Oncology

Epidemiology

- Commonest cancers in the UK:
  - breast / prostate, lung, colorectal, bladder (men), gynae, melanoma, NHL
- Commonest causes of cancer death in the UK:
  - lung, breast, prostate, colorectal, ovarian, oesophageal, pancreatic

Gastrointestinal

Colorectal carcinoma (CRC)

- Majority adenocarcinomas resulting from metaplastic change of colonic polyps
- Risks - age (esp. > 65 years), IBD, FAP, HNPCC, Peutz-Jeghers, nulliparity, obesity, DM
  - protective factors may include NSAIDs, aspirin, HRT, folic acid
- Screening - FOB every 2 years for ages 60 - 69 years
- Symptoms (left-sided) - colicky pain, tenesmus, PR bleed, obstruction, bowel habit change
  - right-sided cancers more insidious with anaemia, FOB, metastasis
- Investigations - FOB, colonoscopy with biopsy, CT / MRI (staging), CEA (prognostic only)
- Management - surgery - hemicolectomy / anterior resection (low sigmoid) / AP (rectal)
  - radiotherapy - for rectal tumours (reduces local recurrence)
  - chemotherapy - if advanced / metastatic - FOLFOX (triple)
  - post-surgical follow-up - regular CT and CEA for 3 years; 50% 5-year survival
- Metastases - liver, peritoneum, lung, brain, bone
- Complications - fistulae e.g. colovesicular causing pneumaturia

Gastric carcinoma

- Relatively rare in UK (5000 / year) but common in Japan, China, South America
- Risks - age (esp. > 55 years), male sex, low SES, H. pylori, smoking, pernicious anaemia
- Symptoms - dyspepsia, dysphagia, regurgitation / vomiting, anaemia, abdominal pain
- Investigations - FBC (anaemia), endoscopy, CT (staging)
- Management - gastrectomy / chemotherapy (5FU), nutrition; 10% 10-year survival

Oesophageal carcinoma

- Increasingly common adenocarcinoma while SCCs (from alcohol / smoking) have declined
- Risks - smoking, alcohol, GORD (Barrett’s oesophagus), achalasia, Plummer-Vinson
- Symptoms - dysphagia, regurgitation / vomiting, melaena, appetite loss, hiccups
- Investigations - endoscopy, barium swallow, CT (staging)
- Management - endoscopic resection if small; consider photodynamic therapy (PDT)
  - oesophagectomy - if advanced; consider lymphadenectomy / chemoradiotherapy
Hepatobiliary

Hepatocellular carcinoma (HCC)

- Risks - cirrhosis - hepatitis, alcohol, HHC, PBC, metabolic syndrome, polycythaemia
- Investigations - USS, AFP, LFTs / clotting / albumin, CXR (raised right hemi-diaphragm)
- Prognosis - CLIP score (Child-Pugh, tumour morphology, AFP, portal venous thrombosis)
- Management - **surgical resection** with chemotherapy - if good liver function
  - if small - guided alcohol injection, radiofrequency / microwave ablation (<3cm)
  - if large - chemoembolisation / chemotherapy, transplantation
- **Milan criteria** for transplantation: < 4 lesions up to 3cm, no extrahepatic / vessel problems
- Metastases - lung, bone, brain

Cholangiocarcinoma

- Majority **ductal adenocarcinoma** at hepatic duct bifurcation (**Klatskin’s tumour**)
- Risks - age > 60 years, PSC (IBD), liver flukes, chemical exposure
- Symptoms - jaundice, hepatomegaly, RUQ pain, palpable gallbladder
- Investigations - LFTs, PT; USS, CT, MRI, ERCP
- Management - **resection** (inc. liver) with chemotherapy if resectable (30%)
  - radiotherapy - improves survival in un-resectable disease; ERCP stent - symptomatic

