fluid into the jejunum and releases vasoactive gut hormones (faintness, sweating, palpitations, cramps, diarrhoea); **late (1 to 3 hours)**: rapid carbohydrate absorption, an exaggerated insulin and incretin surge and **reactive hypoglycaemia** (tremor, sweating, confusion). Small, dry, low-sugar meals first; acarbose for late dumping, octreotide; surgical revision (Roux-en-Y conversion) is rare.
- **Superior mesenteric artery (Wilkie's) syndrome**: rapid weight loss shrinks the fat pad, the **aortomesenteric angle falls below about 22 to 25 degrees** (normally about 38 to 65) and the distance below about 8 mm, compressing the **third part of the duodenum**; bilious vomiting after meals, **relieved prone or knee-chest**; barium or CT shows abrupt cut-off of D3; nasojejunal feeding to regain weight, duodenojejunostomy if that fails.
- **Bariatric (metabolic) surgery** (IFSO/ASMBS 2022): **BMI 35 or more whatever the comorbidity; 30 to 34.9 with metabolic disease**; in Asian people obesity is defined from BMI 25 and surgery offered from 27.5. **Sleeve gastrectomy has been the commonest operation worldwide since about 2014** (older books: Roux-en-Y gastric bypass); banding has declined (slippage, erosion), biliopancreatic diversion is rare (malnutrition). Rapid weight loss brings gallstones (ursodeoxycholic acid prophylaxis); internal hernia after bypass: see Hernia.
- **Gastric outlet obstruction in adults** (from ulcer scarring or antral cancer): succussion splash, vomiting of undigested food; **hypochloraemic, hypokalaemic metabolic alkalosis with paradoxical aciduria** (volume depletion drives sodium retention by aldosterone at the cost of hydrogen and potassium). Correct with **0.9% saline and potassium** before surgery.
- **Zollinger-Ellison syndrome**: gastrinoma, now mostly in the **duodenum** (then pancreas), within **Passaro's gastrinoma triangle** (cystic and common bile duct junction, second and third parts of the duodenum, neck and body of the pancreas); **MEN 1 in about 20 to 25%**. Multiple or atypical ulcers (jejunum), diarrhoea. Diagnosis: **fasting gastrin over 10 times the upper limit (about 1,000 pg/mL) with gastric pH below 2**; **secretin stimulation test** (paradoxical rise of gastrin) when equivocal; stop PPIs first if safe, as they raise gastrin and chromogranin A. Localise with somatostatin receptor PET (Ga-68 DOTATATE), EUS.
- **Gastric cancer**: adenocarcinoma; **classically commonest in the antrum (distal)**, though proximal (cardia) tumours are rising in the West; H. pylori, smoked and salted food, nitrosamines, pernicious anaemia, blood group A. **Lauren classification**: **intestinal** (environmental, H. pylori, gland-forming, older men, spreads by blood to the liver) versus **diffuse** (poorly cohesive, **signet-ring cells**, **CDH1 (E-cadherin) loss**, younger, familial; linitis plastica; spreads through the wall and peritoneum). **Borrmann** classifies the gross appearance (I polypoid to IV diffusely infiltrative); it is not a staging system. **Early gastric cancer** is confined to the mucosa or submucosa whatever the nodes, and is treated by endoscopic submucosal dissection when small and well differentiated. Signs of spread: Virchow's node (Troisier's sign), Sister Mary Joseph nodule, Blumer's shelf, Krukenberg tumour, Irish node (left axilla). Curative surgery: **gastrectomy with D2 lymphadenectomy** (proximal margin about 5 cm, more for diffuse type), with **perioperative FLOT chemotherapy** (FLOT4 trial, 2019); **trastuzumab for HER2-positive** and **nivolumab or pembrolizumab with chemotherapy** in advanced disease. Hereditary diffuse gastric cancer (CDH1 carriers): prophylactic total gastrectomy.
- **GIST**: from the **interstitial cells of Cajal** (the gut's pacemaker cells); **KIT (CD117) and DOG1 positive**, activating **KIT or PDGFRA** mutations; commonest in the **stomach (about 60%)**, then small bowel; spreads by blood to the liver and peritoneum, **rarely to nodes, so no lymphadenectomy**. Risk by **size, mitotic count and site** (Miettinen). Treatment: complete resection with a negative margin and intact pseudocapsule; **imatinib** for unresectable or metastatic disease and **adjuvant imatinib for 3 years** in high-risk tumours; PDGFRA D842V is imatinib-resistant (avapritinib). **Carney triad: gastric GIST, pulmonary chondroma, extra-adrenal paraganglioma** (not the Carney complex of myxomas and spotty pigmentation).

Small bowel and appendix

- **Small bowel obstruction**: colicky pain, vomiting (early and bilious in high obstruction), distension, absolute constipation (late in high obstruction). **Commonest cause: adhesions** in

countries with much abdominal surgery; **in low- and middle-income countries obstructed hernias rival or exceed adhesions**, with volvulus and **abdominal tuberculosis**. X-ray: dilated loops over 3 cm with valvulae conniventes crossing the whole width; CT is the best test (closed loop, ischaemia). Adhesive obstruction without strangulation: drip and suck, and a **water-soluble contrast (Gastrografin) challenge**, both diagnostic and therapeutic (contrast in the colon by 24 hours predicts resolution). Strangulation (fever, tachycardia, constant pain, peritonism, raised lactate): operate.

- **Short bowel syndrome**: in adults **under about 200 cm of functioning small bowel** left; parenteral support is usually needed with under about 100 cm and an end jejunostomy (under about 50 to 60 cm with the colon in continuity); teduglutide (a GLP-2 analogue) promotes adaptation.
- **Whipple disease**: *Tropheryma whipplei*; **PAS-positive foamy macrophages** in the small-bowel lamina propria; arthralgia, diarrhoea, weight loss, later neurological signs; ceftriaxone for 2 weeks, then co-trimoxazole for a year.
- **Abdominal tuberculosis** (common where tuberculosis is endemic, as across South Asia): the **ileocaecal region is the commonest site** (stasis and abundant lymphoid tissue); forms ulcerative, hyperplastic (mass in the right iliac fossa) or stricturing disease, peritoneal (wet ascitic, fibrotic) and nodal. **Against Crohn's: caseating confluent granulomas, transverse (circumferential) ulcers, a patulous ileocaecal valve with a "pulled-up" contracted caecum, positive AFB, GeneXpert or culture, and chest X-ray changes**; Crohn's has longitudinal ulcers, skip lesions and non-caseating granulomas. Ascitic fluid: lymphocytes, high protein, **adenosine deaminase over about 39 IU/L**. Treatment is antitubercular drugs; surgery (strictureplasty, limited resection) for obstruction or perforation.
- **Typhoid (enteric) perforation** (enteric fever is endemic in South Asia, including Nepal): in the **second or third week**, through an ulcerated Peyer's patch on the **antimesenteric border of the terminal ileum**, usually single, within about 60 cm of the ileocaecal valve; signs may be masked by the illness; treatment is resuscitation, antibiotics (ceftriaxone, or azithromycin; carbapenem where resistance is high) and early laparotomy with **primary closure** of the freshened edges, or resection for multiple perforations.
- **Acute appendicitis**: the commonest surgical emergency (and the commonest non-obstetric surgical emergency in pregnancy). **Murphy's triad: pain first, then vomiting, then fever.** Pain shifts from the periumbilical region (visceral, T10) to the right iliac fossa (somatic). **Retrocaecal is the commonest position** (about two-thirds; psoas sign, little tenderness anteriorly); pelvic gives diarrhoea, frequency and the obturator sign, tender on rectal examination. **Rovsing's sign**: pressure in the left iliac fossa causes right iliac fossa pain (gas displaced to the caecum). **McBurney's point**: junction of the **lateral one-third and medial two-thirds** of the line from the anterior superior iliac spine to the umbilicus. Scores: **Alvarado (MANTRELS, out of 10; 7 or more likely)**, AIR, Adult Appendicitis Score. Imaging: **ultrasound first in children and pregnancy** (then MRI), **CT in adults** when doubtful.
- Treatment: **laparoscopic appendicectomy is standard**; **current practice: antibiotics first is a safe option for uncomplicated appendicitis without an appendicolith** (CODA trial 2020; WSES Jerusalem guidelines 2020), though about a quarter to a third recur within years.
- **Appendix mass** (several days, tender mass, patient well): the **conservative Ochsner-Sherren regimen** (fluids, antibiotics, chart of pulse, temperature and mass size); abscess: **percutaneous drainage**; operate if it worsens. Interval appendicectomy is no longer routine in the young, but over about 40 years do **colonoscopy or CT** because of the risk of an underlying neoplasm.
- **Appendiceal tumours**: **neuroendocrine tumour (carcinoid) is the commonest tumour in an appendicectomy specimen** (about 0.3 to 0.9%), usually at the **tip**. ENETS 2023: **under 1 cm, appendicectomy alone; 1 to 2 cm, appendicectomy unless risk factors (base involvement, mesoappendiceal invasion over 3 mm, lymphovascular invasion, grade 2); over 2 cm, right hemicolectomy**. Mucinous neoplasms (LAMN) can rupture to cause **pseudomyxoma peritonei** (cytoreduction and HIPEC). Since appendicitis is the commonest surgical emergency of pregnancy, carcinoid is the commonest tumour in its specimen.
- Intussusception and Meckel's diverticulum: see Paediatric surgery. Carcinoid syndrome: see Surgical oncology.

Large bowel

	Crohn's disease	Ulcerative colitis
Distribution	mouth to anus, **skip lesions**, **terminal ileum commonest**	**rectum always**, continuous proximal spread; backwash ileitis
Depth	**transmural**: fissures, fistulas, strictures, abscesses	mucosa and submucosa
Ulcers	**aphthous first** (earliest lesion), then deep linear and serpiginous ulcers, cobblestoning	diffuse ulceration, pseudo-polyps
Histology	**non-caseating granulomas** (in about half)	crypt abscesses, goblet cell depletion (crypt abscesses occur in both)
Serology	ASCA	**pANCA**; association with primary sclerosing cholangitis
Smoking	worsens	protective
Imaging	**string sign of Kantor**, fistulae; **creeping fat** (mesentery wrapping the bowel) seen at operation and on CT/MR	lead-pipe colon (loss of haustra)
Surgery	not curative; limited resection, strictureplasty	**restorative proctocolectomy with ileal pouch (IPAA) cures**; colectomy for toxic megacolon (over 6 cm)

- Current drugs: anti-TNF (infliximab, adalimumab), vedolizumab, ustekinumab and risankizumab, JAK inhibitors (tofacitinib, upadacitinib); acute severe colitis by Truelove and Witts, with rescue (infliximab or ciclosporin) at day 3 to 5 before colectomy.
- **Sigmoid volvulus**: elderly, constipated, institutionalised or on psychotropic drugs in the West; **in the "volvulus belt" (Africa, South Asia, the Middle East, South America) younger men on high-fibre diets**. X-ray: a huge bent inner tube, **"coffee bean" loop, its apex pointing to the right upper quadrant**, from the left iliac fossa. **Without peritonitis: flexible sigmoidoscopic decompression with a rectal (flatus) tube**, then elective sigmoid resection in the same admission because recurrence is high (over half). Peritonitis or gangrene: **Hartmann's procedure**. **Caecal volvulus**: loop toward the left upper quadrant; **right hemicolectomy** (endoscopic decompression rarely works).
- **Diverticular disease**: false (pulsion) diverticula where the vasa recta pierce the circular muscle. **In Western populations**

the sigmoid is the commonest site; in East and South-East Asia right-sided (caecal, ascending) diverticula predominate. Saw-tooth appearance on barium. **Commonest cause of significant lower GI bleeding in adults** (painless, often right-sided diverticula). Diverticulitis: CT is the test; **Hinchey: I pericolic abscess, II pelvic or distant abscess, III purulent peritonitis, IV faecal peritonitis**. **Current practice: uncomplicated diverticulitis in a well patient may be managed without antibiotics** (AVOD and DIABOLO trials; AGA 2021); abscess over about 3 to 4 cm: percutaneous drainage; Hinchey III: laparoscopic lavage or resection; Hinchey IV: Hartmann's or resection with primary anastomosis and defunctioning stoma. Colonoscopy after recovery to exclude cancer.

- **Ischaemic colitis**: usually non-occlusive low flow in the elderly; **exam answer: the splenic flexure (Griffiths' point, the watershed between superior and inferior mesenteric territories) and the rectosigmoid (Sudeck's point)**; large modern series find the left colon as a whole (descending and sigmoid) most often affected; **the rectum is usually spared** (dual supply). Pain, then bloody diarrhoea; **thumbprinting** on X-ray or barium; CT and colonoscopy; most settle with supportive care, gangrene needs resection.
- **Pseudomembranous colitis**: *Clostridioides difficile* after antibiotics (clindamycin, cephalosporins, fluoroquinolones): profuse watery diarrhoea, fever, leucocytosis; **stool testing first** (glutamate dehydrogenase with toxin immunoassay, or a toxin-gene nucleic acid test); stop the offending antibiotic. **Exam answer: metronidazole for mild disease, oral vancomycin for severe. Current practice (IDSA/SHEA 2021): fidaxomicin preferred, oral vancomycin an alternative, metronidazole only when neither is available**; fulminant: oral (or rectal) vancomycin with IV metronidazole, subtotal colectomy for toxic megacolon or perforation. Colonoscopy is for unclear cases; barium enema risks perforation.
- **Colorectal cancer**: commonest in the **rectum and sigmoid**. Right-sided: anaemia, mass, weight loss; left-sided: change in bowel habit, bleeding, obstruction. **Adenoma-carcinoma sequence: APC, then KRAS, then 18q (DCC, SMAD4) loss, then p53**; the serrated pathway (BRAF, CpG island methylation) causes many right-sided cancers. **CEA is for follow-up after resection, not screening. Lynch syndrome** (MLH1, MSH2, MSH6, PMS2, EPCAM; autosomal dominant; **Amsterdam II criteria: 3 relatives, 2 generations, 1 under 50**; endometrial, ovarian, urothelial cancers too): test every colorectal cancer for mismatch repair deficiency. **Screening**: from **45 years** in US guidance (USPSTF 2021; ACS 2018), 50 in many other countries, earlier with a family history; faecal immunochemical test or colonoscopy.
- Surgery: colon cancer, resection with **5 cm margins** and the lymphovascular pedicle (complete mesocolic excision; right hemicolectomy, left hemicolectomy, sigmoid colectomy); rectum, **total mesorectal excision (Heald)** with a **distal margin of 1 to 2 cm** (1 cm acceptable in low tumours) and a clear circumferential margin over 1 mm. Low anterior resection, ultra-low or intersphincteric resection when the sphincter can be saved; **abdominoperineal resection for low rectal adenocarcinoma that involves the sphincters or leaves no clear distal margin**. Rectal cancer staging by MRI pelvis; **neoadjuvant chemoradiotherapy or total neoadjuvant therapy** (RAPIDO 2021, PRODIGE 23) for locally advanced tumours; "watch and wait" after a complete clinical response; **dMMR rectal cancer can respond completely to dostarlimab alone** (2022).
- Advanced colorectal cancer: test **KRAS/NRAS, BRAF and MSI**: RAS wild-type left-sided tumours benefit from anti-EGFR (cetuximab, panitumumab); **MSI-high: first-line pembrolizumab** (KEYNOTE-177, 2020); BRAF V600E carries a poor prognosis (encorafenib with cetuximab). Liver metastases are resected when possible (5-year survival about 40 to 50%).
- Staging: TNM (AJCC 8th); **Dukes** (A wall, B through the wall, C nodes, D distant; Astler-Coller modified it) is the classic exam staging.
- **Anal canal**: anal **squamous cell carcinoma** (HPV 16, HIV, anoreceptive intercourse) drains to the **inguinal nodes**; **treatment of first choice is chemoradiotherapy (Nigro regimen: 5-FU with mitomycin)**; abdominoperineal resection is kept for residual or recurrent disease. A low **rectal adenocarcinoma** a few centimetres from the verge, by contrast, is treated by surgery after neoadjuvant therapy. Read the stem for the histology.
- **Polyposis syndromes**:

Syndrome	Gene	Key points
FAP	**APC, chromosome 5q21**, autosomal dominant	over 100 adenomas, cancer inevitable by 40 to 50 without surgery; **prophylactic (procto)colectomy** in the late teens; **CHRPE** of the retina; **duodenal (periampullary) cancer and desmoids** are the leading causes of death after colectomy
Gardner's	APC	FAP with osteomas (mandible), desmoid tumours, epidermoid cysts, dental anomalies
Turcot's	APC or mismatch repair genes	polyposis with brain tumours (medulloblastoma with APC, glioblastoma with Lynch)
MUTYH-associated polyposis	MUTYH, **autosomal recessive**	tens to hundreds of adenomas
Peutz-Jeghers	**STK11 (LKB1), 19p**	hamartomas (small bowel commonest; intussusception), **mucocutaneous pigmentation of lips and buccal mucosa**, raised risk of GI, breast, pancreatic, ovarian (sex cord) and testicular (Sertoli) cancers
Juvenile polyposis	SMAD4, BMPR1A	hamartomatous juvenile polyps; SMAD4 overlaps with hereditary haemorrhagic telangiectasia
Cowden	PTEN	hamartomas, breast and thyroid (follicular) cancer

- Neoplastic polyps: tubular, tubulovillous and villous adenomas (villous has the highest cancer risk; villous adenoma of the rectum can cause **hypokalaemia** from mucus loss) and serrated adenomas; hyperplastic, inflammatory and hamartomatous polyps are non-neoplastic. Size over 2 cm, villous change and high-grade dysplasia raise the risk.
- **Haemorrhoids**: primary cushions at **3, 7 and 11 o'clock** (lithotomy), the left lateral, right posterior and right anterior positions of the superior rectal artery branches. **Grades**: I bleed, no prolapse; II prolapse, reduce spontaneously; III prolapse, reduce by hand; IV irreducible. Treatment: fibre and fluids for all; **rubber band ligation** for grades I to III (injection sclerotherapy for I to II); **haemorrhoidectomy (Milligan-Morgan open, Ferguson closed) for grade III and IV** and

failed banding; stapled haemorrhoidopexy, Doppler-guided artery ligation (HAL/THD) as alternatives. Thrombosed external haemorrhoid: excision within 72 hours, otherwise conservative.

- **Anal fissure**: a split in the anoderm below the dentate line, **posterior midline in about 90%** (anterior in women after childbirth; lateral or multiple fissures suggest Crohn's, TB, HIV, syphilis or cancer); severe pain on defecation, bright blood; chronic: sentinel pile, hypertrophied papilla, exposed internal sphincter. Treatment: fibre, sitz baths, **topical diltiazem or GTN** (chemical sphincterotomy), botulinum toxin; **lateral internal sphincterotomy is the gold standard** for chronic fissures that fail.
- **Fistula-in-ano**: from infection of an **anal (intersphincteric) gland**. **Goodsall's rule**: an external opening **anterior to the transverse anal line** tracks **straight (radially)** to the dentate line; one **posterior** to it tracks **curved to the posterior midline**; anterior openings more than 3 cm from the margin may also curve back. **Parks classification: intersphincteric (commonest), trans-sphincteric, suprasphincteric, extrasphincteric. MRI is the best test for complex fistulae**. Low simple fistula: **fistulotomy**; high or complex: **seton** (draining or cutting), **LIFT** (ligation of the intersphincteric fistula tract), advancement flap, fistula plug, to protect continence.
- **Perianal abscess**: incision and drainage, without waiting for fluctuation. **Pilonidal sinus**: natal cleft, hair-bearing young men (hirsuties, sitting jobs); excision with off-midline closure (Karydakis, Limberg flap) or minimally invasive techniques (pit picking, Bascom).
- **Solitary rectal ulcer syndrome**: usually on the **anterior rectal wall, about 5 to 10 cm from the verge**, from straining, digital evacuation and internal prolapse; may be multiple, polypoid or only red; histology: **fibromuscular obliteration of the lamina propria**; biopsy to exclude cancer; fibre, biofeedback and treating constipation first, rectopexy for prolapse.
- **Rectal prolapse**: abdominal **rectopexy (laparoscopic ventral mesh rectopexy)** for fit patients; perineal procedures for the frail: **Delorme's** (mucosal sleeve resection with muscle plication), **Altemeier's** (perineal rectosigmoidectomy), **Thiersch's** (anal encircling suture).
- **Dentate (pectinate) line**: above, endoderm, columnar epithelium, superior rectal (portal) drainage, internal iliac nodes, **painless** (autonomic); below, ectoderm, squamous epithelium, inferior rectal (systemic) drainage, **superficial inguinal nodes**, painful (somatic, pudendal nerve).
- **Stomas**: **ileostomy**: spouted 2 to 3 cm, right iliac fossa, liquid output, **skin excoriation the commonest problem**, dehydration and electrolyte loss, gallstones and urate stones; **colostomy**: flush, left iliac fossa, **parastomal hernia the commonest late complication**, prolapse, retraction, stenosis.
- Mesenteric ischaemia is covered under Vascular surgery; lower GI bleeding from Meckel's diverticulum in children under Paediatric surgery.

Caustic ingestion, foreign bodies and why CO2 is used

- **Refeeding syndrome** after gut surgery, obstruction or fistula with prolonged starvation: feeding raises insulin, which drives **phosphate (the hallmark fall), potassium and magnesium into cells** and uses up thiamine; arrhythmias, respiratory failure, fluid overload; start at 10 kcal/kg a day in those at high risk, **thiamine before feeding** (NICE CG32; see Perioperative care).
- **Caustic (corrosive) ingestion**: **alkalis (drain cleaners, caustic soda) cause liquefaction necrosis** that penetrates deep into the oesophagus, whereas **acids cause coagulation necrosis and mostly burn the stomach** (self-limiting, though a pyloric stricture follows). **Do not induce vomiting, do not give a neutralising agent (heat), do not pass a blind tube**; give nothing by mouth, resuscitate, secure the airway if stridor or oedema, and perform **endoscopy within 12 to 24 hours** (within 24 to 48 hours is safe; avoid it from about day 3 to week 3, when the healing wall is weakest) to grade injury (**Zargar grades 0 to 3b**); grade 3 injuries need surgery or close observation for perforation; **late oesophageal stricture appears at 3 weeks to months** (dilation) and carries a **raised risk of squamous cell carcinoma** after decades.
- **Foreign body of the oesophagus**: the commonest sites are the narrowings, **cricopharyngeus (the commonest and the narrowest)**, then the aortic arch, left main bronchus and diaphragm. Coins are usually removed endoscopically (a flexible scope or Foley catheter in some settings); **button batteries (mucosal burns within 2 hours) and sharp objects need emergency removal**. A water-soluble contrast swallow shows a perforation.
- **Why laparoscopy uses CO_2**: it is **non-combustible** (safe with diathermy), **highly soluble in blood so that a small gas embolus is absorbed quickly** and it is quickly excreted by the lungs; the price is **hypercapnia and acidosis** from absorption (so ventilation must increase) and shoulder-tip pain. Room air, nitrous oxide (supports combustion) or oxygen are unsuitable, and helium and argon are insoluble. **Minimal-access benefits**: less pain, shorter stay, smaller scars, faster return to work, fewer wound complications; **drawbacks**: loss of tactile feedback and the 2D view (less so with 3D and robotic systems), a learning curve, the cost, and physiological effects of pneumoperitoneum (reduced venous return, raised intracranial and intraocular pressure).
- **H. pylori eradication** is confirmed by a urea breath test (or stool antigen) **at least 4 weeks after the antibiotics, with PPIs stopped 2 weeks before**.
- **Gastric ulcer needs biopsy**: **a benign-looking gastric ulcer can be malignant, so take multiple edge biopsies at endoscopy and check healing by repeat endoscopy at 6 to 8 weeks**; a duodenal ulcer is almost never malignant and is not biopsied for that reason (test for H. pylori, though). Barrett's oesophagus predisposes to **adenocarcinoma** (squamous cancer is the other type; see above).

Hepatobiliary and pancreas

Gallstones and the gallbladder

- Stones: cholesterol (commonest in the West; the "fat, female, fertile, forty" pattern is a teaching aid), **pigment** (black, in haemolysis and cirrhosis; brown, in infected ducts, common in East Asia), mixed. Ultrasound is the investigation of choice for gallbladder stones.
- **Biliary colic**: constant (not truly colicky) pain under 6 hours, no fever, normal gallbladder wall. **Acute cholecystitis**: pain over 6 hours, fever, leucocytosis, **Murphy's sign**, thick wall and pericholecystic fluid on ultrasound (HIDA scan non-filling is the most accurate test). **Tokyo Guidelines 2018 (TG18)** grade severity I to III; **early laparoscopic cholecystectomy, ideally within 72 hours of symptoms** (and up to about 7 to 10 days), rather than interval surgery; **percutaneous**

cholecystostomy for the unfit or grade III not fit for surgery. **Boas' sign**: hyperaesthesia below the right scapula.

- **Critical view of safety (Strasberg)**: the hepatocystic triangle cleared of fat and fibrous tissue, the lower third of the gallbladder separated from the liver bed, and **only two structures (cystic duct and cystic artery) seen entering the gallbladder**, before clipping. **Calot's triangle**: cystic duct, common hepatic duct and cystic artery (the original description; the hepatocystic triangle has the inferior surface of the liver as its upper border); contains the cystic artery and **Lund's (Calot's) node**. Bile duct injury: **Strasberg** (A to E) or **Bismuth** (I to V, by the level of a stricture) classifications; a major injury is repaired by **Roux-en-Y hepaticojejunostomy**, by a specialist.
- **Mirizzi syndrome**: a stone impacted in the cystic duct or **Hartmann's pouch compresses the common hepatic duct**, causing obstructive jaundice; **Csendes types**: I external compression; **II to IV cholecystobiliary fistula** of increasing size; V cholecystoenteric fistula (Va without, Vb with gallstone ileus). Important because it raises the risk of bile duct injury; subtotal cholecystectomy is often safest.
- **Gallstone ileus**: a large stone erodes through a cholecystoduodenal fistula and impacts in the **terminal ileum** (the narrowest part); **Rigler's triad: pneumobilia, small bowel obstruction, ectopic radiopaque stone**; enterolithotomy proximal to the stone. **Bouveret's syndrome**: the stone obstructs the duodenum or pylorus (gastric outlet obstruction).
- **Courvoisier's law**: in a **jaundiced** patient, a **palpable, non-tender gallbladder is unlikely to be due to stones**, because a gallbladder scarred by chronic stone disease cannot distend; a **periampullary or pancreatic head cancer** is likely. Exceptions: **double impaction** (one stone in the cystic duct making a mucocele, another in the common duct), recurrent pyogenic (Oriental) cholangiohepatitis, pancreatic calculi, and a mucocele from a cystic duct stone without jaundice from it.
- **Gallbladder cancer**: adenocarcinoma, women; **gallstones are the commonest risk factor** (large stones), also porcelain gallbladder (calcified wall; risk lower than once thought, about 6%; cholecystectomy is advised), polyps over 1 cm, anomalous pancreaticobiliary junction, choledochal cyst, Salmonella carriage. **Incidence is among the world's highest in northern India (the Gangetic plain), with Nepal among the highest-ranked countries for women (World Cancer Research Fund, 2022 figures), and in Chile and Bolivia.** Spreads directly to liver segments IV and V. Nevin staging is historical; TNM is used. Incidental T1b or deeper cancer after cholecystectomy: re-resection (liver bed and nodes).
- **Gallbladder polyps**: cholesterol polyps commonest; **cholecystectomy for polyps of 10 mm or more**, or 6 to 9 mm with risk factors (age over 60, Indian ethnicity, primary sclerosing cholangitis, sessile); follow up smaller ones (European joint guideline 2022).
- **Choledochal cysts** (**Todani** classification): **type I, fusiform or cystic dilatation of the common bile duct, the commonest** (about 80 to 90%); II diverticulum; III choledochocele; IVa intra- and extrahepatic; **V, intrahepatic only (Caroli's disease)**. Classic triad pain, jaundice and mass (in children). Cancer risk (cholangiocarcinoma): excision with Roux-en-Y hepaticojejunostomy, not drainage.

Common bile duct stones and cholangitis

- **Charcot's triad: fever with rigors, jaundice, right upper quadrant pain** (ascending cholangitis). **Reynolds' pentad adds hypotension and altered mental state** (suppurative cholangitis). Management: fluids, blood cultures, antibiotics, and **urgent biliary decompression by ERCP** (sphincterotomy, stone extraction or stent); percutaneous transhepatic drainage if ERCP fails; open exploration only as a last resort. TG18 timing: severe (grade III) urgently once resuscitated; moderate within 24 hours.
- Suspected duct stones: risk by ASGE 2019 (stone seen on ultrasound or cholangitis: straight to ERCP; intermediate risk: **MRCP or EUS** first). Laparoscopic common bile duct exploration is an alternative to ERCP.
- Common elements: Charcot's triad and Murphy's triad of appendicitis share **pain and fever**.

Portal hypertension and variceal bleeding

- **Ascites: serum-ascites albumin gradient (SAAG)**: **1.1 g/dL or more means portal hypertension** (cirrhosis, heart failure, Budd-Chiari); **under 1.1** means peritoneal disease (tuberculosis, carcinomatosis) or hypoalbuminaemia (nephrotic syndrome); with a high SAAG, ascitic protein over 2.5 g/dL points to a post-sinusoidal (cardiac, Budd-Chiari) cause, under 2.5 to cirrhosis.
- **Spontaneous bacterial peritonitis**: **ascitic neutrophils 250/mm^3 or more** with no surgical source, usually one organism (E. coli commonest); **intravenous cefotaxime (a third-generation cephalosporin) plus albumin** (1.5 g/kg on day 1, 1 g/kg on day 3, to prevent hepatorenal syndrome); norfloxacin or ciprofloxacin prophylaxis after an episode; several organisms or very high protein suggests secondary (surgical) peritonitis. **Hepatic encephalopathy**: lactulose first, **rifaximin added to prevent recurrence**.
- **Acute variceal bleeding (Baveno VII, 2022)**: resuscitation with **restrictive transfusion (threshold haemoglobin 7 g/dL, target 7 to 9)**; avoid over-correcting; **vasoactive drug at once (terlipressin, somatostatin or octreotide)** for 2 to 5 days; **antibiotic prophylaxis (ceftriaxone 1 g/day up to 7 days)**; **endoscopy within 12 hours** with **band ligation** for oesophageal varices (cyanoacrylate glue for gastric fundal varices). **Pre-emptive TIPS within 72 hours (ideally 24)** for high-risk patients: Child-Pugh C (10 to 13 points) or Child-Pugh B over 7 with active bleeding at endoscopy. **Rescue TIPS** for failure; balloon tamponade (Sengstaken-Blakemore) or a self-expanding stent as a bridge.
- Prophylaxis: **non-selective beta-blocker, carvedilol preferred** (Baveno VII) or band ligation for primary prophylaxis of large varices; **beta-blocker plus banding for secondary prophylaxis**.
- Severity scores: **Child-Pugh** (bilirubin, albumin, INR, ascites, encephalopathy; A 5 to 6, B 7 to 9, C 10 to 15) and **MELD** (bilirubin, INR, creatinine, with sodium in MELD-Na). Surgical shunts are now rare: total (portocaval) versus selective (**Warren distal splenorenal shunt**, which keeps portal flow to the liver and causes less encephalopathy). In children and in non-cirrhotic portal hypertension (extrahepatic portal vein obstruction), bleeding is usually well tolerated.

Pancreas

- **Acute pancreatitis**: gallstones and alcohol commonest; also hypertriglyceridaemia (over 1,000 mg/dL), hypercalcaemia, drugs (azathioprine, valproate), post-ERCP, trauma, scorpion

venom, mumps. **Diagnosis needs two of three: typical epigastric pain radiating to the back, serum lipase (or amylase) over three times normal, imaging features. Lipase is more specific and stays raised longer**; amylase also comes from salivary glands and normalises in days. CT is not needed for diagnosis in a typical case; when needed for complications, after 72 hours.

- **Revised Atlanta (2012)**: **mild** (no organ failure or local complications), **moderately severe** (transient organ failure under 48 hours, or local complications), **severe: organ failure persisting beyond 48 hours** (modified Marshall score). Severity scores: Ranson (at admission and 48 hours), Glasgow/Imrie (3 or more severe), APACHE II (8 or more), **BISAP**, CRP over 150 mg/L at 48 hours, Balthazar CT severity index.
- **Treatment**: **fluids: exam answer "aggressive" early hydration; current practice, moderate goal-directed Ringer's lactate**, since aggressive fluid caused more fluid overload without benefit (**WATERFALL trial, 2022**; ACG 2024 and AGA guidance); analgesia; **early oral or enteral feeding (within 24 to 72 hours)** rather than nil by mouth or parenteral nutrition; **no prophylactic antibiotics**, only for proven or strongly suspected infected necrosis (gas in a collection on CT); **ERCP within 24 hours only with cholangitis** (not for predicted severe gallstone pancreatitis without it); **cholecystectomy in the same admission for mild gallstone pancreatitis** (PONCHO, 2015).
- **Local complications (Atlanta)**: under 4 weeks, acute peripancreatic fluid collection (interstitial oedematous pancreatitis) or acute necrotic collection (necrotising); **over 4 weeks, pseudocyst** (fluid only, a well-defined wall) or **walled-off necrosis**. **Infected necrosis: the step-up approach** (PANTER trial, 2010): antibiotics, then **percutaneous or endoscopic drainage**, then minimally invasive or endoscopic necrosectomy, **delayed until about 4 weeks** when the collection is walled off; open necrosectomy is a last resort.
- **Signs of haemorrhagic pancreatitis**: **Grey Turner's (flank, retroperitoneal blood tracking to the flank)**, **Cullen's (periumbilical, via the falciform ligament)**, Fox's (below the inguinal ligament). Seen in a minority; they mark severe disease. Others: sentinel loop, colon cut-off sign, hypocalcaemia (fat saponification), subcutaneous fat necrosis.
- **Pseudocyst**: a collection over 4 weeks old whose **wall has no epithelial lining** (fibrous and granulation tissue); commonest in the lesser sac. **Exam answer: drain if over 6 cm and persisting over 6 weeks. Current practice: drain only if symptomatic or complicated (infection, obstruction, bleeding from a pseudoaneurysm, rupture), whatever the size**; **endoscopic (EUS-guided) cystogastrostomy** is preferred to surgical cystogastrostomy or cystojejunostomy.
- **Chronic pancreatitis**: alcohol commonest in the West; **tropical calcific pancreatitis in South Asia** (young, large ductal stones, diabetes, SPINK1 mutations); **pancreatic calcification on X-ray or CT**, "**chain of lakes**" duct on MRCP or ERCP; steatorrhoea when lipase output falls below about 10%; pain is the main indication for surgery. Operations: **Puestow (lateral pancreaticojejunostomy) for a dilated duct (over 7 mm)**, **Frey's** (head coring with ductal drainage), **Beger's** (duodenum-preserving head resection), Whipple's for a head mass; endoscopic stenting and ESWL of stones first in many centres.
- **Annular pancreas**: a ring of pancreas round the **second part of the duodenum** (abnormal migration of the ventral bud); Down syndrome; double-bubble on X-ray (not specific); **bypassed by duodenoduodenostomy (or duodenojejunostomy), never divided**: the ring is working pancreas with a duct, so division risks a pancreatic fistula and pancreatitis, and an intrinsic duodenal stenosis or atresia often coexists. **Pancreas divisum** (failed fusion of the dorsal and ventral ducts) is the commonest congenital pancreatic anomaly.
- **Pancreatic adenocarcinoma**: **head (60 to 70%)**, **KRAS mutation in over 90%**; smoking the main avoidable risk; painless progressive jaundice, weight loss, back pain, new diabetes, migratory thrombophlebitis (Trousseau's sign); **CA 19-9** (follow-up, not screening). **Pancreas-protocol CT is the key test**; resectability by vessel contact (resectable, borderline, locally advanced). **Whipple's pancreaticoduodenectomy** (or pylorus-preserving) for the head; distal pancreatectomy with splenectomy for body and tail; **adjuvant modified FOLFIRINOX** (PRODIGE 24, 2018; gemcitabine, the classic answer, with capecitabine for the less fit), neoadjuvant therapy for borderline tumours. Commonest complication of Whipple's: **delayed gastric emptying**; the most feared: pancreatic fistula (ISGPS grading).
- **Periampullary and ampullary carcinoma**: **fluctuating (intermittent) jaundice** as the tumour sloughs and the duct reopens, **silver (aluminium-paint) stools** from acholic stool mixed with blood, weight loss, anaemia; **double duct sign** (dilated common bile and pancreatic ducts, also seen in pancreatic head cancer); **better prognosis than pancreatic head cancer** because it presents early; Whipple's.
- **Pancreatic cystic neoplasms**: **serous cystadenoma** ("grandmother lesion", microcystic honeycomb with a central stellate scar, almost always benign); **mucinous cystic neoplasm** (middle-aged women, **body and tail, ovarian-type stroma**, resect); **IPMN** (older men, communicates with the duct; main-duct type has a high cancer risk and is resected; branch-duct IPMN followed by Fukuoka/European criteria); solid pseudopapillary neoplasm (young women).
- **Insulinoma**: the **commonest functional pancreatic neuroendocrine tumour**, 90% benign and solitary and under 2 cm; **Whipple's triad** (symptoms of hypoglycaemia, low glucose, relief with glucose); **72-hour supervised fast** with raised insulin and **C-peptide** (low C-peptide with high insulin means injected insulin); enucleation. Gastrinoma: see above.

Liver

- **Anatomy**: **Couinaud's eight segments**, each with its own portal pedicle and hepatic venous drainage; **Cantlie's line** (gallbladder fossa to the IVC) divides right and left lobes functionally; segment I (caudate) drains by its own short veins straight into the IVC. Falciform ligament divides segments II and III from IV anatomically.
- **Budd-Chiari syndrome**: hepatic vein (or IVC) obstruction (myeloproliferative disease, thrombophilia, webs, common in Asia); abdominal pain, tender hepatomegaly, ascites; **the caudate lobe is spared and hypertrophies** because its drainage bypasses the occluded hepatic veins; Doppler ultrasound first; anticoagulation, angioplasty or stenting, TIPS, transplant.
- **Pringle manoeuvre**: clamping the **hepatoduodenal ligament** (hepatic artery, portal vein, common bile duct) stops inflow; **bleeding that continues points to the hepatic veins or**

retrohepatic IVC (or, rarely, an aberrant left hepatic artery from the left gastric artery). Warm ischaemia is tolerated about 60 minutes (intermittently longer).