Lung

- 95% are bronchial carcinomas - metastases usually parenchymal, asymptomatic
  - majority are non-small cell - mostly squamous, adenocarcinoma, large-cell etc.
  - 15% are small cell - arise from APUD cells (hormone-producing)
- Symptoms - cough, dyspnoea, chest pain, haemoptysis, clubbing, fever, dysphagia
- Investigations - CXR, contrast/PET CT (staging), bronchoscopy, biopsy, pleural cytology
- Management - **smoking cessation**; primarily surgery if NSC or multi-chemotherapy if SC
  - lobar resection - in mild localised non-small cell disease - with nodal biopsy
  - radiotherapy - if unsuitable for surgery
  - chemotherapy - adjunct in severe disease e.g. cisplatin with vinblastine / gemcitabine
- Metastases - bone, brain, liver, adrenals
- Complications - Pancoast’s, SVCO, AF, erythema multiforme, hypercalcaemia (squamous)
  - small cell - SIADH, Cushing’s, hyperthyroidism, Lambert-Eaton, CTD, osteoarthropathy

Pancoast’s syndrome

- Invasion of cervical sympathetic plexus by apical lung tumour - typically squamous cell
  - rarely breast cancer, lymphoma, metastatic carcinoma, pneumonia, TB, amyloidosis
- Symptoms - Horner’s, shoulder / arm pain, intrinsic hand muscle wasting, RLN palsy
- Management - induction chemotherapy, tumour resection
Lymphoma

Hodgkin's lymphoma

- Malignant lymphoma characterised by Reed-Sternberg cells (multinucleated giant cells)
  - affects those aged 15 - 30 years or > 50 years; associated with EBV, HIV, smoking
- Symptoms - painless lymphoid swelling (esp. supraclavicular); may be cough, dyspnoea
  - in 25% - fatigue, fever, night sweats, weight loss, pruritis; pain may be alcohol-induced
- Investigations - FBC (anaemia), ESR, LDH, albumin, HIV; excisional biopsy, CXR, CT
- Staging - Ann Arbor (multiple regions, sides of diaphragm, symptoms, ESR)
- Management - chemoradiotherapy; pneumococcal / influenza vaccines
  - chemotherapy e.g. ABVD (multi-agent), up to 8 cycles if advanced - risk of leukaemia
  - 5% nodular lymphocyte predominant (NLPHL) - early stage with radiotherapy alone
  - follow-up - 4 / 2 time a year for first 2 years, then annually (e.g. FBC, ESR, TSH)
- Complications - leukaemia, solid tumours, melanoma, pancreatic ca., hypothyroidism, CVD

Non-Hodgkin's lymphoma

- More common than HL, more likely to disseminate; may be mature B or T cell-based
  - affects the middle-aged; associated with EBV, hep. C, toxins, autoimmunity, H. pylori
- Symptoms - painless progressive peripheral lymphadenopathy; and as for HL
- Burkitt's lymphoma - high-grade B cell from c-myc mutation, affects ileocaecal region
  - tends to present in children with painful abdominal mass and obstruction
  - may be jaw and thyroid swellings; CNS often involved - do BMA and LP
- MALT lymphoma - mostly gastric but also head, neck, lung, eye; tend to remain localised
  - tends to present in women aged > 60 years with dyspepsia, nausea, gastric bleeding
  - diagnose by endoscopy and gastric biopsy; consider CT if dissemination suspected
- Mycosis fungoides - cutaneous T cell affecting ‘bathing suit areas’ with patches / plaques
  - more commonly affects black men; may be associated with glass / pottery / ceramics
  - LDH and uric acid may be high in aggressive disease; skin biopsy shows Sézary cells
- Management
  - B-cell NHL - multi-chemotherapy (rituximab / CHOP); consider intrathecal methotrexate
  - Burkitt’s - multi-chemotherapy (highly effective); bone marrow transplant if extensive
  - MALT - H. pylori eradication therapy; chemoradiotherapy if advanced / extensive
  - Mycosis fungoides - topical steroids / chemotherapy, PUVA; chemotherapy if severe
Leukaemia