- **Commonest liver tumour: metastasis** (colorectal commonest source). **Commonest benign: haemangioma** (peripheral nodular enhancement with centripetal fill-in on CT/MRI; never biopsy). **Focal nodular hyperplasia**: young women, **central stellate scar**, no malignant potential, leave alone. **Hepatocellular adenoma**: young women on **oral contraceptives** (and anabolic steroids), can bleed or turn malignant (beta-catenin type); stop the pill, resect if over 5 cm or in men. Commonest primary malignant: **hepatocellular carcinoma**; in children, **hepatoblastoma**.
- **Hepatocellular carcinoma**: hepatitis B (the commonest cause in Asia and Africa; can occur without cirrhosis), hepatitis C, alcohol, MASLD (fatty liver), aflatoxin (TP53 codon 249). **Surveillance by ultrasound (with AFP) every 6 months in cirrhosis.** Diagnosis **without biopsy** in a cirrhotic liver by **arterial-phase hyperenhancement with portal-venous washout** on multiphase CT or MRI (LI-RADS 5). **BCLC staging** guides treatment: resection (Child A, no portal hypertension), **transplant within the Milan criteria (one tumour up to 5 cm, or up to three tumours each up to 3 cm, no vascular invasion)**, ablation (radiofrequency, microwave) for small tumours, TACE for intermediate, and for advanced disease **atezolizumab with bevacizumab** (IMbrave150, 2020) or durvalumab with tremelimumab as **first-line** (sorafenib, the older exam answer, and lenvatinib are alternatives). AFP over 400 ng/mL is highly suggestive. Fibrolamellar variant: young, no cirrhosis, normal AFP, better outlook.
- **Amoebic liver abscess**: *Entamoeba histolytica*, young men, **single, right lobe** (posterosuperior), "anchovy sauce" pus (sterile, trophozoites in the wall), serology positive; **metronidazole is the drug of choice**, then a **luminal agent** (diloxanide furoate or paromomycin); **aspiration only** for a large left-lobe abscess (risk of pericardial rupture), imminent rupture or no response in 3 to 5 days.
- **Pyogenic liver abscess**: commonest source **biliary** (cholangitis), then portal (appendicitis, diverticulitis) and cryptogenic; **Klebsiella pneumoniae** (hypervirulent strains in East Asia, with eye and brain metastatic infection) and E. coli; multiple more often; **percutaneous drainage plus antibiotics**; look for colon cancer when Streptococcus bovis or Klebsiella is found.
- **Hydatid cyst**: *Echinococcus granulosus*; the **dog is the definitive host**, sheep (and other livestock) the intermediate host, **humans accidental intermediate hosts**; **liver commonest (right lobe), then lung**. Cyst layers: pericyst (host), laminated membrane, germinal layer (makes brood capsules and daughter cysts). Casoni test is obsolete; ELISA serology. Ultrasound staging: **Gharbi I to V or WHO-IWGE: CE1 unilocular with "double line" wall, CE2 multivesicular with daughter cysts (honeycomb), CE3a detached endocyst ("water-lily sign"), CE3b daughter cysts in a solid matrix, CE4 heterogeneous solid ("ball of wool"), CE5 calcified (inactive)**. Treatment: **albendazole** (with PAIR, puncture-aspiration-injection-respiration, for CE1 and CE3a), or surgery (pericystectomy, or deroofing with scolicidal agents such as 20% hypertonic saline) for complicated cysts; avoid spillage (**anaphylaxis**, secondary hydatidosis); CE4 and CE5 can simply be watched. Ruptured cyst into the biliary tree causes cholangitis ("hydatid jaundice"). *E. multilocularis* (fox) causes the tumour-like alveolar echinococcosis.

Hernia

Inguinal canal and femoral canal anatomy

- **Inguinal canal**: about 4 cm long, running downward, forward and medially from the deep ring to the superficial ring, above the medial half of the inguinal ligament. **Anterior wall**: external oblique aponeurosis throughout, plus internal oblique laterally. **Posterior wall**: transversalis fascia throughout, plus the **conjoint tendon medially**. **Roof**: arching fibres of internal oblique and transversus abdominis. **Floor**: inguinal ligament, with the lacunar ligament medially.
- **Deep (internal) ring**: an opening in the transversalis fascia **1.25 cm above the midpoint of the inguinal ligament** (halfway between the anterior superior iliac spine and the pubic tubercle), lateral to the inferior epigastric vessels. The femoral artery lies at the **mid-inguinal point** (halfway between the anterior superior iliac spine and the pubic symphysis). **Superficial ring**: a triangular gap in the external oblique aponeurosis **immediately above the pubic tubercle** (its lateral crus attaches to the tubercle).
- **Contents**: the spermatic cord in men (round ligament in women) and the **ilioinguinal nerve, which runs on the cord, not in it, and enters through the canal wall, not the deep ring**. The cord has three coverings (external spermatic fascia from external oblique, cremasteric fascia and muscle from internal oblique, internal spermatic fascia from transversalis fascia) and three arteries (testicular, cremasteric, artery to the vas), three nerves (genital branch of the genitofemoral, sympathetic fibres, ilioinguinal on it), the vas, the pampiniform plexus, lymphatics and the processus vaginalis remnant.
- **Hesselbach's (inguinal) triangle**: **lateral, the inferior epigastric vessels; medial, the lateral border of rectus abdominis; inferior, the inguinal ligament.** Direct hernias come through it.
- **Femoral canal**: the medial compartment of the femoral sheath, about 1.25 cm long; **anterior, inguinal ligament; posterior, pectineal (Cooper's) ligament over pectineus; medial, lacunar ligament; lateral, femoral vein**; contains fat, lymphatics and the **lymph node of Cloquet**. Its mouth (femoral ring) is narrow and rigid.

Types and their behaviour

- **Inguinal hernia is the commonest hernia in both sexes** (lifetime risk about 27% in men, 3% in women); **indirect is the commonest type in both sexes, in children and in young men**; direct hernias are acquired, in older men, from a weak posterior wall, and rarely strangulate. **Femoral hernia is commoner in women than in men, but even in women inguinal hernia is commoner than femoral.**
- **Indirect**: through the deep ring, **lateral to the inferior epigastric vessels**, along the cord inside the cremaster, may reach the scrotum; from a **patent processus vaginalis** (right side commoner, as the right testis descends later). **Direct**: **medial to the inferior epigastric vessels**, through Hesselbach's triangle, bulging forward, rarely into the scrotum. Clinically, the **deep ring occlusion test** controls an indirect hernia, but the distinction is reliably made only at operation. Relation to the **pubic tubercle: inguinal above and medial; femoral below and lateral**. A scrotal swelling one can get above is not a hernia.

- **Classification**: **Nyhus** (I indirect with a normal ring; II indirect with an enlarged ring; IIIA direct; IIIB large indirect or pantaloon; IIIC femoral; IV recurrent) and the European Hernia Society's (primary or recurrent; lateral, medial or femoral; defect size by fingerbreadths).
- **Definitions**: **reducible**; **irreducible (incarcerated)**: cannot be returned, usually from adhesions or a narrow neck; **obstructed**: bowel lumen blocked, blood supply intact; **strangulated**: blood supply compromised (tense, tender, red, no cough impulse, systemic upset), an emergency. **Femoral hernia has the highest risk of strangulation** (narrow rigid neck bounded by the lacunar ligament; about 1 in 5 present as emergencies), but because inguinal hernias are so much commoner, **indirect inguinal is the hernia most often strangulated in absolute numbers**. Do not force reduction (taxis) of a possibly strangulated hernia: "reduction en masse" returns the sac with gangrenous bowel still trapped at its neck.
- **Richter's hernia**: only part of the **antimesenteric wall** is trapped, so it can strangulate and perforate **without obstruction**; commonest in **femoral** hernias (also obturator and laparoscopic port sites).
- **Eponyms**: **Littre's** (Meckel's diverticulum); **Amyand's** (appendix in an inguinal hernia); **de Garengeot's** (appendix in a femoral hernia); **Maydl's** ("W" hernia: two loops in the sac, the strangulated loop inside the abdomen); **pantaloon (saddle-bag)**: direct and indirect sacs straddling the inferior epigastric vessels; **sliding hernia** (hernia en glissade): a viscus forms part of the sac wall (caecum on the right, sigmoid on the left, bladder), so the sac must not be opened carelessly; **Gibbon's**: hernia with a hydrocele; **Berger's**: into the pouch of Douglas; **Béclard's**: femoral through the saphenous opening; **Laugier's**: femoral through the lacunar ligament; **Cloquet's**: femoral under the pectineal fascia; **Ogilvie's**: through a defect in the conjoint tendon; **Spigelian** and lumbar below.
- **Spigelian hernia**: through the **Spigelian aponeurosis at the linea semilunaris** (lateral edge of rectus), usually at or below the **arcuate line** where the posterior rectus sheath is absent ("Spigelian belt"); **interparietal**, under an intact external oblique, so easily missed: ultrasound or CT; high strangulation risk, repair with mesh (laparoscopic).
- **Lumbar hernias**: **superior (Grynfeltt-Lesshaft) triangle** (12th rib, internal oblique, quadratus lumborum/erector spinae; the floor is transversalis aponeurosis) is the commoner site; **inferior (Petit's) triangle** (iliac crest, external oblique, latissimus dorsi). Incisional lumbar hernias follow loin incisions.
- **Obturator hernia**: through the obturator canal, **elderly thin multiparous women** ("little old lady's hernia"), right more often; presents as small bowel obstruction with the **Howship-Romberg sign** (pain down the medial thigh to the knee, from obturator nerve compression, worse on extension, abduction and medial rotation of the hip); absent adductor reflex on the side of the hernia is the **Hannington-Kiff sign**; **CT** diagnoses; often Richter's type.
- **Umbilical hernia in children**: through the umbilical ring, commoner in African-descended and premature babies; **most close by 4 to 5 years**, so repair only if persisting beyond that age or very large; strangulation is rare. **Paraumbilical hernia in adults**: through the linea alba just above or below the umbilicus, obese multiparous women, cirrhotic ascites; the neck is narrow, so strangulation is commoner. Repair: the **Mayo "vest over pants" repair is historical**; **current practice (EHS/AHS 2020 guideline): mesh repair for defects of 1 cm or more**, sutured repair for smaller.
- **Epigastric hernia**: through the linea alba between xiphoid and umbilicus, usually **extraperitoneal fat** without a sac; small and tender. **Divarication of the recti** is not a hernia (no defect; no strangulation).
- **Incisional hernia**: about 10 to 20% after midline laparotomy; **wound infection is the most important risk factor**, with obesity, smoking, diabetes, steroids, emergency surgery, poor closure technique; prevented by small-bite closure (see Perioperative care). Repair with **mesh**, preferably **retromuscular (sublay, Rives-Stoppa)**; onlay, inlay and intraperitoneal onlay mesh (IPOM, laparoscopic) are alternatives; **component separation (anterior, or posterior with transversus abdominis release)** for large defects; **loss of domain** (contents living outside the abdomen) is prepared for with preoperative botulinum toxin into the lateral muscles or progressive pneumoperitoneum (Goni-Moreno).
- **Internal hernia after Roux-en-Y gastric bypass**: through **Petersen's defect** (between the Roux limb mesentery and the transverse mesocolon) or the jejunojejunostomy's mesenteric defect; intermittent colicky pain or obstruction, often after much weight loss; closing the defects at the operation lowers the rate. Paraduodenal hernias (left, into the fossa of Landzert; right, into Waldeyer's fossa) are congenital internal hernias.
- **Diaphragmatic and hiatus hernias**: **Bochdalek** (posterolateral, usually **left**, congenital, neonatal respiratory distress); **Morgagni** (anterior retrosternal, usually **right**, adults, often incidental). **Hiatus hernia**: **type I sliding** (gastro-oesophageal junction above the diaphragm; commonest, about 95%; reflux); type II true para-oesophageal (junction in place, fundus herniates; risk of volvulus); type III mixed; type IV other organs. Symptomatic para-oesophageal hernias are repaired.

Repair

- **Watchful waiting**: men with an asymptomatic or minimally symptomatic inguinal hernia can be watched safely (Fitzgibbons, JAMA 2006), though about two-thirds come to surgery for pain within 10 years. **Femoral hernias and hernias in women are repaired** (risk of a hidden femoral hernia).
- **Operation of choice for a reducible inguinal hernia in a fit adult: Lichtenstein open tension-free mesh repair** (lightweight large-pore polypropylene mesh). **HerniaSurge International Guidelines (2018)**: mesh for all adult inguinal hernias; Lichtenstein or a laparoscopic repair (**TEP or TAPP**) where expertise exists; **laparoscopic preferred for bilateral hernias, recurrence after open repair, and women** (it shows a femoral hernia too); open repair for recurrence after laparoscopic repair; laparoscopy gives less chronic pain and faster return to work.
- **Tissue repairs**: **Bassini** (conjoint tendon and transversalis to the inguinal ligament, triple layer); **Shouldice** (four-layer imbrication of the transversalis fascia; the best non-mesh repair, lowest recurrence among tissue repairs); **McVay** (conjoint tendon to **Cooper's ligament**; for direct and femoral hernias; needs a relaxing incision); Desarda (a strip of external oblique aponeurosis); Marcy (tightening the deep ring, for small indirect hernias). **Herniotomy (sac ligation) alone in children**, soon after diagnosis because incarceration is

commonest in infancy (premature infants are repaired before discharge from the neonatal unit).

- **Laparoscopic**: **TEP** (totally extraperitoneal: never enters the peritoneum, fewer visceral injuries and adhesions, smaller space, steeper learning curve) and **TAPP** (transabdominal preperitoneal: easier orientation, more bowel injury, port-site hernias and adhesions). The preperitoneal spaces are the **space of Retzius** (prevesical) and the **space of Bogros** (lateral). **Stoppa (giant prosthetic reinforcement of the visceral sac)**: open preperitoneal mesh for complex bilateral or recurrent hernias.
- **Laparoscopic danger areas**: **triangle of doom** (vas deferens medially, gonadal vessels laterally): the **external iliac artery and vein**; no tacks. **Triangle of pain** (gonadal vessels medially, **iliopubic tract** above): **lateral femoral cutaneous nerve, femoral branch of the genitofemoral nerve and femoral nerve**; tacks below the iliopubic tract cause numbness or burning of the anterolateral thigh (meralgia paraesthetica). **Corona mortis**: a vascular connection between the obturator and the external iliac or inferior epigastric vessels over Cooper's ligament, a bleeding hazard in femoral and laparoscopic repair.
- **Nerve injury**: in **open repair the ilioinguinal nerve** (numbness of the base of the penis, scrotum or labia and upper medial thigh) is commonest, with the iliohypogastric and genital branch of the genitofemoral; in **laparoscopic repair the lateral femoral cutaneous nerve**.
- **Femoral hernia approaches**: **low (Lockwood, infrainguinal)** for elective repair in thin patients; **inguinal (Lotheissen)** through the posterior wall of the canal; **high (McEvedy, extraperitoneal)** for strangulation, giving room to resect bowel; laparoscopic TEP or TAPP for elective repair. Plug or mesh repair; bowel viability checked.
- **Complications**: **chronic postherniorrhaphy pain (over 3 months; about 10%, severe in 2 to 4%) is the commonest long-term complication**, now more frequent than recurrence; **recurrence about 1 to 4% after mesh repair** (10% or more after some tissue repairs); seroma (commonest early, especially after laparoscopy); haematoma; **ischaemic orchitis and testicular atrophy** from thrombosis of the pampiniform plexus (avoid dissecting a scrotal sac distally); mesh infection; vas injury.

Breast

Benign breast disease

- **Fibroadenoma**: commonest benign tumour and **commonest lump at 15 to 25 years**; smooth, rubbery, highly mobile ("breast mouse"); triple assessment; leave if small and confirmed by core biopsy; **excise if over about 3 cm, growing, symptomatic, or atypical on biopsy**. An involuting fibroadenoma in an older woman calcifies coarsely (**"popcorn" calcification** on mammography). Giant fibroadenoma over 5 cm; juvenile fibroadenoma in adolescents.
- **Fibrocystic change (aberrations of normal development and involution, ANDI)**: the commonest benign condition overall, cyclical pain and nodularity at 25 to 50. **Breast cysts**: commonest at 35 to 50 (perimenopausal); aspirate; a bloody aspirate, a residual lump or recurrence needs biopsy.
- **Phyllodes tumour**: fibroepithelial with **leaf-like stromal overgrowth**, older than fibroadenoma (40s), rapid growth, large smooth lump with stretched shiny skin and dilated veins (no ulceration usually); benign, borderline or malignant by stromal features; **core biopsy, not FNAC**; **exam answer: wide local excision with a margin of at least 1 cm** (not enucleation, which recurs); current practice (NCCN 2024): a 1 cm margin for borderline and malignant tumours, while a benign phyllodes excised with a negative but narrower margin need not be re-excised. **Spreads by blood (lung), not to nodes, so no axillary surgery.**
- **Nipple discharge**: **bloody discharge from a single duct: intraductal papilloma is the commonest cause** (aged 35 to 50; a solitary papilloma in a large duct beneath the areola); ductography or ultrasound; **microdochectomy** (single duct excision). Over 50, or with a lump, carcinoma must be excluded first. **Duct ectasia**: older, multiple ducts, green, brown or cheesy discharge, **slit-like nipple retraction**; **total duct excision (Hadfield's)** if troublesome. **Milky bilateral (galactorrhoea): prolactin** (prolactinoma, drugs such as antipsychotics and metoclopramide, hypothyroidism).
- **Periductal mastitis**: young **smokers** (smoking damages the ducts), subareolar abscess and **mammary duct fistula** (Zuska's disease); excise the duct and fistula. **Lactational breast abscess**: Staphylococcus aureus; **ultrasound-guided needle aspiration (repeated) with antibiotics (flucloxacillin)**, incision only for skin necrosis; **continue breastfeeding** or expressing from that side.
- **Fat necrosis**: after trauma, surgery or radiotherapy; a hard irregular lump that can mimic cancer clinically and on mammography (oil cysts); confirm by biopsy. **Mondor's disease**: thrombophlebitis of a superficial chest wall vein (thoracoepigastric), a tender cord; self-limiting.
- **Gynaecomastia**: physiological (neonatal, pubertal, old age), drugs (**spironolactone**, digoxin, cimetidine, anabolic steroids, finasteride, antiandrogens), cirrhosis, hypogonadism (Klinefelter's), testicular tumours (hCG), hyperthyroidism; Simon grading; treat the cause, tamoxifen for painful recent onset, liposuction or subcutaneous mastectomy (Webster) when long-standing.

Breast cancer: risk, pathology, prognosis

- The commonest cancer in women worldwide (GLOBOCAN 2022). Risk factors: **BRCA1 (17q; triple-negative and medullary-pattern tumours, ovarian cancer)** and **BRCA2 (13q; male breast cancer, prostate, pancreas)**, TP53 (Li-Fraumeni), PTEN (Cowden), PALB2, **CDH1 (lobular cancer)**; early menarche, late menopause, nulliparity, first birth after 30, not breastfeeding, obesity after menopause, alcohol, combined HRT, chest radiation (Hodgkin's), atypical hyperplasia, LCIS. Commonest site: **upper outer quadrant** (most tissue).
- **Pathology (WHO 5th edition, 2019)**: **invasive carcinoma of no special type (ductal) is commonest** (about 75%); **invasive lobular second** (about 10 to 15%; **E-cadherin loss**, single-file cells, often multifocal and bilateral; spreads to **peritoneum, GI tract, ovaries, meninges and bone marrow**); "medullary carcinoma" is now classed as NST with medullary pattern (BRCA1, lymphocytes, good outcome for its grade); tubular, mucinous (colloid) and cribriform types have the best outlook. **Inflammatory breast cancer**: dermal lymphatic tumour emboli, peau d'orange, erythema over a third of the breast, **T4d**, the most aggressive, mimics mastitis; neoadjuvant chemotherapy then modified radical mastectomy (no breast conservation or sentinel node).

- **DCIS**: often found as **clustered microcalcifications** on screening; comedo (high-grade, necrosis) type worse; treated by wide excision with a **2 mm margin** plus radiotherapy, or mastectomy for extensive disease; endocrine therapy for ER-positive. **Van Nuys Prognostic Index (USC/VNPI)** scores four factors 1 to 3 each: **size, margin width, pathological grade (nuclear grade and necrosis) and age**: total **4 to 6 excision alone, 7 to 9 excision plus radiotherapy, 10 to 12 mastectomy**. **LCIS** is a risk marker (both breasts), except the pleomorphic type, which is excised.
- **Paget's disease of the nipple**: unilateral, eczema-like scaling, crusting and erosion **starting on the nipple** (eczema starts on the areola and is often bilateral), not healing with steroids, from an **underlying DCIS or invasive carcinoma**; biopsy shows large pale **Paget cells** (CK7 positive) in the epidermis; mammography for the underlying tumour.
- **Triple assessment: clinical examination, imaging and needle biopsy**. **Imaging: ultrasound first under 35 to 40 years** (dense breasts; for a 25-year-old with a lump, ultrasound), **mammography (with ultrasound) from 35 to 40**; MRI for lobular cancer, implants, BRCA carriers, occult primary. **Core needle biopsy is preferred to FNAC** (distinguishes invasive from in situ, gives receptors). **BI-RADS**: 0 incomplete; 1 negative; 2 benign; 3 probably benign (short-interval follow-up); **4 suspicious (biopsy)**; 5 highly suggestive (95% or more); **6 known biopsy-proven cancer**.
- **Prognosis**: TNM stage most important; **axillary node status is the best single prognostic factor** in operable disease; then size, grade, lymphovascular invasion, receptors. **Nottingham Prognostic Index = 0.2 × size (cm) + node stage (1 to 3) + grade (1 to 3)**; under 3.4 good. **Molecular subtypes**: luminal A (ER+, PR+, HER2−, low Ki-67; best), luminal B, HER2-enriched, **triple-negative/basal-like (worst, young, BRCA1)**. Gene expression tests (**Oncotype DX 21-gene recurrence score**, TAILORx 2018 and RxPONDER 2021; MammaPrint) decide adjuvant chemotherapy in ER-positive HER2-negative disease.
- **HER2** by immunohistochemistry (ASCO/CAP 2018, reaffirmed 2023): **0 and 1+ negative; 2+ equivocal, so reflex in situ hybridisation (FISH or bright-field ISH)**; 3+ positive. HER2-positive: **trastuzumab with pertuzumab** and chemotherapy, trastuzumab emtansine (T-DM1) for residual disease (KATHERINE, 2019). **HER2-low (IHC 1+, or 2+ with negative ISH): trastuzumab deruxtecan in metastatic disease** (DESTINY-Breast04, 2022; HER2-ultralow added in 2024).
- **Endocrine therapy for ER/PR-positive disease** (5 to 10 years): **tamoxifen** (SERM) in premenopausal women (raises endometrial cancer and thromboembolism risk; protects bone after menopause). **Fulvestrant is a selective oestrogen receptor degrader (SERD)**, not a SERM: it binds the receptor and has it degraded, with no partial agonist effect; given intramuscularly in advanced disease, often with a CDK4/6 inhibitor (oral SERDs such as elacestrant for ESR1-mutant disease, 2023). **Aromatase inhibitors (anastrozole, letrozole, exemestane) in postmenopausal women**, because oestrogen then comes **mainly from aromatisation of adrenal androgens in fat** (the ovaries have stopped); in premenopausal women the ovary is the main source and an inhibitor alone causes rebound gonadotrophin stimulation, so it is given only **with ovarian suppression** (GnRH agonist; SOFT and TEXT trials). AIs cause bone loss and arthralgia. **CDK4/6 inhibitors** (palbociclib, ribociclib, abemaciclib) with endocrine therapy in advanced disease and, now, **adjuvant abemaciclib (monarchE) and ribociclib (NATALEE)** for high-risk early disease. **Olaparib** for BRCA carriers (adjuvant, OlympiA 2021). **Triple-negative: neoadjuvant chemotherapy with pembrolizumab** (KEYNOTE-522, 2020).

Surgery and follow-up

- **Breast-conserving surgery (wide local excision) plus whole-breast radiotherapy gives the same survival as mastectomy** (NSABP B-06, Milan trials) for suitable tumours: small relative to the breast, unifocal, clear margins achievable, radiotherapy possible (not in the first or second trimester, not after previous chest radiotherapy, not with diffuse malignant calcification or inflammatory cancer). **Margin for invasive cancer: "no ink on tumour"** (SSO-ASTRO 2014); for DCIS, 2 mm. Neoadjuvant chemotherapy can downsize a tumour to allow conservation.
- **Axilla**: **sentinel node biopsy** (blue dye such as patent blue or isosulfan blue, with technetium-99m labelled colloid; indocyanine green or magnetic tracers as alternatives) for **clinically node-negative** disease; **axillary clearance** for proven nodal disease, but omitted in women with **one or two positive sentinel nodes having breast conservation with whole-breast radiotherapy (ACOSOG Z0011, 2011)**; **axillary radiotherapy is an alternative to clearance (AMAROS)**; SENOMAC and SOUND (2023) extend de-escalation.
- **Mastectomy types**: simple (total) mastectomy; **modified radical mastectomy**: breast plus axillary clearance, **preserving pectoralis major**: **Patey removes pectoralis minor** (giving access to level III nodes), **Scanlon divides it**, **Auchincloss preserves it** (levels I and II only); **Halsted radical** also removes pectoralis major and minor (obsolete); skin-sparing and nipple-sparing mastectomy with immediate reconstruction (implant, **latissimus dorsi flap**, **pedicled TRAM** or free **DIEP flap**).
- **Axillary levels** in relation to **pectoralis minor**: **level I lateral (below)**, **level II behind** (with the **interpectoral Rotter's nodes**, between pectoralis major and minor), **level III medial** (apical, infraclavicular). Internal mammary nodes lie along the internal thoracic vessels behind the costal cartilages and drain the medial breast.
- **Complications**: **seroma (commonest)**; **winged scapula from the long thoracic nerve (of Bell; C5 to C7) to serratus anterior**; weak arm adduction and medial rotation from the thoracodorsal nerve (latissimus dorsi); **numbness of the upper inner arm from the intercostobrachial nerve** (often divided); **lymphoedema** (after clearance about 15 to 20%, after sentinel biopsy about 5%; also after radiotherapy); **Stewart-Treves lymphangiosarcoma** in long-standing lymphoedema.
- **Screening**: **USPSTF 2024: mammography every 2 years from 40 to 74**; UK NHS: every 3 years from 50 to 71; high-risk (BRCA) women add annual MRI from about 30.
- **Metastases**: **bone commonest** (lytic; hypercalcaemia), then lung, liver, brain. **Male breast cancer**: about 1% of cases, older men, **BRCA2**, Klinefelter's syndrome, oestrogen exposure; usually ER-positive; mastectomy and tamoxifen.

Thyroid and endocrine surgery

Thyroid nodules and carcinoma

Type	Key points
Papillary (commonest, about 80 to 85%)	**Orphan Annie eye (ground-glass, optically clear) nuclei**, nuclear grooves, pseudoinclusions, **psammoma bodies**; **lymphatic spread** (neck nodes, "lateral aberrant thyroid"); best prognosis; **radiation exposure** (Chernobyl), **BRAF V600E** (commonest), RET/PTC fusions; adolescents and young women
Follicular (about 10%)	**haematogenous spread to bone and lung**; malignancy shown only by **capsular or vascular invasion on histology**, so **FNAC cannot tell it from adenoma**; RAS mutations, PAX8-PPARG; iodine-deficient areas; thyroglobulin as marker
Oncocytic (Hürthle cell) carcinoma	made a **separate entity from follicular carcinoma in the WHO 5th edition (2022)**; poorer radioiodine uptake; Hürthle (oncocytic) cells are also seen in Hashimoto's
Medullary (3 to 5%)	**parafollicular C cells, calcitonin** (and **CEA**) as markers, amyloid stroma (procalcitonin), sporadic (75%) or familial (**MEN 2, RET** proto-oncogene); does not take up iodine; **total thyroidectomy with central neck dissection**; screen for phaeochromocytoma first; **selpercatinib or pralsetinib (RET inhibitors)** for advanced disease
Anaplastic (1 to 2%; the least common of the main types)	elderly, rapid hard growth, airway compression, **worst prognosis** (median survival months); no radioiodine; **BRAF V600E-mutant tumours respond to dabrafenib with trametinib**
Lymphoma	older women with **Hashimoto's thyroiditis**, rapidly enlarging goitre; MALT or diffuse large B-cell; chemotherapy, not surgery

- **NIFTP** (non-invasive follicular thyroid neoplasm with papillary-like nuclear features, 2016): the former encapsulated non-invasive follicular variant of papillary carcinoma, renamed as a low-risk neoplasm treated by lobectomy alone.
- **Evaluation of a nodule**: TSH first (low TSH: radionuclide scan, a hot nodule is rarely malignant); **ultrasound with a risk score (ATA pattern or ACR TI-RADS)** decides which nodules need **FNAC** (generally solid nodules of 1 cm or more with suspicious features). Suspicious features: hypoechoic, microcalcification, irregular margins, taller than wide, extrathyroidal extension.
- **Bethesda System for Reporting Thyroid Cytopathology (3rd edition, 2023)** with the approximate risk of malignancy: **I non-diagnostic (repeat FNAC with ultrasound)**; **II benign (about 4%; follow up)**; **III atypia of undetermined significance** (the 2023 edition dropped "follicular lesion of undetermined significance"; about 22%; repeat FNAC or molecular testing); **IV follicular neoplasm (about 30%; diagnostic lobectomy or molecular testing)**; **V suspicious for malignancy (about 74%)**; **VI malignant (about 97%)**. The UK **Thy** system runs Thy1 non-diagnostic, Thy2 benign, Thy3a atypia, Thy3f follicular lesion, Thy4 suspicious, **Thy5 malignant**.
- **A solitary nodule with FNAC "follicular neoplasm" and normal TSH: diagnostic hemithyroidectomy (lobectomy)** for histology; an adenoma needs nothing more; a carcinoma may need **completion thyroidectomy and radioiodine**. Molecular tests (ThyroSeq, Afirma) can spare surgery for Bethesda III and IV nodules where available.
- **Treatment of differentiated cancer (ATA 2015)**: **papillary microcarcinoma under 1 cm without nodes or extension: active surveillance or lobectomy**; **1 to 4 cm low-risk: lobectomy or total thyroidectomy**; **over 4 cm, extrathyroidal extension, nodal or distant spread: total thyroidectomy** with therapeutic neck dissection, then **radioiodine** (I-131) for intermediate and high risk, **TSH suppression** with levothyroxine by risk, and **serum thyroglobulin with ultrasound** for follow-up after total thyroidectomy. Radioiodine-refractory disease: lenvatinib or sorafenib; RET or NTRK fusions: targeted drugs. Prognostic scores: AMES, AGES, MACIS.

Benign thyroid disease and thyroidectomy

- **Hashimoto's thyroiditis** (**struma lymphomatosa**): autoimmune, women, **anti-TPO** and anti-thyroglobulin antibodies; firm diffuse rubbery goitre; lymphoid follicles with germinal centres and **Hürthle cells**; **commonest cause of hypothyroidism where iodine intake is sufficient** (iodine deficiency is the commonest cause worldwide); risk of **primary thyroid lymphoma**. **Subacute (de Quervain's) granulomatous thyroiditis**: post-viral, **painful tender gland**, fever, high ESR, transient thyrotoxicosis with **low radioiodine uptake**, giant cells; NSAIDs or steroids. **Riedel's thyroiditis**: **woody hard** fibrosis extending beyond the capsule into neck structures, part of **IgG4-related disease** (with retroperitoneal fibrosis, sclerosing cholangitis); mimics anaplastic cancer.
- **Graves' disease**: TSH receptor stimulating antibodies; diffuse goitre with bruit, eye disease, pretibial myxoedema. Options: carbimazole or methimazole (agranulocytosis; **propylthiouracil in the first trimester**), radioiodine (avoid in pregnancy and in active eye disease), surgery. **Surgery: total thyroidectomy** (ATA 2016; subtotal thyroidectomy is the older operation) for a large goitre, suspicious nodule, significant eye disease, pregnancy-planning or failure of drugs. **Preparation**: antithyroid drugs to euthyroid, beta-blocker, and **potassium iodide (Lugol's iodine) for about 7 to 10 days before surgery to reduce gland vascularity**. **Subtotal thyroidectomy** leaves a remnant of about **4 to 8 g** (the posterior part of each lobe), protecting the parathyroids and recurrent laryngeal nerves; its drawback is recurrent thyrotoxicosis.
- **Toxic multinodular goitre (Plummer's disease)** and toxic adenoma (hot nodule): radioiodine or surgery. **Retrosternal goitre**: tracheal compression, **Pemberton's sign** (facial plethora on raising both arms); mostly removed through a cervical incision.
- **Thyroid storm**: fever, tachycardia, agitation after surgery or stress in a poorly prepared patient: **propylthiouracil** (blocks peripheral T4 to T3 conversion), then iodine at least 1 hour later, **propranolol**, hydrocortisone, cooling and supportive care.
- **Thyroglossal cyst**: the commonest congenital midline neck swelling, **moves upward on swallowing and on protruding the tongue**; a **thyroglossal fistula is never congenital: it is acquired**, after an infected cyst bursts or is incised, or after incomplete excision (a branchial fistula, by contrast, is congenital); **Sistrunk's operation**: excision of the cyst and tract **with the central part of the body of the hyoid bone** (simple excision recurs). Confirm normal thyroid tissue elsewhere (ultrasound) first; a **lingual thyroid** may be the only thyroid tissue. Papillary carcinoma can arise in it.

- **Indications for thyroidectomy**: malignancy or suspicion of it, compression (airway, oesophagus), thyrotoxicosis, cosmetic goitre.

Complications of thyroidectomy

- **Haemorrhage (within hours)**: tense swelling, stridor, from compression of veins and **laryngeal oedema**; **open the wound at the bedside immediately (cut the skin and the strap muscle sutures) and evacuate the clot**, then return to theatre; never wait for imaging (the "SCOOP" steps: skin exposure, cut sutures, open skin, open muscles, pack).
- **Hypocalcaemia** (parathyroid injury or devascularisation; usually day 2 to 5): perioral and fingertip tingling, carpopedal spasm, **Chvostek's sign** (facial twitch on tapping the facial nerve) and **Trousseau's sign** (carpal spasm with a cuff inflated above systolic), prolonged QT, laryngospasm and seizures. **Treat symptomatic patients with intravenous 10% calcium gluconate (10 to 20 mL over 10 minutes, then an infusion)**, then oral calcium and **calcitriol**; a low PTH a few hours after surgery predicts it, allowing early calcium. **Hungry bone syndrome** after parathyroidectomy for severe disease. Reimplant a devascularised parathyroid in the sternomastoid.
- **Recurrent laryngeal nerve**: runs in the **tracheo-oesophageal groove**, closely related to the **inferior thyroid artery** and **Berry's ligament**; a **non-recurrent right laryngeal nerve** occurs with an aberrant right subclavian artery (arteria lusoria). **Unilateral injury: hoarse, weak, breathy voice; bilateral: both cords in the paramedian position, stridor and airway obstruction** after extubation, needing reintubation or tracheostomy. Identify the nerve; intraoperative nerve monitoring helps.
- **External branch of the superior laryngeal nerve** (supplies **cricothyroid**, which tenses the cords): **loss of high-pitched notes, voice fatigue** (important for singers); runs close to the **superior thyroid artery** (Cernea types), so ligate that artery's branches close to the gland. Internal branch (sensory above the cords) injury gives aspiration.
- Others: thyroid storm, **hypothyroidism (lifelong levothyroxine after total thyroidectomy)**, tracheomalacia (rare), wound infection, keloid.

Parathyroid and adrenal

- **Primary hyperparathyroidism**: commonest cause of hypercalcaemia in outpatients (malignancy in inpatients); **solitary adenoma (80 to 85%)**, multigland hyperplasia (10 to 15%; **MEN 1 and MEN 2A**), multiple adenomas (about 5%), **carcinoma (under 1%)**. "Bones, stones, abdominal groans and psychic moans"; most are now asymptomatic. **Localisation: ultrasound with sestamibi scan**, or 4D-CT, or choline PET, before **focused (minimally invasive) parathyroidectomy**, confirmed by **intraoperative PTH falling by more than 50% at 10 minutes** (Miami criterion); bilateral exploration if not localised. **Surgery in asymptomatic disease (Fifth International Workshop, 2022)**: serum calcium **more than 1 mg/dL (0.25 mmol/L) above the upper limit**; **age under 50**; **osteoporosis (T-score −2.5 or less) or vertebral fracture**; **eGFR under 60**; **kidney stones or nephrocalcinosis**, or hypercalciuria (over 250 mg/day in women, 300 in men). **Secondary hyperparathyroidism** (chronic kidney disease, vitamin D deficiency: low or normal calcium) is medical (cinacalcet, vitamin D analogues); **tertiary** (autonomous glands after long secondary disease, often after transplant; high calcium) needs subtotal or total parathyroidectomy with autotransplantation.
- **Phaeochromocytoma**: adrenal medulla; extra-adrenal tumours are **paragangliomas** (organ of Zuckerkandl). The old "**rule of 10s**" is out of date: **about 30 to 40% have a germline mutation** (RET, VHL, NF1, SDHx), so all are offered genetic testing. Episodic headache, sweating, palpitations, hypertension. **Diagnosis: plasma free or urinary fractionated metanephrines**; then CT or MRI (bright on T2); functional imaging with **Ga-68 DOTATATE PET or MIBG** for extra-adrenal or metastatic disease. **Preparation: alpha blockade first (phenoxybenzamine, or doxazosin) for 10 to 14 days with a high-salt diet and fluids to re-expand volume, then a beta-blocker for tachycardia**, never a beta-blocker alone (unopposed alpha vasoconstriction, hypertensive crisis); then **laparoscopic adrenalectomy**; hypotension and hypoglycaemia follow removal.
- **Adrenal incidentaloma**: test every one for phaeochromocytoma (metanephrines), cortisol excess (1 mg dexamethasone suppression test) and, if hypertensive, aldosterone (aldosterone to renin ratio); **benign if under 10 Hounsfield units on unenhanced CT** (lipid-rich adenoma); **resect if functional or suspicious on imaging**; size over 4 cm is the classic exam threshold (ESE 2023 guidance weighs imaging features over size). **Conn's syndrome**: hypertension, hypokalaemia; adrenal vein sampling to tell adenoma (adrenalectomy) from bilateral hyperplasia (spironolactone).
- **MEN syndromes**:

Syndrome	Gene	Features
MEN 1 (Wermer)	**MEN1 (menin), 11q13**	**parathyroid hyperplasia (commonest, about 95%), pancreatic and duodenal neuroendocrine tumours (gastrinoma commonest functional), pituitary adenoma (prolactinoma commonest)**
MEN 2A (Sipple)	**RET, codon 634 commonest**	**medullary thyroid carcinoma (nearly all), phaeochromocytoma (about 50%, often bilateral), parathyroid hyperplasia**; cutaneous lichen amyloidosis, Hirschsprung's disease
MEN 2B	**RET M918T**	**medullary carcinoma (earliest and most aggressive)**, phaeochromocytoma, **mucosal neuromas (lips, tongue, eyelids), intestinal ganglioneuromatosis, marfanoid habitus; no parathyroid disease**

- **Prophylactic thyroidectomy by RET risk (ATA 2015): highest risk (M918T, MEN 2B): in the first year of life**; **high risk (codon 634 and A883F): at or before 5 years**, guided by calcitonin; moderate risk: when calcitonin rises.
- Neurofibromatosis type 1 (NF1, 17q): neurofibromas (the commonest tumour), café-au-lait spots, axillary freckling, Lisch nodules, optic glioma; phaeochromocytoma, GIST, malignant peripheral nerve sheath tumour.