• Symptoms - **bone marrow failure** (to varying degrees), bony / cutaneous / CNS infiltration
  • anaemia (normocytic) - *fatigue*, pallor, dyspnoea, palpitations, pruritis
  • neutropenia - *recurrent infection* and *unexplained fever*
  • thrombocytopenia - *bleeding diathesis* e.g. epistaxis, petechiae, menorrhagia, DIC
  • high cell turnover - **splenomegaly** causing *LUQ pain* / *early satiety*

• Investigations - **blood film**, BMA, LDH / uric acid (high - cell turnover)
  • acute leukaemia involves relatively *immature* WBCs - counts may be low / normal / high
    • at least **20% blasts** in BMA and / or blood film diagnostic (WHO)
  • chronic leukaemia involves more *mature* WBCs - **leukocytosis** (usually neutropenic)

Chronic lymphocytic (CLL)

• Malignant monoclonal immature nonreactive B cell expansion
  • majority detected incidentally while asymptomatic; may be *lymphadenopathy*

• Investigations - FBC (**lymphocytosis**), blood film (smudge cells), p53

• Management - splenectomy; watch-and-wait if low grade; chemotherapy only if symptoms
  • multi-chemotherapy (CAP, CHOP); consider fludarabine with rituximab
  • allogenic bone marrow transplant - only cure but unlikely in elderly

• Complications - lymphoma (Richter’s syndrome - fever, pain, weight loss)

Acute myeloid (AML)

• Maturational arrest of myeloblasts with failure of apoptosis; may be 8;21 translocation

• Risks - advancing age, aplastic anaemia, PNH, PRV, Down’s, radiotherapy, chemotherapy

• Management - multi-chemotherapy; allogenic bone marrow transplant if severe
  • consider blood transfusion, antibiotics, allopurinol, leukophoresis

Chronic myeloid (CML)

• BCR-ABL (*tyrosine kinase*) 9;22 translocation - shortened chromosome 22 (**Philadelphia**)

• Phases - chronic (asymptomatic; majority diagnosed), accelerated, blastic (ALL-like, fatal)

• Symptoms - fever, **night sweats**, abdominal distension, LUQ pain (splenic infarction), gout

• Investigations - FBC (**selective leukocytosis**), blood film (**marrow-like**), cytogenetics

• Management - **imatinib** (TKI); bone marrow transplant if refractory

Acute lymphoblastic (ALL)

• Commonest childhood cancer - majority monoclonal B cell proliferation (12;21 translocation)

• Risks - FH, **Down’s**, radiation, ‘immunological naivety’

• Investigations - immunophenotyping / flow cytometry (differentiate from AML), cytogenetics

• Management - multi-chemotherapy (highly effective) then methotrexate maintenance

• Complications - cardiomyopathy, pulmonary fibrosis, growth delay, hypothyroidism, infertility
**Pancreatic**
- Majority exocrine **ductal adenocarcinoma** appearing after age 70 years
- Risks - smoking, alcohol, obesity, DM, chronic pancreatitis, FAP, Peutz-Jeghers, IBD, PUD
- Symptoms - epigastric / **back pain**, **painless jaundice**, steatorrhoea, **palpable gallbladder**
- Investigations - FBC (thrombocytosis), LFTs, glucose (high), CA19-9 (response monitoring)
  - **USS** (up to 85% sensitivity - esp. **endoscopic**), CT (staging)
- Management - **Whipple’s procedure** if resectable (15%) with **chemotherapy** e.g. 5FU
  - **chemotherapy** if un-resectable (majority) - **gemcitabine** - limited efficacy
  - biliary stents for jaundice, pancreatic supplements, **metoclopramide** for nausea
- Metastases - **liver**, peritoneum, lungs; 5% 5-year survival

**Prostate**
- Majority **adenocarcinoma** - slow-growing; at least 10% lifetime risk
- Risks - advanced age, FH (inc. breast cancer), meaty diet, farming, radiation
- Symptoms - LUTS, UTI, haematuria, haematospermia, perineal pain, impotence, tenesmus
- Investigations - **PSA**, TRUS, urinalysis, creatinine (renal disease), transrectal biopsy, CT
- Staging - **Gleason score** (differentiation - up to 10; > 7 has high risk of local progression)
- Management - watch-and-wait (Gleason < 7), bladder training, erectile dysfunction support
  - **prostatectomy** if localised; **radiotherapy** / brachytherapy if young, with anti-androgen
  - **anti-androgen therapy** if metastatic - **Goserelin** (with **cyproterone** for first 3wks - flare)
    - consider orchidectomy; chemotherapy as last resort
- Metastases - **bone**, lymphatics, liver, brain