Salivary glands and the facial nerve

- **Facial nerve in the parotid**: emerges at the **stylomastoid foramen**, found at surgery by the **tragal pointer** (about 1 cm deep and inferior), the posterior belly of digastric and the tympanomastoid suture; divides at the pes anserinus into **temporal, zygomatic, buccal, marginal mandibular and cervical** branches. **Marginal mandibular injury** (it runs along the lower border of the mandible): **drooping of the angle of the mouth and lower lip** with eye closure and forehead intact. The **great auricular nerve** is sensory (ear lobe numbness after parotidectomy).
- **Parotid tumours**: about 80% of salivary tumours arise in the parotid, and about 80% of parotid tumours are benign ("rule of 80s"); the smaller the gland, the likelier a tumour is

malignant (sublingual and minor glands mostly malignant). **Pleomorphic adenoma**: commonest salivary tumour, mixed epithelial and chondromyxoid stroma, **incomplete capsule with pseudopods**, so **superficial parotidectomy (or extracapsular dissection) with a margin, never enucleation** (recurrence, often multinodular); carcinoma ex pleomorphic adenoma after many years. **Warthin's tumour** (adenolymphoma): **older men, smokers, often bilateral and multifocal**, parotid tail, **hot on technetium-99m pertechnetate scan**. **Mucoepidermoid carcinoma: commonest malignant salivary tumour** (parotid; also the commonest in children). **Adenoid cystic carcinoma**: commonest malignant tumour of the submandibular and minor salivary glands (palate); **perineural spread** (see Surgical oncology).

- **Frey's syndrome** after parotidectomy: **gustatory sweating** and flushing of the cheek, from regrowth of the **auriculotemporal nerve's** parasympathetic secretomotor fibres into sweat glands; starch-iodine (Minor's) test; botulinum toxin. Submandibular gland excision risks the marginal mandibular, lingual and hypoglossal nerves. Salivary stones: **submandibular commonest (about 80%)** (alkaline, mucous, upward flow in Wharton's duct).

Pituitary and other endocrine conditions

- **Acromegaly** (growth hormone excess, almost always from a somatotroph adenoma of the pituitary; gigantism if before epiphyseal fusion): coarse features, large hands and feet, prognathism, carpal tunnel syndrome, hypertension, diabetes, sleep apnoea, cardiomyopathy and colon polyps. **Screen with serum IGF-1 (raised); confirm with an oral glucose tolerance test: growth hormone fails to fall below 1 µg/L** (the normal glucose load suppresses GH by feedback; the adenoma is autonomous, and GH may even rise). **MRI of the pituitary**. **Treatment: transsphenoidal surgery first** (cures most microadenomas); **somatostatin analogues (octreotide, lanreotide, pasireotide)**, the dopamine agonist cabergoline and the **GH-receptor antagonist pegvisomant** for residual disease; radiotherapy last. Visual field loss (bitemporal hemianopia) comes from the chiasm.
- **Prolactinoma** is the commonest functioning pituitary adenoma: **cabergoline** is first-line, surgery for resistance. **Cushing's disease**: ACTH-secreting adenoma, transsphenoidal surgery.
- **Hypocalcaemia and tetany** after thyroidectomy: perioral numbness and paraesthesia first, then **carpopedal spasm, Chvostek's and Trousseau's signs**, prolonged QT; give **intravenous calcium gluconate** (10 mL of 10%) for symptoms, then oral calcium and calcitriol; usually hypoparathyroidism from gland devascularisation (see complications above).

Urology

Stones

- **Investigation of choice for suspected ureteric colic: non-contrast CT of the kidneys, ureters and bladder (CT KUB)**, low-dose; it shows almost all stones (including radiolucent uric acid), their size and site, and other causes of pain. **Ultrasound first in pregnancy and children**; a plain KUB film misses radiolucent and small stones; intravenous urography is obsolete. Colic from the upper ureter is referred to the loin and groin; from the lower ureter to the testis or labium through the **genitofemoral nerve (L1, L2)**.
- **Composition**: **calcium oxalate is the commonest stone** (monohydrate hard, "jackstone" or dumb-bell; dihydrate envelope-shaped crystals), radio-opaque; calcium phosphate; **uric acid**: **radiolucent**, forms in **acid urine** (gout, myeloproliferative disease, chemotherapy), dissolved by **alkalinising the urine to pH 6.5 to 7 with potassium citrate**, plus allopurinol; **cystine**: autosomal recessive cystinuria (defective tubular reabsorption of cystine, ornithine, lysine, arginine), **hexagonal ("benzene ring") crystals**, positive cyanide-nitroprusside test, faintly radio-opaque ("ground glass"), very hard, **resistant to ESWL**; treat with fluids, alkalinisation, tiopronin or penicillamine. **Struvite (triple phosphate: magnesium ammonium phosphate)**: forms in **alkaline urine with urease-producing bacteria (Proteus, Klebsiella, Pseudomonas; not E. coli)**, **"coffin-lid" crystals**, the usual **staghorn calculus**; women more often.
- **Staghorn calculus**: **PCNL is the first-line treatment** (EAU guideline), with ESWL or flexible ureteroscopy for residual fragments ("sandwich" therapy), and complete stone clearance plus eradication of infection, since residual fragments regrow. Untreated, it destroys the kidney (xanthogranulomatous pyelonephritis, below).
- **Renal stones by size (EAU 2024)**: **under 1 cm: ESWL or flexible ureteroscopy (RIRS)**; **1 to 2 cm: ESWL or endourology** (lower-pole stones over 1 cm do poorly with ESWL); **over 2 cm: percutaneous nephrolithotomy (PCNL)** first. Open pyelolithotomy is rarely needed. PCNL is contraindicated with **untreated UTI, uncorrected coagulopathy and pregnancy**; a supracostal (11th intercostal space) puncture risks **hydrothorax**. ESWL: contraindicated in pregnancy, bleeding disorders, untreated UTI, obstruction below the stone and aortic aneurysm near the stone; complication **steinstrasse** ("street of stones" in the ureter).
- **Ureteric stones**: under 5 mm usually pass (about 70 to 80%); **medical expulsive therapy with an alpha-blocker (tamsulosin) for distal stones over 5 mm** (up to 10 mm); **ureteroscopy with laser (holmium or thulium) lithotripsy** for larger stones, failure of passage or unremitting pain; ESWL for proximal stones. NSAIDs are the first-line analgesic for colic.
- **Infected obstructed kidney** (fever with an obstructing stone; pyonephrosis): a urological emergency; **urgent decompression by percutaneous nephrostomy or a retrograde ureteric (JJ) stent**, because **antibiotics cannot sterilise an obstructed system** and septic shock follows; definitive stone treatment waits until the infection has settled.
- **Emphysematous pyelonephritis**: gas in the renal parenchyma, almost always in **diabetics** (or an obstructed kidney), **E. coli** most often, then Klebsiella; septic shock; CT diagnoses (Huang-Tseng classes); resuscitation, antibiotics, glucose control, relief of obstruction and **percutaneous drainage**, with **nephrectomy** for extensive or failing cases. **Xanthogranulomatous pyelonephritis**: chronic obstruction by a **staghorn stone** with **Proteus** (or E. coli), an enlarged non-functioning kidney, **lipid-laden foamy macrophages**, the CT "bear paw" sign; **nephrectomy**; it can mimic renal cell carcinoma.
- **Metabolic work-up** for recurrent stones: serum calcium (hyperparathyroidism), urate, 24-hour urine (calcium, oxalate, citrate, urate, volume). Prevention: over 2.5 L of urine a day, normal calcium intake (low calcium diets raise oxalate absorption), less salt and animal protein; thiazides for hypercalciuria.

Urological trauma

- **Kidney**: commonest urological organ injured in trauma; haematuria; **contrast CT with delayed (excretory) phase** in the stable patient; AAST grades I to V; most are managed non-operatively, with angioembolisation for bleeding; exploration for an expanding or pulsatile haematoma or an unstable patient.
- **Bladder**: **extraperitoneal rupture is commoner** (about 60%; **pelvic fracture**, bony spicules; contrast streaks around the bladder base): **catheter drainage for about 2 weeks** (repair if it involves the bladder neck, or if the patient is having a laparotomy for other injuries). **Intraperitoneal rupture** (blow to a **full bladder**, the dome tears; contrast outlines bowel loops; urinary ascites and raised creatinine from reabsorption): **surgical repair**. Diagnosis by **CT or conventional cystogram** with the bladder adequately filled (at least 350 mL).
- **Anterior urethra: straddle injury** (fall astride a bar or beam) crushes the **bulbar urethra** against the pubic arch: perineal **butterfly haematoma**, blood at the meatus, retention; urine extravasating deep to **Colles' fascia** (when Buck's fascia is torn) spreads to the perineum, scrotum, penis and lower abdominal wall but **not the thighs** (Colles' fascia fuses with the fascia lata). Management: retrograde urethrogram; a partial tear may heal with a suprapubic catheter; a complete tear, suprapubic catheter and delayed repair (or early repair in selected cases).
- **Posterior urethra: pelvic fracture** tears the **membranous (prostatomembranous) urethra**: blood at the meatus, retention, a **high-riding or impalpable prostate** (Vermooten's sign); **retrograde urethrogram first, never a blind catheter**; **suprapubic catheter**, then delayed urethroplasty after about 3 months (or early endoscopic realignment). Complications: stricture, erectile dysfunction, incontinence.
- **Urethral stricture**: commonest causes now iatrogenic (catheters, instruments) and trauma; gonococcal strictures historically; bulbar urethra commonest site; urethrogram; optical urethrotomy for short bulbar strictures, urethroplasty for longer or recurrent.

Prostate

- **Zones (McNeal)**: **BPH arises in the transition zone** (periurethral), so it obstructs early; **carcinoma arises in the peripheral zone** (about 70%; the posterior part felt on rectal examination), so it often **presents late** and is felt as a hard nodule; the central zone holds the ejaculatory ducts.
- **BPH**: lower urinary tract symptoms scored by IPSS; rectal examination, urinalysis, PSA (after counselling), flow rate, post-void residual. Drugs: **alpha-blockers (tamsulosin; quick relief; floppy iris syndrome at cataract surgery)**; **5-alpha reductase inhibitors (finasteride, dutasteride; shrink the gland over months; halve the PSA)**, combined for large glands; tadalafil. Surgery for refractory symptoms, retention, recurrent infection, stones, bleeding or renal impairment: **TURP (the reference standard for glands of 30 to 80 mL)**, **holmium laser enucleation (HoLEP)** for any size, open or robotic simple prostatectomy for very large glands; minimally invasive options (Urolift, Rezum).
- **TURP syndrome**: **absorption of hypotonic irrigant (1.5% glycine, sorbitol or water) through opened venous sinuses**, causing **dilutional hyponatraemia**, fluid overload, confusion, seizures, bradycardia, hypotension and **visual disturbance (glycine is an inhibitory retinal neurotransmitter)**, hyperammonaemia; risk rises with resection time over 60 minutes and high irrigation pressure. Treat: stop, oxygen, diuretic for overload, **hypertonic saline for severe symptomatic hyponatraemia**. **Bipolar TURP with saline irrigation avoids it.** Commonest long-term effect of TURP: **retrograde ejaculation**. Landmarks: **resection stops proximal to the verumontanum** (just above the external sphincter, protecting continence); the bladder neck and ureteric orifices mark the proximal limit. An enlarged **median lobe** projects into the bladder and acts as a ball valve, causing retention.
- **Prostate cancer**: adenocarcinoma, older men; **PSA** is organ-specific, not cancer-specific (raised by BPH, prostatitis, retention, catheterisation, biopsy, ejaculation; a rectal examination barely changes it); total PSA normal roughly 0 to 4 ng/mL, with age-specific ranges, PSA density and free-to-total ratio. **Multiparametric MRI before biopsy is now standard** (PRECISION, 2018; **PI-RADS** 1 to 5), then targeted plus systematic biopsy, **transperineal** route preferred (fewer infections). **Gleason score** (sum of the two commonest patterns) is reported as **ISUP grade groups 1 to 5** (group 1 = Gleason 6). **PSMA PET** for staging and recurrence.
- **Spread**: lymphatic first to the **obturator** (and internal iliac) nodes; blood and **Batson's vertebral venous plexus to the lumbar spine, pelvis and femur**, with **sclerotic (osteoblastic) metastases**; **alkaline phosphatase rises from osteoblastic activity**; bone scan or PSMA PET. **A man with sclerotic vertebral lesions: serum PSA** to find the primary (prostatic acid phosphatase is historical). Breast cancer metastases are mostly lytic; myeloma is lytic with Bence Jones protein. Posteriorly **Denonvilliers' fascia** (rectoprostatic septum) separates the prostate and seminal vesicles from the rectum: it delays posterior spread and gives the plane for radical prostatectomy and rectal excision.
- **Treatment**: low risk: **active surveillance**; localised intermediate and high risk: **radical prostatectomy (robotic) or radiotherapy with androgen deprivation**; metastatic: **androgen deprivation (GnRH agonist with an antiandrogen cover against the flare, GnRH antagonist degarelix or relugolix, or bilateral orchidectomy)** combined from the start with an **androgen receptor pathway inhibitor (abiraterone, enzalutamide, apalutamide, darolutamide)** and/or **docetaxel**; castration-resistant disease: **lutetium-177 PSMA-617** (VISION, 2021), **PARP inhibitors (olaparib)** for BRCA and other repair-gene mutations, radium-223 for bone-only disease. Prostatectomy side effects: incontinence, erectile dysfunction.

Scrotum and testis

- **Testicular torsion**: peaks in **neonates (extravaginal)** and **adolescents (intravaginal, bell-clapper deformity)**; sudden severe pain, vomiting, **high-riding, horizontally lying testis**, **absent cremasteric reflex**, **Prehn's sign negative** (elevation does not relieve the pain). **Urgent surgical exploration** without delaying for Doppler when the picture is typical; untwist, fix both testes (**bilateral orchidopexy**), remove a necrotic testis. Salvage about 90% within 6 hours, falling steeply after 12 to 24. **Torsion of the appendix testis (hydatid of Morgagni)**: younger boys, tender nodule at the upper pole, **"blue dot" sign**, managed conservatively. **Epididymo-orchitis**: gradual, fever, dysuria, pain eased on elevation (Prehn's positive), cremasteric reflex present; Chlamydia and gonorrhoea under 35, E. coli in older men; mumps orchitis after puberty.

- **Varicocele**: dilated **pampiniform plexus**, "bag of worms" that empties on lying down; **left-sided in about 90%**, because the **left testicular vein drains at a right angle into the left renal vein** (longer column, nutcracker compression between aorta and SMA, no valve); the right drains obliquely into the IVC. **A sudden left varicocele, or one that does not empty on lying, in an older man suggests renal cell carcinoma** with tumour thrombus in the left renal vein; an isolated right varicocele suggests a retroperitoneal mass or IVC obstruction. Treatment for pain, testicular atrophy in adolescents, or subfertility with abnormal semen: **microsurgical subinguinal varicocelectomy** or radiological embolisation.
- **Hydrocele**: transilluminates, the testis is not separately felt, one can get above it; primary (idiopathic) in adults, secondary to tumour, infection or trauma (scan the testis in young men); in children a **communicating hydrocele from a patent processus vaginalis** (most resolve by 1 to 2 years, otherwise herniotomy). **Filarial hydrocele** (Wuchereria bancrofti) in endemic areas: lymphatic filariasis is endemic in 64 of Nepal's districts, more in the Terai (WHO Nepal, 2026), now mostly past mass drug administration. Operations: **Lord's plication** for thin-walled sacs, **Jaboulay's eversion** (or excision) for large thick sacs. Epididymal cyst (spermatocele): above and behind the testis, separate from it.
- **Testicular tumours**: the **commonest solid malignancy of men aged 15 to 35**; **germ cell tumours (about 95%)**; risk factors **cryptorchidism** (raised risk in both testes, more in the undescended one), family history, previous tumour, Klinefelter's, germ cell neoplasia in situ. **Seminoma**: commonest, peak 30 to 40, **AFP always normal** (**a raised AFP means non-seminomatous elements**), hCG mildly raised in some, LDH and PLAP raised; **very radiosensitive and chemosensitive** (carboplatin or BEP). **Non-seminomatous germ cell tumours** (embryonal carcinoma, **yolk sac tumour: AFP, Schiller-Duval bodies, commonest in infants and young boys**, **choriocarcinoma: very high hCG, early blood spread**, teratoma), peak 20 to 30. **Lymphoma: commonest testicular tumour over 60**, often bilateral. **Lymphatic spread to the para-aortic (retroperitoneal) nodes at the renal hilum, not the inguinal nodes** (unless the scrotal skin is involved). **Never biopsy or aspirate through the scrotum** (it seeds the scrotal skin and inguinal nodes): ultrasound, markers (AFP, hCG, LDH; the "S" of TNM-S) taken before surgery, then **radical inguinal orchidectomy with high ligation of the cord at the deep ring**; CT chest, abdomen and pelvis for staging. Cure rates exceed 95% overall.
- **Penile fracture**: rupture of the **tunica albuginea** of the corpus cavernosum, usually during intercourse: a snap, immediate detumescence, swelling and bruising (**"aubergine" or eggplant deformity**); check for urethral injury (blood at the meatus, urethrogram or cystoscopy); **urgent surgical repair**, which preserves erectile function and avoids curvature better than conservative care. **Peyronie's disease**: fibrous plaque of the tunica albuginea, painful erection and curvature, associated with Dupuytren's contracture; stable disease: plication or grafting, collagenase injection.
- **Priapism**: **ischaemic (low-flow) priapism is an emergency** (painful, rigid, dark acidotic blood on aspiration; sickle cell disease, intracavernosal drugs, antipsychotics): **aspiration and intracavernosal phenylephrine**, then shunt surgery; non-ischaemic (high-flow, after perineal trauma, painless, bright red blood) is not urgent (embolisation if persistent).
- **Penile premalignant lesions**: **erythroplasia of Queyrat** (carcinoma in situ on the glans or prepuce: a velvety red plaque in an uncircumcised man; topical 5-fluorouracil or imiquimod, laser, excision); Bowen disease (the same on the keratinised shaft); **Buschke-Löwenstein tumour** (giant condyloma, verrucous); balanitis xerotica obliterans (lichen sclerosus) is white and sclerotic.
- **Carcinoma of the penis**: squamous cell carcinoma in **uncircumcised men with phimosis and poor hygiene**, HPV 16 and 18; **the glans is the commonest site**; spreads to the **inguinal nodes** (dynamic sentinel node biopsy for clinically node-negative T1b or higher); glans-sparing or partial penectomy with a small clear margin (modern practice accepts under 1 cm, rather than the old 2 cm), total penectomy with perineal urethrostomy for proximal tumours.

Kidney and bladder

- **Haematuria**: **painless visible haematuria in a smoker over about 40 is bladder cancer until proved otherwise**: **flexible cystoscopy** plus upper-tract imaging (**CT urography**); ultrasound alone does not exclude a bladder tumour. Painful haematuria suggests stone or infection.
- **Bladder cancer**: **urothelial (transitional cell) carcinoma** in over 90%; **smoking is the commonest risk factor**; also aromatic amines (aniline dyes, benzidine, beta-naphthylamine: rubber and dye workers), cyclophosphamide (acrolein), pioglitazone, pelvic radiation. **Squamous cell carcinoma with Schistosoma haematobium** (Egypt) and chronic catheters or stones; adenocarcinoma in the urachal remnant (dome). **Non-muscle-invasive (Ta, T1, CIS)**: **TURBT** (with detrusor muscle in the specimen; re-resection for T1), a single dose of intravesical chemotherapy (mitomycin) after resection, and **intravesical BCG** (induction and maintenance) for high-risk disease including CIS. **Muscle-invasive (T2 or more)**: **neoadjuvant cisplatin-based chemotherapy then radical cystectomy** with urinary diversion (ileal conduit, neobladder), or trimodal bladder-sparing therapy; metastatic: **enfortumab vedotin with pembrolizumab** is now first-line (EV-302, 2023).
- **Renal cell carcinoma**: from the proximal tubule; **clear cell type commonest (VHL gene, 3p loss)**, then papillary (MET in type 1) and chromophobe; risk factors smoking, obesity, hypertension, end-stage renal disease (acquired cystic disease), von Hippel-Lindau. The **classic triad of loin pain, mass and haematuria is late and seen in about 10%**; most are now found incidentally on imaging. Spreads into the **renal vein and IVC** (tumour thrombus) and by blood (**"cannonball" lung metastases**, bone: lytic). **Paraneoplastic**: polycythaemia (erythropoietin), hypercalcaemia (PTHrP), hypertension (renin), **Stauffer's syndrome** (reversible hepatic dysfunction without metastasis), fever. Treatment: **partial nephrectomy for small (T1) tumours**, radical nephrectomy for larger, ablation or surveillance for small tumours in the frail; **adjuvant pembrolizumab** for high-risk resected disease (KEYNOTE-564, 2021); metastatic: **immune checkpoint inhibitor combinations** (nivolumab with ipilimumab, or pembrolizumab with axitinib or lenvatinib); RCC is radio- and chemoresistant. **Angiomyolipoma**: fat-containing benign tumour, tuberous sclerosis; bleeds when over 4 cm (embolise). **Oncocytoma**: benign, central scar. **Wilms' tumour** in children: see Paediatric surgery.
- **Bosniak classification of renal cysts (version 2019, CT or MRI)**: **I simple (thin smooth wall, no septa, calcification or enhancement, water density): benign, no follow-up**; **II**

minimally complex (few thin septa, fine calcification, high-attenuation cyst under 3 cm): benign, no follow-up; **IIF: followed by imaging** (at 6 and 12 months, then yearly for 5 years); **III (thick or irregular enhancing wall or septa): about 50% malignant, surgery or surveillance**; **IV (enhancing soft-tissue nodule): about 90% malignant, surgery**. A simple cyst shown clearly on good ultrasound is treated as benign too.

- **Horseshoe kidney**: the commonest renal fusion anomaly; the lower poles joined by an isthmus that is **held low (about L3 to L4) by the inferior mesenteric artery**; malrotated, the ureters passing in front of the isthmus; pelviureteric obstruction, infection, stones, a higher Wilms' tumour risk; associated with **Turner syndrome**.
- **Duplex kidney and ectopic ureter**: in a duplex system, the **Weigert-Meyer rule**: the **upper-pole ureter opens lower and more medially** (ectopic, may end in a **ureterocele** and obstruct), the **lower-pole ureter opens higher and more laterally** (refluxes). **In girls an ectopic ureter can open below the sphincter (urethra, vestibule, vagina), giving continuous dribbling despite normal voiding**; in boys it always opens above the external sphincter (prostatic urethra, seminal vesicle, vas), so boys are never wet from it (they get infection or epididymitis instead). Diagnosis by ultrasound, MR urography, cystoscopy and vaginoscopy; upper-pole heminephrectomy or ureteric reimplantation.
- **Pelviureteric junction obstruction**: intrinsic narrowing or a crossing lower-pole vessel; loin pain after drinking (Dietl's crisis); **MAG3 diuretic renogram** shows obstruction and split function; **Anderson-Hynes dismembered pyeloplasty** (laparoscopic or robotic). **Renal function tests by isotope**: DMSA for scarring and split function, MAG3 or DTPA for drainage.
- Hypospadias, posterior urethral valves, vesicoureteric reflux and undescended testis: see Paediatric surgery.

Paraphimosis, vasectomy and other penile and scrotal points

- **Paraphimosis**: a tight foreskin retracted behind the glans cannot be returned; the constriction ring causes **venous then arterial obstruction, oedema and glans ischaemia**, an emergency. **Reduction: analgesia (penile block), compress the glans with a gloved hand or ice or sugar to reduce oedema, push the glans back while pulling the foreskin forward**; if it fails, **a dorsal slit** (puncture techniques also described) and later circumcision. Phimosis, by contrast, is a foreskin that cannot be retracted; physiological in boys until about 5 years.
- **Vasectomy**: bilateral division and ligation of the **vas deferens** through scrotal incisions or a no-scalpel technique; day-case under local anaesthesia. **Contraception is not immediate: needs a semen analysis at about 12 weeks (and after at least 20 ejaculations)** showing azoospermia (AUA 2012: 8 to 16 weeks); late failure about 1 in 2,000 after clearance (early failure about 1 in 200); no effect on erection or testosterone. **Reversal (vasovasostomy)**: success falls with the time since the vasectomy (patency about 97% and pregnancy about 76% within 3 years, falling to about 71% and 30% after 15 years: Vasovasostomy Study Group); epididymovasostomy when sperm are absent in the vas fluid. **Complications**: haematoma, infection, sperm granuloma, chronic scrotal pain.

Vascular surgery

Chronic limb ischaemia (peripheral arterial disease)

- Atherosclerosis is the cause in nearly all; risk factors **smoking (the strongest)**, diabetes, hypertension, dyslipidaemia, age, chronic kidney disease. The commonest site of occlusion is the **superficial femoral artery in the adductor (Hunter's) canal**, giving **calf claudication**; aortoiliac disease gives buttock and thigh claudication. **Leriche syndrome**: aortoiliac occlusion with **buttock claudication, erectile dysfunction and absent femoral pulses**.
- **Fontaine stages**: I asymptomatic; **II intermittent claudication** (IIa over 200 m, IIb under 200 m); **III ischaemic rest pain** (night pain in the forefoot, eased by hanging the leg down); **IV ulceration or gangrene**. **Rutherford categories** 0 to 6 (1 to 3 mild to severe claudication, 4 rest pain, 5 minor tissue loss, 6 major tissue loss). **Chronic limb-threatening ischaemia (CLTI)** (Global Vascular Guidelines 2019) is rest pain or tissue loss with objective ischaemia (ankle pressure under 50 mmHg, toe pressure under 30 mmHg, or ABPI under about 0.4); limb threat is staged by **WIfI** (wound, ischaemia, foot infection).
- **Examination**: pulses, **Buerger's test** (pallor on elevation; the angle at which the foot blanches, under 20 degrees in severe ischaemia; **reactive rubor (sunset foot) on dependency**), capillary refill, ulcers on the toes, heel and pressure points.
- **Ankle-brachial pressure index (ABPI) = highest ankle systolic pressure ÷ higher brachial systolic pressure** (AHA/ACC 2016; ESC 2024): **over 1.40 non-compressible (calcified) arteries**, typical of **diabetes and chronic kidney disease (medial calcific sclerosis, Mönckeberg's)**, so unreliable (some older texts use 1.3): use the **toe pressure or toe-brachial index (abnormal under 0.7)**, waveforms or duplex; **1.00 to 1.40 normal; 0.91 to 0.99 borderline; 0.90 or less diagnostic of PAD**; about 0.5 to 0.9 is typical of claudication; **under about 0.4 (or ankle pressure under 50 mmHg) critical (limb-threatening) ischaemia**. Compression bandaging for venous ulcers needs an ABPI of 0.8 or more.
- **Imaging**: **duplex ultrasound first**; CT angiography or MR angiography to plan intervention; digital subtraction angiography is the reference standard and allows treatment at the same sitting.
- **Treatment**: **best medical therapy for everyone: stop smoking, supervised exercise (the first treatment for claudication; walking to near-maximal pain for 30 to 60 minutes three times a week for 12 weeks), high-intensity statin, single antiplatelet (clopidogrel or aspirin)**, blood pressure and glucose control; **low-dose rivaroxaban 2.5 mg twice daily with aspirin** cuts major limb and cardiac events (COMPASS 2017; VOYAGER-PAD 2020 after revascularisation); **cilostazol** improves walking distance (not in heart failure). **Revascularisation** for disabling claudication despite this, and for CLTI: **endovascular angioplasty and stenting** (first for short aortoiliac and femoropopliteal lesions; TASC II classes A to D guide endovascular versus open) or **surgical bypass**: **infrainguinal, the autologous great saphenous vein (reversed or in situ) has the best patency** (endothelium, compliance), while **above the inguinal ligament prosthetic grafts (Dacron, PTFE) do well** (high flow, large calibre); prosthetic grafts below the knee do poorly; in CLTI with a good vein, bypass beat endovascular treatment (BEST-CLI, 2022); aortobifemoral bypass for extensive

aortoiliac disease. Amputation for unreconstructable CLTI or extensive gangrene.

- **Amputation levels**: as distal as will heal; **below-knee amputation** is preferred to above-knee when possible (far better walking with a prosthesis, lower energy cost); the ideal below-knee stump is about 12 to 15 cm below the tibial plateau with a long posterior myocutaneous flap (Burgess); Syme's (ankle disarticulation, keeps the heel pad) and ray amputations for distal disease. Wet gangrene: urgent guillotine amputation, then definitive closure.
- **Diabetic foot**: **neuropathic ulcers** (warm, painless, pulses present, under pressure points such as the metatarsal heads, punched out with callus) versus **ischaemic ulcers** (cold, painful, pulseless, toes and heel); mixed are common. Classification: **Wagner grades 0 to 5** (the exam classic; 0 at-risk foot, 1 superficial ulcer, 2 deep to tendon or bone, 3 abscess or osteomyelitis, 4 forefoot gangrene, 5 whole-foot gangrene); current practice uses **WIfI and SINBAD** (IWGDF 2023). Probe-to-bone test and MRI for osteomyelitis; offloading (total contact cast), debridement, antibiotics for infection, revascularisation. Charcot neuroarthropathy: warm swollen foot, immobilise.
- **Buerger's disease (thromboangiitis obliterans)**: **young men who smoke or chew tobacco** (common in South Asia, including bidi smokers); segmental inflammatory thrombosis of **small and medium arteries and veins** of the legs and arms, **migratory superficial thrombophlebitis**, claudication of the foot arch, rest pain, digital ulcers and gangrene, Raynaud's; **Shionoya criteria** (onset before 45, smoking, infrapopliteal occlusion, upper limb involvement or phlebitis, no other atherosclerotic risk factors). Angiography: **corkscrew collaterals**, abrupt segmental occlusions. **Complete cessation of tobacco in every form is the only treatment that halts it**; prostacyclin analogues (iloprost), sympathectomy (lumbar or thoracoscopic) and wound care are adjuncts; bypass is rarely possible.

Acute limb ischaemia

- **The six Ps**: pain, pallor, pulselessness, paraesthesia, paralysis, perishing cold (**paraesthesia and paralysis mean the limb is threatened**). **Embolus**: sudden onset, a source (**atrial fibrillation** commonest, mural thrombus after MI, aneurysm), normal pulses in the other leg; lodges at bifurcations, **commonest the common femoral**. **Thrombosis in situ**: on a background of claudication, collaterals soften the onset, weak pulses in the other leg.
- **Rutherford classes of acute limb ischaemia**: **I viable** (no sensory loss or weakness); **IIa marginally threatened** (minimal sensory loss of the toes; prompt treatment); **IIb immediately threatened** (sensory loss beyond the toes with rest pain, mild to moderate weakness; **immediate revascularisation**); **III irreversible** (profound anaesthesia and paralysis, fixed mottling, inaudible arterial and venous Doppler signals; **amputation**).
- **Treatment (ESVS 2020)**: **immediate intravenous unfractionated heparin (about 5,000 units bolus)** to stop propagation, analgesia; **embolectomy with a Fogarty balloon catheter** for embolus; **catheter-directed thrombolysis** (not for IIb when time is short) or bypass for thrombosis. **Fasciotomy** (four compartments of the leg, through two incisions) for compartment syndrome after reperfusion (pain on passive stretch is the earliest sign; pulses are often still present). **Reperfusion injury**: hyperkalaemia, acidosis, **myoglobinuria and acute kidney injury**, arrhythmias. Then look for and treat the source (anticoagulate for AF).

Aneurysms and the aorta

- **Abdominal aortic aneurysm**: aortic diameter over 3 cm, **mostly infrarenal**; men over 65, **smoking (the strongest risk factor)**, family history, hypertension; **diabetes is protective**. **Screening: one ultrasound for men at 65** (UK NAAASP; USPSTF 2019 for men 65 to 75 who have ever smoked). **Elective repair at 5.5 cm in men; 5.0 cm in women** (SVS 2018; ESVS 2024: women 5.0), **growth over 1 cm a year, or any symptoms** (tenderness, back pain). Smaller aneurysms: ultrasound surveillance, stop smoking, statin, antiplatelet.
- **Repair**: **EVAR (endovascular aneurysm repair)** has lower early mortality but more reinterventions and needs lifelong surveillance; open repair is durable; choice by anatomy (neck length and angulation), age and fitness. **Endoleaks** after EVAR: **type I (at the attachment sites) and type III (between components or through the fabric) raise sac pressure and need urgent treatment**; **type II (backflow from lumbar arteries or the inferior mesenteric artery) is the commonest**, often watched unless the sac grows; type IV graft porosity; type V endotension.
- **Ruptured AAA**: abdominal or back pain, collapse, a pulsatile mass; the classic triad (pain, hypotension, pulsatile mass) is seen in about half; **permissive hypotension (systolic about 70 to 90 mmHg, conscious patient)**, straight to theatre; CT only if stable; **EVAR when the anatomy is suitable** (IMPROVE trial). Mortality is very high overall.
- **Peripheral aneurysms**: **popliteal is the commonest peripheral (non-aortic) aneurysm** (about 70%), **bilateral in about half and associated with AAA in about a third** (so scan the aorta and the other knee); **they threaten the limb by thrombosis and distal embolism, rarely rupture**; repair when over **about 2 cm**, with thrombus, or symptomatic (bypass with exclusion, or stent graft). Femoral aneurysm next. **Visceral**: **splenic artery commonest** (women; risk of **rupture in pregnancy**; repair if over 2 to 3 cm, in women of childbearing age, or pseudoaneurysm). **Mycotic (infected) aneurysm**: Salmonella and Staphylococcus aureus. **False aneurysm (pseudoaneurysm)**: after femoral puncture; ultrasound-guided thrombin injection. Commonest cause of true aneurysms: degenerative (atherosclerotic) disease.
- **Aortic dissection**: hypertension, Marfan's, bicuspid aortic valve; tearing pain radiating to the back, unequal arm pulses, aortic regurgitation; **CT angiography** (transoesophageal echo in the unstable). **Stanford A (ascending aorta involved; DeBakey I and II): emergency surgery**; **Stanford B (descending only; DeBakey III): blood pressure and heart rate control (IV beta-blocker first, systolic about 100 to 120, heart rate under 60), with TEVAR for complicated cases** (malperfusion, rupture, refractory pain or hypertension).

Carotid and other arterial conditions

- **Carotid stenosis**: atherosclerosis at the carotid bifurcation; TIA, amaurosis fugax, stroke. **Duplex ultrasound is the first test**; CT or MR angiography to confirm. **Symptomatic stenosis 70 to 99% (NASCET method): carotid endarterectomy, ideally within 2 weeks of the event** (benefit falls quickly with delay); **50 to 69%: benefit in selected patients** (men, recent hemispheric events); under 50%: medical therapy. **Asymptomatic stenosis: best medical therapy for most** (antiplatelet, statin, blood pressure), endarterectomy only for selected high-risk features (ESVS 2023). **Carotid stenting** is

an alternative in high surgical risk or hostile neck (more periprocedural strokes, fewer MIs). Nerves at risk in endarterectomy: hypoglossal, vagus/recurrent laryngeal, marginal mandibular, greater auricular.

- **Carotid body tumour (chemodectoma, paraganglioma)**: painless mass at the bifurcation, **moves side to side but not up and down**, may transmit pulsation; **splays the internal and external carotids ("lyre sign")** on angiography; **Shamblin classification** I to III of its relation to the vessels; SDH mutations; **do not biopsy**; excision (with preoperative embolisation for large tumours).
- **Takayasu arteritis** ("pulseless disease"): granulomatous large-vessel arteritis of the aorta and its branches (the **subclavian arteries** most often), **young women, commoner in Asia**; absent or weak arm pulses, bruits, unequal arm pressures, claudication, raised ESR; CT, MR or PET angiography; glucocorticoids with a steroid-sparing drug such as methotrexate, and tocilizumab or a TNF inhibitor for relapsing or refractory disease (EULAR 2018), revascularisation when the disease is quiescent. Giant cell arteritis affects the over-50s (temporal artery); Buerger's disease young smoking men's distal limb vessels; polyarteritis nodosa medium arteries.
- **Subclavian steal syndrome**: proximal subclavian stenosis, reversed vertebral flow, arm claudication and dizziness on arm exercise, a blood pressure difference between arms over 20 mmHg. **Thoracic outlet syndrome**: compression of the brachial plexus (commonest, neurogenic), subclavian vein or artery by a **cervical rib**, scalene muscles or the first rib; Adson's and Roos tests; first rib resection. **Raynaud's phenomenon**: white, blue then red; primary in young women, secondary to connective tissue disease (scleroderma), vibration tools, Buerger's; calcium channel blockers.
- **Acute mesenteric ischaemia**: **embolism to the superior mesenteric artery is the commonest cause** (40 to 50%; from AF; lodges a few centimetres beyond its origin, beyond the middle colic artery, so the proximal jejunum is spared); thrombosis at the origin (on chronic disease; the whole small bowel affected); **non-occlusive** (low-output states, vasopressors); **mesenteric venous thrombosis** (thrombophilia, portal hypertension). **Pain out of proportion to the abdominal signs**, because visceral ischaemic pain precedes the transmural necrosis that produces peritonitis; diarrhoea, blood later; lactate and acidosis are late. **CT angiography is the investigation of choice** (ESVS 2017); **heparin**, then embolectomy or endovascular revascularisation and **laparotomy with resection of dead bowel**, with a **second-look laparotomy** at 24 to 48 hours. **Chronic mesenteric ischaemia**: post-prandial pain ("intestinal angina"), **fear of food, weight loss**; usually two of the three mesenteric vessels are stenosed; endovascular stenting.
- **Arteriovenous fistula**: traumatic or congenital (and surgical for dialysis); **continuous "machinery" murmur with systolic accentuation and a thrill**, dilated veins, raised local temperature, distal ischaemia (steal), limb lengthening if in a child, and **high-output cardiac failure** with a **wide (high) pulse pressure**, not a low one. **Branham's (Nicoladoni-Branham) sign**: compressing the artery proximal to the fistula raises peripheral resistance and blood pressure, so a baroreflex **slows the pulse**, and the thrill and bruit stop. **For haemodialysis, the radiocephalic fistula at the wrist (Brescia-Cimino; the anatomical snuffbox fistula a more distal variant) is the first choice** ("fistula first"; distal before proximal, non-dominant arm), then brachiocephalic, then brachiobasilic with transposition, then prosthetic grafts; a mature fistula ("rule of 6s": flow over 600 mL/min, diameter over 6 mm, within 6 mm of the skin, by about 6 weeks). Allen's test checks the palmar arch (ulnar supply) before radial procedures.

Veins and lymphatics

- **Varicose veins**: primary (valve failure) or secondary (after DVT, pelvic mass, AV fistula); great saphenous (medial, saphenofemoral junction 2.5 to 4 cm below and lateral to the pubic tubercle) and small saphenous (behind, saphenopopliteal junction) systems; perforators (Cockett's in the medial calf, Boyd's below the knee, Hunterian and Dodd's in the thigh). **Duplex ultrasonography is the investigation of choice**: **reflux over 0.5 seconds in superficial veins and perforators** (over 1 second in the femoral and popliteal veins) and deep vein patency. Bedside: **Brodie-Trendelenburg test** (saphenofemoral incompetence), **Perthes' test** (deep vein patency), the tourniquet test; **saphena varix** gives a cough impulse and a thrill in the groin that empties on lying.
- **CEAP classification (2020 update)**: **C0** no visible disease; **C1** telangiectasia or reticular veins; **C2** varicose veins (**C2r** recurrent); **C3** oedema; **C4a pigmentation or eczema**; **C4b lipodermatosclerosis or atrophie blanche**; **C4c corona phlebectatica** (new in 2020); **C5 healed ulcer**; **C6 active ulcer** (C6r recurrent); plus E (aetiology), A (anatomy), P (pathophysiology).
- **Treatment (NICE CG168, 2013; ESVS 2022)**: **endovenous thermal ablation (radiofrequency or laser) is first-line** for truncal reflux, then **ultrasound-guided foam sclerotherapy**, then **surgery (high saphenofemoral ligation and stripping to the knee)**; non-thermal non-tumescent options (cyanoacrylate glue, mechanochemical ablation). Compression stockings for symptoms when intervention is not wanted. The **saphenous nerve** (with the great saphenous vein below the knee) and **sural nerve** (with the small saphenous vein) are at risk.
- **Venous ulcer**: the commonest leg ulcer, in the **gaiter area above the medial malleolus**, shallow with a sloping edge, pigmentation and lipodermatosclerosis around; **compression (about 40 mmHg at the ankle, multilayer) once ABPI is 0.8 or more** is the mainstay; **early endovenous ablation speeds healing and cuts recurrence** (EVRA trial, 2018). A non-healing ulcer needs biopsy (Marjolin's).
- **Deep vein thrombosis**: Virchow's triad (stasis, endothelial injury, hypercoagulability); **inherited thrombophilia: factor V Leiden (resistance to activated protein C) is the commonest** (about 5% of people of European descent), then the prothrombin G20210A mutation; protein C, protein S and antithrombin deficiencies are rarer but more thrombogenic, and in South Asians factor V Leiden is uncommon, so these deficiencies make up a larger share; routine screening after a provoked clot is of little use; most begin in the **calf (soleal sinuses)**, but **pulmonary emboli come mainly from proximal (iliofemoral and popliteal) thrombi**; **Wells score**, then **D-dimer** (to exclude in low probability) and **compression duplex ultrasound** (the test of choice); Homans' sign is unreliable and of historical interest. **Anticoagulation with a DOAC (rivaroxaban, apixaban) or LMWH, for at least 3 months** (provoked; warfarin, the older choice, overlaps with heparin for at least 5 days until the INR is 2 to 3 for 24 hours) and longer for unprovoked or cancer-related (DOACs now also used in cancer). **Phlegmasia alba dolens** (white, swollen) and

phlegmasia cerulea dolens (blue, painful, threatening venous gangrene): catheter-directed thrombolysis or thrombectomy. **IVC filter only when anticoagulation is contraindicated** in proximal DVT. Post-thrombotic syndrome is the long-term problem.

- **Pulmonary embolism**: **CT pulmonary angiography** is the test of choice (V/Q scan in pregnancy or renal failure); **commonest ECG finding sinus tachycardia** (S1Q3T3 is classic but uncommon); massive PE with shock: **systemic thrombolysis**, or catheter or surgical embolectomy.
- **Lymphoedema**: **primary** (Milroy's disease, congenital, **FLT4/VEGFR3**; praecox at puberty, **Meige's**; tarda after 35) or **secondary**: worldwide the commonest cause is **filariasis** (Wuchereria bancrofti; endemic in much of Nepal, see Urology), elsewhere surgery and radiotherapy (axillary or inguinal), tumour, infection. **Stemmer's sign** (cannot pinch the skin on the dorsum of the second toe). Lymphoscintigraphy is the investigation of choice. Treatment: **complete decongestive therapy** (manual drainage, multilayer bandaging, exercise, skin care), compression garments; surgery (lymphovenous anastomosis, lymph node transfer, debulking such as Charles' operation) in selected cases; **Stewart-Treves lymphangiosarcoma** in long-standing lymphoedema.

Raynaud's phenomenon

- **Raynaud's phenomenon**: first, **avoid cold, stop smoking, stop causative drugs (beta blockers, ergot)**; then **calcium channel blockers (nifedipine, amlodipine) are the first-line drug**; severe or ischaemic digits get **prostacyclin analogues (iloprost infusion), phosphodiesterase-5 inhibitors, topical nitrate**; digital sympathectomy in refractory cases; **primary Raynaud's** (young women, symmetric, no tissue loss, normal capillaroscopy and ANA) versus **secondary** (scleroderma, SLE, vibration injury, cervical rib, Buerger's).

Paediatric surgery

Vomiting and obstruction in infants

- **Bilious vomiting in a neonate is malrotation with midgut volvulus until proved otherwise**, a surgical emergency (the whole midgut can die in hours). **Upper GI contrast study is the investigation of choice**: the **duodenojejunal flexure lies to the right of the midline** (and low), corkscrew duodenum in volvulus; Doppler ultrasound shows the **whirlpool sign** and reversed SMA-SMV relation. **Ladd's procedure**: untwist anticlockwise, divide **Ladd's bands**, widen the mesentery, place the small bowel on the right and the colon on the left, and remove the appendix.
- **Infantile hypertrophic pyloric stenosis**: **firstborn boys (male 4:1), 2 to 8 weeks (peak 3 to 6)**, family history, early erythromycin; **projectile non-bilious vomiting after every feed**, a hungry baby, visible gastric peristalsis left to right, an **olive-shaped mass** in the right upper quadrant felt during a test feed. **Ultrasound confirms**: **pyloric muscle 3 mm or more thick, canal 15 to 17 mm or more long**. **Hypochloraemic hypokalaemic metabolic alkalosis** (paradoxical aciduria late). It is a medical, not a surgical, emergency: **correct fluid and electrolytes first** (aim chloride over about 100 mmol/L and bicarbonate under about 28) because alkalosis causes **postoperative apnoea**; then **Ramstedt pyloromyotomy** (open supraumbilical or laparoscopic), feeding within hours.
- **Duodenal atresia**: bilious vomiting from the first day (most are below the ampulla), polyhydramnios, **Down syndrome in about 30%**, **"double bubble" with no distal gas** on X-ray; **duodenoduodenostomy (Kimura's diamond)**. **Jejunoileal atresia**: from an intrauterine **vascular accident**, several types (type IIIb "apple peel" or Christmas tree), multiple bubbles; resection and anastomosis.
- **Meconium ileus**: the first sign of **cystic fibrosis** in about 15% of affected babies; thick meconium obstructs the terminal ileum; X-ray shows dilated loops with a **"soap bubble" (ground glass) appearance** and no fluid levels; **Gastrografin (hyperosmolar contrast) enema** relieves uncomplicated cases; sweat test or genetic test later.
- **Hirschsprung's disease**: **absence of ganglion cells** in the submucosal (Meissner's) and myenteric (Auerbach's) plexuses from **failed craniocaudal migration of neural crest cells** (RET proto-oncogene; **Down syndrome**); the aganglionic segment always starts at the internal sphincter and extends proximally, **rectosigmoid in about 75 to 80%**, total colonic in a few; boys 4:1. **Failure to pass meconium within 48 hours** (90% of normal term babies pass it in 24 hours), distension, bilious vomiting; an **explosive release of gas and stool on withdrawing the examining finger** ("squirt sign"); older children, chronic constipation from birth with an empty rectum. **Enterocolitis** is the commonest cause of death. **Contrast enema shows the transition zone**, a narrow distal (aganglionic, diseased) segment and a dilated proximal (normal) colon, and guides the surgeon; anorectal manometry shows absent rectoanal inhibitory reflex. **Gold standard: rectal biopsy (suction in infants, full-thickness in older children) showing absent ganglion cells, hypertrophied nerve trunks, raised acetylcholinesterase staining and absent calretinin staining.** Treatment: decompression (rectal washouts), then **pull-through**: **Swenson**, **Duhamel**, **Soave (endorectal)**, today often **transanal endorectal pull-through (De la Torre)** in one stage.
- **Anorectal malformations**: high (above the levator, supralevator) and low (translevator); associated **VACTERL** anomalies (vertebral, anorectal, cardiac, tracheo-oesophageal, renal, limb); in boys a rectourethral (bulbar or prostatic) fistula is commonest, in girls a **rectovestibular fistula**; meconium on the perineum or a bucket-handle deformity means a low lesion; a cross-table prone lateral X-ray (invertogram, Wangensteen-Rice, the classic) at 24 hours; low lesions are repaired as a primary anoplasty, high ones by colostomy, then **posterior sagittal anorectoplasty (PSARP, Peña)**.
- **Necrotising enterocolitis**: **premature, low birth weight, formula-fed infants**; distension, bloody stools, feed intolerance; X-ray **pneumatosis intestinalis**, portal venous gas, free air; **modified Bell's staging** I to III; most are treated medically (stop feeds, gastric decompression, antibiotics, TPN); laparotomy or peritoneal drain for perforation; late strictures. Breast milk and probiotics protect.

Oesophageal atresia and the abdominal wall

- **Oesophageal atresia with tracheo-oesophageal fistula (Gross classification)**: **type C (about 85%): blind upper pouch with a distal (lower) fistula to the trachea**, the commonest; **type A (about 8%): pure atresia without fistula, gasless abdomen** (long gap); type E (H-type) fistula without atresia (about 4%), presents later with coughing on feeds and recurrent pneumonia; types B and D (upper pouch fistula) rare. **Polyhydramnios** antenatally; **drooling, choking and**

cyanosis with the first feed, and a **nasogastric tube that coils in the upper pouch** on X-ray (a size 10 Fr tube; air in the stomach means a distal fistula). **VACTERL** in about half (cardiac anomalies the commonest, and the main driver of survival; Spitz classification by birth weight under 1,500 g and major cardiac anomaly). Repair: **ligation of the fistula and end-to-end anastomosis by right (extrapleural) thoracotomy or thoracoscopy**; complications: anastomotic leak, stricture, recurrent fistula, gastro-oesophageal reflux, tracheomalacia.

- **Congenital diaphragmatic hernia**: **Bochdalek, posterolateral, left-sided in about 85%**; bowel in the chest, scaphoid abdomen, mediastinal shift; **pulmonary hypoplasia and pulmonary hypertension** decide survival; do not bag-mask ventilate (gastric distension): intubate, pass a gastric tube, gentle ventilation; **surgery is delayed until the baby is stable** (it is not an emergency operation); severe cases antenatally: **fetoscopic endoluminal tracheal occlusion (FETO)** improves survival (TOTAL trials, 2021). Morgagni hernias are anterior and usually right.
- **Abdominal wall defects**:

	Exomphalos (omphalocele)	Gastroschisis
Defect	through the umbilical ring, **covered by a sac** (amnion and peritoneum), cord inserts into the sac	**beside the umbilicus, usually to the right, no sac**; cord normal
Contents	bowel, often liver	bowel (thickened, matted from amniotic exposure), rarely liver
Associations	**common: chromosomal (trisomy 13, 18, 21), cardiac, Beckwith-Wiedemann**	uncommon apart from **intestinal atresia**; **young mothers**, smoking, drugs
Prognosis	depends on the associated anomalies	good; gut dysfunction is the main problem

- So **gastroschisis generally has the better outlook**: it rarely comes with chromosomal or cardiac anomalies, and outcome depends on the bowel; exomphalos is worsened by its associations.
- Gastroschisis needs urgent cover of the bowel (cling film or a silo) and fluid; reduction primarily or with a **preformed silo** in stages.

Intussusception and Meckel's diverticulum

- **Intussusception**: commonest cause of intestinal obstruction from **3 months to 3 years (peak 6 to 9 months)**; most are **ileocolic** and idiopathic, from **hypertrophied Peyer's patches** after a viral illness (adenovirus); **pathological lead points** (Meckel's diverticulum, polyp, duplication cyst, lymphoma, Henoch-Schönlein purpura) are commoner over about 2 to 3 years and in adults. **Colicky pain with drawing up of the legs, pallor, vomiting, "red currant jelly" stool** (late), a **sausage-shaped mass in the right upper quadrant** and an empty right iliac fossa (**Dance's sign**). **Ultrasound is the investigation of choice**: **target (doughnut) sign** in cross-section, **pseudokidney** in long section. **Treatment: image-guided air (pneumatic) or hydrostatic enema reduction** (success about 80 to 90%; recurrence about 10%) unless there is **peritonitis, perforation or shock**; surgery for failure. Rotavirus vaccines: the first (RotaShield) was withdrawn in 1999 for intussusception; current vaccines (Rotarix, RotaTeq) carry a small risk (about 1 to 6 per 100,000), far outweighed by benefit.
- **Adult intussusception**: rare, and **a lead point is found in about 90%**, often a tumour (malignant in the colon more often than in the small bowel), so it is **resected without reduction** when malignancy is possible; series differ on whether enteric or colonic types are commoner.
- **Meckel's diverticulum**: persistence of the **vitellointestinal (omphalomesenteric) duct**; a **true diverticulum** (all layers) on the **antimesenteric border of the ileum**; the **rule of 2s**: about 2% of people, about 2 feet (60 cm) from the ileocaecal valve, about 2 inches (5 cm) long, symptomatic in about 2% (usually before 2 years), 2 types of ectopic tissue (**gastric commonest**, then pancreatic), male 2:1. **Commonest presentation in children: painless rectal bleeding** (maroon), from ulceration of the adjacent ileum by acid from ectopic gastric mucosa; in adults, obstruction (intussusception, volvulus around a band, Littre's hernia) and diverticulitis mimicking appendicitis. **Technetium-99m pertechnetate scan (Meckel's scan)** shows the gastric mucosa. Treatment: diverticulectomy or resection of the ileal segment for bleeding; incidental asymptomatic diverticula in adults are usually left.

Urology in children

- **Undescended testis (cryptorchidism)**: about 3% of term and 30% of preterm boys, most descend by 3 months; **orchidopexy for one not down by 6 months (corrected age), ideally between 6 and 12 months and no later than 18 months** (EAU 2021, AUA 2014), because germ cell loss starts in the first year; hormone treatment is not recommended. Risks: **infertility, testicular cancer (seminoma commonest; about 4 to 6 times raised, not removed by orchidopexy but easier to detect), torsion, associated inguinal hernia (patent processus vaginalis), trauma, psychological**. **Palpable: inguinal orchidopexy (dartos pouch)**; **impalpable: examination under anaesthesia, then laparoscopy** (Fowler-Stephens orchidopexy for an intra-abdominal testis); ultrasound does not help. Bilateral impalpable testes with hypospadias: think of **disorders of sex development** (congenital adrenal hyperplasia). **Retractile testis** can be brought down and stays (watch); **ectopic testis** lies off the line of descent, commonest in the **superficial inguinal pouch**.
- **Hypospadias**: the meatus on the **ventral** side of the penis, **distal (glanular, coronal, subcoronal) in about 70%**; **chordee** (ventral curvature) and a **dorsal hooded foreskin**; **avoid circumcision** (the foreskin is used in the repair); **repair at 6 to 18 months** (commonly 6 to 12), by **tubularised incised plate (Snodgrass) urethroplasty** for distal types and staged repairs for proximal; the steps are **orthoplasty (straightening the chordee), urethroplasty, glanuloplasty, meatoplasty, then skin cover**; commonest complication **urethrocutaneous fistula**. Proximal hypospadias with undescended testes needs a DSD work-up. **Epispadias**: dorsal meatus, part of the exstrophy-epispadias complex.
- **Posterior urethral valves**: the **commonest cause of bladder outlet obstruction in boys**; antenatal bilateral hydronephrosis with a thick-walled bladder ("keyhole sign") and oligohydramnios; poor stream, retention, urinary infection, renal failure; **micturating cystourethrogram (MCU/VCUG) is diagnostic** (dilated posterior urethra); catheter drainage, then **endoscopic valve ablation**; long-term renal and bladder follow-up.
- **Vesicoureteric reflux**: graded I to V on MCU (I ureter only; II to the pelvis without dilatation; III mild dilatation; IV moderate with blunted calyces; V gross tortuosity); a cause of pyelonephritis and **renal scarring (DMSA scan)**; many low

grades resolve; antibiotic prophylaxis, endoscopic injection (Deflux) or ureteric reimplantation for breakthrough infections.

- **Phimosis**: physiological in young boys (do not retract forcibly); pathological from balanitis xerotica obliterans; topical steroid, circumcision; **paraphimosis** is reduced urgently.

Childhood tumours and other conditions

- **Wilms' tumour (nephroblastoma)** versus **neuroblastoma**, the two common abdominal masses of childhood:

	Wilms' tumour	Neuroblastoma
Age	2 to 5 years	**under 2** (commonest extra-cranial solid tumour of infancy)
Origin	kidney (metanephric blastema)	**adrenal medulla** and sympathetic chain (neural crest)
Mass	smooth, flank, **rarely crosses the midline**; haematuria, hypertension	irregular, hard, **crosses the midline**; child unwell
Calcification	rare	**common (stippled)**
Markers and genes	**WT1 (11p13)**, WT2 (11p15); **WAGR**, **Denys-Drash**, **Beckwith-Wiedemann**, hemihypertrophy, aniridia	**urinary VMA and HVA**; **N-MYC amplification (poor prognosis)**; MIBG scan
Special features	spreads to the lungs; **excellent prognosis** (about 90% survival)	**periorbital bruising ("raccoon eyes")**, **opsoclonus-myoclonus**, "blueberry muffin" skin nodules, **stage MS (4S) in infants regresses spontaneously**
Treatment	**nephrectomy and chemotherapy (COG: surgery first) or preoperative chemotherapy (SIOP)**; never biopsy through the flank before staging in COG practice	by risk group: observation to surgery, chemotherapy, stem cell transplant, anti-GD2 antibody

- **Biliary atresia**: progressive obliteration of the extrahepatic ducts; **jaundice persisting beyond 2 weeks with pale stools and dark urine** in a thriving infant; conjugated hyperbilirubinaemia; ultrasound **triangular cord sign** and an absent or small gallbladder, **HIDA scan with no excretion into the bowel**; liver biopsy or operative cholangiogram confirms. **Kasai portoenterostomy** before about **60 days** of age gives the best results; **biliary atresia is the commonest indication for liver transplantation in children**.
- **Inguinal hernia in children**: indirect, from a patent processus vaginalis; boys, **premature babies**, right side commoner; **herniotomy soon after diagnosis**, because incarceration is commonest in the first year. Infantile hydrocele: communicating, usually resolves by 1 to 2 years.
- **Cleft lip and palate**: cleft lip repair at about **3 months** (the classic "**rule of 10s**": over 10 weeks old, 10 lb, haemoglobin 10 g/dL; Millard rotation-advancement); **cleft palate at 6 to 12 months, before speech develops** (velopharyngeal function and speech come first, maxillary growth second); a team approach with speech therapy, orthodontics and ENT (glue ear).
- **Sacrococcygeal teratoma**: commonest neonatal tumour, girls; Altman types I to IV (I mostly external, IV wholly presacral); excise with the coccyx early (malignant change rises with age).
- **Paediatric trauma (ATLS 11)**: blood products at 10 mL/kg for haemorrhagic shock; atropine pretreatment for infant RSI; needle cricothyroidotomy, not surgical cricothyroidotomy, in infants and young children; children compensate for blood loss well, so hypotension is a late, ominous sign.

Surgical oncology

Principles

- **Staging**: **TNM (AJCC 8th edition, 2017; UICC 8th)**: T the primary, N the regional nodes, M distant metastasis; clinical (cTNM), pathological (pTNM), after neoadjuvant treatment (ypTNM); stage groups I to IV. Classic named staging systems: **Dukes** (colorectal), **Ann Arbor with Cotswolds modification, now Lugano 2014** (lymphoma), **FIGO** (gynaecological), **Masaoka-Koga** (thymoma), Nevin (gallbladder, historical), **Breslow and Clark** (melanoma). **Borrmann** (gastric) and **Siewert** (gastro-oesophageal junction) are gross and anatomical classifications, not stages. Grade describes differentiation; stage describes spread and matters more for prognosis.
- Performance status by **ECOG (0 fully active to 4 bedbound, 5 dead)** or Karnofsky; it decides fitness for chemotherapy.
- **Resection margins** (classic exam figures, now refined by pathology): **colon about 5 cm**; **stomach about 5 cm proximally (6 cm or more for diffuse type)**; **rectum 1 to 2 cm distally**, with a clear circumferential margin; oesophagus traditionally 10 cm (current practice: a clear margin with total resection of the mucosa at risk); **GIST: a negative (R0) margin with an intact pseudocapsule, no fixed distance and no lymphadenectomy**; melanoma and breast: see below. R0 no residual tumour, R1 microscopic, R2 macroscopic.
- **Neoadjuvant therapy** shrinks the tumour before surgery and tests its biology (rectum, oesophagus, stomach, breast, pancreas borderline); **adjuvant therapy** treats micrometastases after resection.
- **Sentinel lymph node biopsy**: the first node draining the tumour; used in **breast cancer, melanoma, penile cancer, vulval cancer, early oral cavity cancer and Merkel cell carcinoma**; blue dye plus radioisotope (or indocyanine green).
- **Routes of spread**: lymphatic (most carcinomas); **haematogenous, typically for sarcomas, renal cell carcinoma, follicular thyroid carcinoma, hepatocellular carcinoma and choriocarcinoma, and the bone-seeking cancers (prostate, breast, lung, kidney, thyroid)**; transcoelomic (ovary, stomach: Krukenberg); perineural (adenoid cystic, pancreas, prostate, head and neck squamous cancers); implantation (port sites, needle tracts). The commonest site of metastasis overall is the lymph nodes, then the liver.
- **Psammoma bodies** (concentric calcifications): **papillary thyroid carcinoma, serous papillary ovarian (and peritoneal) carcinoma, meningioma, mesothelioma**, papillary renal cell carcinoma (and occasionally prolactinoma); not in rhabdomyosarcoma.

Genes and hereditary cancer syndromes

Gene	Type	Location	Tumours
APC	tumour suppressor	5q21	FAP, colorectal adenoma-carcinoma sequence

Gene	Type	Location	Tumours
RB1	tumour suppressor	13q14	retinoblastoma, osteosarcoma
TP53	tumour suppressor	17p13	Li-Fraumeni (sarcoma, breast, brain, adrenal cortex, leukaemia); most human cancers
BRCA1 / BRCA2	tumour suppressor (DNA repair)	17q21 / 13q13	breast, ovary; BRCA2 also male breast, prostate, pancreas
VHL	tumour suppressor	3p25	clear cell RCC, haemangioblastoma, phaeochromocytoma
NF1 / NF2	tumour suppressor	17q11 / 22q12	neurofibromatosis 1 (neurofibromas, MPNST, GIST, phaeochromocytoma) / 2 (bilateral vestibular schwannomas, meningioma)
WT1	tumour suppressor	11p13	Wilms' tumour
PTEN	tumour suppressor	10q23	Cowden (breast, follicular thyroid, endometrium)
CDH1	tumour suppressor	16q22	hereditary diffuse gastric cancer, lobular breast cancer
MLH1, MSH2, MSH6, PMS2	mismatch repair	3p, 2p, 2p, 7p	Lynch syndrome
RET	proto-oncogene	10q11	MEN 2A and 2B (medullary thyroid carcinoma), Hirschsprung's (loss of function)
KRAS	proto-oncogene	12p12	pancreas (over 90%), colorectal (about 40%), lung
HER2 (ERBB2)	proto-oncogene	17q12	breast, gastric (amplified)
MYC / N-MYC	proto-oncogene	8q24 / 2p24	Burkitt's lymphoma / neuroblastoma

- Knudson's "two-hit" hypothesis: both alleles of a tumour suppressor must be lost; an inherited first hit explains early, bilateral and multiple tumours.

Tumour markers

Marker	Main use
CEA	**colorectal cancer follow-up** (also medullary thyroid, gastric, pancreatic); not for screening
CA 19-9	**pancreatic** and biliary cancer (absent in Lewis-antigen-negative people; raised by cholangitis)
CA 125	**epithelial ovarian cancer** (raised in endometriosis, PID, ascites, pregnancy)
CA 15-3	breast cancer monitoring (metastatic)
AFP	**hepatocellular carcinoma**, **yolk sac tumour**, hepatoblastoma; normal in pure seminoma
beta-hCG	**choriocarcinoma**, gestational trophoblastic disease, some seminomas and NSGCT
LDH	germ cell tumours (bulk), lymphoma, melanoma (AJCC M-category)
PSA	prostate cancer (diagnosis and follow-up)
Calcitonin	**medullary thyroid carcinoma**
Thyroglobulin	follow-up of differentiated (papillary, follicular) thyroid cancer after total thyroidectomy
Chromogranin A	neuroendocrine tumours (falsely raised by PPIs and renal failure)
Urinary 5-HIAA	**carcinoid syndrome** (serotonin metabolite)
Metanephrines (plasma or urine)	phaeochromocytoma, paraganglioma
VMA, HVA (urine)	neuroblastoma
S-100, HMB-45, Melan-A, SOX10	melanoma (immunohistochemistry)
PLAP	seminoma
Bence Jones protein, serum free light chains	myeloma

Neuroendocrine tumours, Krukenberg and salivary malignancy

- **Neuroendocrine tumours (carcinoids)**: graded by Ki-67 and mitoses (WHO G1 to G3, and neuroendocrine carcinoma); in the GI tract **commonest in the small bowel (ileum) and rectum** (the appendix in older series, as most are found incidentally). Serotonin is inactivated by the liver, so **carcinoid syndrome** (flushing, secretory diarrhoea, wheeze, **right-sided valve fibrosis: tricuspid regurgitation and pulmonary stenosis**, pellagra from tryptophan diversion) **appears from midgut tumours only after liver metastases** (or from bronchial and ovarian tumours draining systemically). **Diagnosis: 24-hour urinary 5-hydroxyindoleacetic acid (5-HIAA)**; chromogranin A in blood; localisation by **somatostatin receptor PET (Ga-68 DOTATATE)**, which replaced octreotide scintigraphy. **Treatment**: resection (with the nodes and mesentery for small-bowel tumours), **somatostatin analogues (octreotide, lanreotide)** for symptoms and growth control (PROMID, CLARINET), **peptide receptor radionuclide therapy with lutetium-177 DOTATATE** (NETTER-1, 2017), telotristat for diarrhoea, liver-directed therapy. **Carcinoid crisis** during surgery or embolisation: intravenous octreotide (cover all procedures).
- **Krukenberg tumour**: bilateral ovarian metastases containing **signet-ring cells (mucin-secreting adenocarcinoma)**, **usually from the stomach** (also colon, appendix, breast, biliary); spread classically **transcoelomic**, though retrograde lymphatic and blood spread are now thought to matter more. A primary ovarian mucinous tumour is unilateral more often. Other signs of intra-abdominal spread: **Virchow's node** (left supraclavicular, Troisier's sign), **Sister Mary Joseph nodule** (umbilical), **Blumer's shelf** (rectovesical or rectouterine pouch on rectal examination), Irish node (left axilla).
- **Adenoid cystic carcinoma** of salivary glands: commonest malignant tumour of the **submandibular and minor salivary glands** (palate); slow growing but relentless, with **perineural invasion** (pain, facial palsy, skip lesions along nerves), **late local recurrence** after 10 to 20 years and **lung metastases** by blood; nodal spread is uncommon (so no routine neck dissection); **cribriform ("Swiss cheese")** pattern; MYB-NFIB fusion; wide excision with postoperative radiotherapy. **Mucoepidermoid carcinoma** is the commonest malignant salivary tumour overall (parotid; MAML2 fusion), graded low to high.

Skin cancers and melanoma

- **Basal cell carcinoma**: the **commonest skin cancer** (and commonest cancer in white populations); sun-exposed head and neck, **above a line from the angle of the mouth to the ear lobe**, **inner canthus**; **pearly raised rolled edge with telangiectasia** and central ulceration (**rodent ulcer**); locally invasive, **almost never metastasises**; excision with a 4 mm margin, **Mohs micrographic surgery** for high-risk facial sites and recurrences, topical imiquimod or 5-FU for superficial types, radiotherapy; **hedgehog-pathway inhibitors (vismodegib, sonidegib)** for advanced disease; Gorlin's syndrome (PTCH1).
- **Cutaneous squamous cell carcinoma**: sun damage, actinic keratoses, immunosuppression (transplant recipients), chronic ulcers and scars (**Marjolin's ulcer**), arsenic, HPV; **everted edge**, ulcerated; spreads to nodes (more often from the lip, ear and scars); excision with a 4 to 6 mm margin; keratoacanthoma grows fast and regresses but is excised like SCC.
- **Melanoma**: from melanocytes; **ABCDE** (asymmetry, border irregularity, colour variation, diameter over 6 mm, evolution); types: **superficial spreading (commonest in white populations)**, **nodular (most aggressive, vertical growth from the start)**, lentigo maligna (elderly, face, best outlook), and **acral lentiginous (palms, soles, nail bed; the commonest type in Asian and dark-skinned people, including South Asians)**; subungual melanoma: **Hutchinson's sign** (pigment on the nail fold). **Excision biopsy with a 1 to 2 mm margin** (never shave); the **Breslow thickness (mm) is the most important prognostic factor for the primary**, ulceration next; Clark levels (I to V, anatomical) are historical. **Wide local excision margins (NCCN)**: in situ 0.5 to 1 cm; **up to 1 mm: 1 cm; 1 to 2 mm: 1 to 2 cm; over 2 mm: 2 cm**. **Sentinel node biopsy for tumours over 0.8 mm or ulcerated (T1b and above)**; completion lymph node dissection for a positive sentinel node is no longer routine (MSLT-II, DeCOG-SLT; observation with ultrasound). **BRAF V600E mutation in about half (cutaneous)**: **BRAF plus MEK inhibitors (dabrafenib with trametinib)**; **immunotherapy (nivolumab with ipilimumab, pembrolizumab, nivolumab with relatlimab)** for advanced disease and **adjuvant therapy for stage IIB to IV**; acral and mucosal melanomas carry KIT mutations more often. Metastasises widely (lung, liver, brain, the GI tract), sometimes decades later; uveal melanoma spreads mainly to the liver.

Soft tissue sarcoma and other surgical cancers

- **Soft tissue sarcoma**: commonest in adults **liposarcoma and undifferentiated pleomorphic sarcoma** (formerly malignant fibrous histiocytoma), then leiomyosarcoma; in children **rhabdomyosarcoma** (embryonal, head and neck, genitourinary). Warning features of a lump: **over 5 cm, deep to the fascia, growing, painful, or recurrent after excision**: **MRI first, then image-guided core biopsy placed along the line of the future excision** (never an excision biopsy of a suspicious deep lump: it contaminates the field); spread by **blood to the lungs** (CT chest); nodes are rare except in "SCARE" tumours (synovial, clear cell, angiosarcoma, rhabdomyosarcoma, epithelioid); **wide excision with a margin of normal tissue plus radiotherapy** (before or after) for high-grade tumours. Retroperitoneal sarcomas (often liposarcoma) are resected en bloc in specialist centres. Lipoma (the commonest benign soft tissue tumour) is superficial and soft, with a positive slip sign. Primary splenic malignancy: lymphoma commonest overall; **angiosarcoma the commonest primary non-lymphoid malignant tumour of the spleen**.
- **Benign lumps that are asked**: **cystic hygroma** (macrocystic lymphatic malformation): an infant's soft, compressible, multiloculated swelling in the **posterior triangle**, **brilliantly transilluminant**, often present at birth, linked with Turner syndrome; sclerotherapy (OK-432, bleomycin, doxycycline) or excision, sirolimus for extensive lesions. **Branchial cyst** (second cleft): young adults, **anterior border of sternomastoid at the junction of its upper and middle thirds**, not transilluminant, cholesterol crystals in the fluid; a branchial fistula is congenital and opens internally in the tonsillar fossa. **Glomus tumour**: a benign tumour of the glomus body, usually **subungual**, with the triad of **paroxysmal pain, pinpoint tenderness (Love's test) and cold sensitivity** and a bluish spot; excision.
- **Oral cavity cancer**: squamous cell carcinoma, **very common in South Asia** from **chewed tobacco (khaini, gutkha), betel quid with areca nut, smoking and alcohol**; **buccal mucosa and gingivobuccal sulcus** in South Asia, the **lateral tongue** in the West; precursors: **erythroplakia (highest malignant potential)**, leukoplakia, **oral submucous fibrosis (areca nut)**; **depth of invasion** enters the AJCC 8th T stage; wide excision with neck dissection (elective neck dissection for clinically node-negative tumours over 3 to 4 mm deep, D'Cruz trial 2015), adjuvant radiotherapy. **HPV-positive oropharyngeal cancer** (p16) has a better prognosis and its own staging.
- **Neck node levels**: **I** submental (Ia) and submandibular (Ib); **II** upper jugular (to the hyoid); **III** middle jugular (to the cricoid); **IV** lower jugular (to the clavicle); **V** posterior triangle; **VI** central compartment (thyroid, larynx); VII superior mediastinum. **Radical neck dissection** removes levels I to V with the **sternocleidomastoid, internal jugular vein and spinal accessory nerve**; **modified radical** preserves at least one of these three (shoulder function); **selective** removes only the levels at risk (supraomohyoid I to III for oral cancer). A neck lump in an adult over 40 is metastatic until proved otherwise: examine the upper aerodigestive tract and do **FNAC (not excision biopsy)**.
- **Lung cancer staging** (TNM 8th): T1 3 cm or less; T2 over 3 to 5 cm (or main bronchus, visceral pleura); **T3 over 5 to 7 cm** (or chest wall, separate nodule in the same lobe); **T4 over 7 cm** (or mediastinum, diaphragm, another ipsilateral lobe); in non-smokers and women, **adenocarcinoma** is the commonest type (EGFR, ALK targets).

Oncological emergencies

- **Malignant spinal cord compression**: back pain, weakness, sensory level, sphincter loss (late); breast, lung and prostate metastases, myeloma; **urgent whole-spine MRI**, **dexamethasone (16 mg/day)**, then radiotherapy or decompressive surgery (Patchell, 2005) within 24 hours.
- **Superior vena cava obstruction**: **lung cancer commonest cause** (small cell), then lymphoma; facial swelling, distended neck and chest veins, Pemberton's sign; CT; **SVC stenting** for rapid relief, then treat the tumour (biopsy first when lymphoma is possible, as steroids can hide it).
- **Hypercalcaemia of malignancy**: PTHrP (squamous cancers), bone metastases, calcitriol (lymphoma); **intravenous 0.9% saline, then zoledronic acid** (or denosumab), calcitonin for rapid short effect.

- **Tumour lysis syndrome**: after treating bulky, fast-growing tumours (Burkitt's lymphoma, acute leukaemia): **hyperkalaemia, hyperphosphataemia, hypocalcaemia, hyperuricaemia**, acute kidney injury; prevent with fluids and **allopurinol, or rasburicase** for high risk.
- **Immune checkpoint inhibitor toxicity** (anti-PD-1, PD-L1, CTLA-4): immune-related colitis, hepatitis, pneumonitis, endocrinopathies (hypophysitis, thyroiditis), dermatitis; steroids, with the drug held. Modern targets: HER2 (breast, gastric), EGFR and ALK (lung), KIT and PDGFRA (GIST), BRAF (melanoma, colorectal, anaplastic thyroid), RET (medullary thyroid), MSI-high/dMMR (any site; pembrolizumab).

Biopsy and skin cancer: points that are asked

- **Biopsy types**: **fine-needle aspiration cytology** (cytology only; no architecture), **core (trucut) needle biopsy** (histology; for breast, soft tissue and prostate lumps), **incisional biopsy** (a wedge of the lesion; for a large tumour or the one needing diagnosis before major surgery), **excisional biopsy** (the whole lesion; for small lesions), **punch biopsy** (skin), **frozen section** (rapid intraoperative opinion), **endoscopic biopsy**. A biopsy track should be placed so that it can be **excised with the definitive operation** (soft tissue sarcoma, breast).
- **Melanoma: incisional (or shave or punch) biopsy of a suspected melanoma is avoided because a partial sample may miss the deepest part and understate the Breslow thickness**, which decides the pathological stage, the **width of the wide excision (1 cm for under 1 mm; 1 to 2 cm for 1 to 2 mm; 2 cm for over 2 mm)** and whether a **sentinel node biopsy** is offered (usually over 0.8 mm, or ulcerated). Biopsy does **not** spread melanoma, and sentinel node biopsy is still possible after excision. Therefore the rule is **excision biopsy with a 1 to 2 mm margin**; **incisional biopsy is accepted only where excision would be disfiguring or impractical (a large lesion on the face, lentigo maligna, an acral site)**, and then a **punch biopsy from the thickest or most suspicious part** is taken.
- **Skin cancers** (see above): **basal cell carcinoma commonest; squamous cell with an everted edge and lymph node spread; melanoma deadliest**. **Treatment of skin cancers by risk**: low-risk BCC is excised with 4 mm margins, high-risk sites get Mohs surgery.

Spleen, lymph nodes and filariasis

- **Spleen**: causes of splenomegaly: **portal hypertension, haematological (CML, myelofibrosis, haemolytic anaemias, lymphoma), infections (malaria, kala-azar, typhoid, TB, tropical splenomegaly)**; massive splenomegaly in India and Nepal's region is classically **kala-azar, chronic malaria, CML and myelofibrosis**. **Indications for splenectomy**: trauma, **hereditary spherocytosis** (reduced spherocyte survival; curative, delayed to after 5 to 6 years), **immune thrombocytopenic purpura (ITP) after steroid failure**, hypersplenism, autoimmune haemolysis, splenic abscess and tumours. **Post-splenectomy risk: overwhelming post-splenectomy infection (OPSI) by encapsulated organisms, Streptococcus pneumoniae, Haemophilus influenzae type b and Neisseria meningitidis**; the spleen clears opsonised capsulated bacteria and makes early IgM. **Vaccinate against all three at least 2 weeks before an elective splenectomy, or about 2 weeks after an emergency one**; offer antibiotic prophylaxis (penicillin) lifelong, above all in the first 2 years after the operation and in those under 16 or over 50 (BCSH 2011), an annual influenza vaccine, and a card for the patient; **thrombocytosis follows**, so consider aspirin if the platelet count is above 1,000; Howell-Jolly bodies on film confirm asplenia.
- **Lymph nodes**: **acute lymphadenitis** follows a local infection (antibiotics, drain a node abscess); **tuberculous cervical lymphadenitis** (scrofula; common in Nepal and South Asia): painless, matted, **soft or fluctuant 'cold' abscess** with a collar-stud form (**'cold' because a granulomatous, caseating response lacks the heat, redness and pain of a pyogenic abscess**; the pus is full of bacilli), **investigation: FNAC (caseating granulomas; AFB, Xpert)**, **treatment: standard antituberculous drugs (2 months of four drugs and 4 months of two); aspirate fluctuant nodes with a wide needle through normal skin; incision causes a chronic sinus**; excision only for residual nodes or diagnosis. **Lymphangitis**: red streaks from a distal infection, treat with antibiotics.
- **Filariasis (Wuchereria bancrofti)**: **microfilariae appear in the blood at night (nocturnal periodicity, peak 10 pm to 2 am)**, so the **thick blood film is taken at night** (the daytime sample is often negative); the **circulating filarial antigen test (ICT or Og4C3) works at any time**. Acute filarial lymphangitis and adenolymphangitis give fever and inflammation spreading **distally from the node**, the reverse of bacterial lymphangitis; chronic stage: lymphoedema, **elephantiasis, hydrocele, chyluria**. **Treatment: diethylcarbamazine with albendazole (DA), or the triple-drug IDA regimen (with ivermectin) now recommended by WHO**; hygiene care of the limb prevents acute attacks. Nepal's programme used mass administration of DA (endemic districts: see Urology).

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