**PSA**
- Protease enzyme that decreases semen viscosity - nonspecific for **prostate cancer**
- Elevated in BPH, urinary retention, prostatitis, catheterisation, ejaculation, UTI, DRE
- If elevated - transrectal biopsy; 1 / 3 with high PSA have prostate cancer

**Breast**
- **Ductal** or **lobular carcinoma** - may be *invasive* or *in situ*; lifetime risk **1 in 8 women**
- Risks - age, FH, BRCA1/2, TP53, nulliparity, early menarche, late menopause, combined HRT, chest radiation, not breastfeeding, alcohol; in men - gynaecomastia
- **Screening** - 3-yearly dual-image mammography for all women aged 50 - 70 years
- Symptoms - **breast lump**, may be painful (unusual); also nipple change / **bloody discharge**
- Investigations - mammography, **USS** (esp. younger), MRI, **core biopsy** / FNA
  - also **hormonal receptor** / **HER2** status, CA 15-3 (prognosis), CT (metastases)
- Staging - I (local, < 2cm), II (axillary node, < 5cm), IIIA (> 5cm) / B (spread), IV (distal mets)
- Management - **2 out of 3** suitable for **breast-conserving** surgery with radiotherapy
  - **wide local excision** with **sentinel node biopsy** if possible; mastectomy otherwise
• if hormonal receptor positive - **5 years** of adjuvant pharmacotherapy:
  • if *premenopausal* - tamoxifen (risk of VTE, endometrial cancer)
  • if *postmenopausal* - anastrozole (worsens menopausal symptoms)
• if HER2-positive - 1 year of herceptin (IV, risk of cardiotoxicity)
• if advanced / metastatic - adjuvant chemotherapy / DMARDs
  *Metastases - bone, liver, lung, brain*

**Paget’s disease of the breast**
• Rare **areolar carcinoma** often associated with underlying breast cancer (40% DCIS)
  • may rarely be extramammary carcinomas e.g. Bartholin’s gland, bladder, vagina, cervix
• Symptoms - *eczematous nipple changes* - erythema, scale, pruritis erosions, discharge
• Investigations - biopsy, immunohistochemistry, mammography, MRI
• Management - aim for breast-conserving surgery with radiotherapy / chemotherapy
  • associated breast cancers tend to be hormone receptor negative

**Cervical**
• Majority **squamous cell carcinoma**; less commonly adenocarcinoma, may be mixed
  • **CIN** (epithelium-limited disease) - I (basal third), II (two thirds), III (full thickness)
  • **invasive** if breaches basement membrane - micro-invasion if < 5mm
• Risks - **HPV** (16, 18, 31, 33), multiple sexual partners, smoking, COCP, low immunity
• Symptoms - **vaginal discharge, IMB**, vaginal pain, urinary frequency, haematuria
• Investigations - Chlamydia (IMB), colposcopy / biopsy; CT / MRI (staging)
  • only biopsy provides definitive histological diagnosis e.g. CIN
• Staging (FIGO) - 0 (CIS), I (cervix only), II (beyond uterus), III (pelvic wall), IV (distant mets)
• Management - **loop excision diathermy** if CIN-II / III (risk of pre-term delivery)
  • cone biopsy if micro-invasive stage I
  • radical trachelectomy (80% of cervix) if node-negative early disease - impairs fertility
  • Wertheim’s hysterectomy if node-negative invasive disease - risk of urinary retention
  • chemoradiotherapy if beyond late stage I - risk of urinary / bowel frequency
• Prognosis - at least 90% in stage I, > 60% stage II, > 30% stage III, 20% stage IV

**Smear testing**
• Screening **three-yearly** for women aged 25 - 49, then five-yearly until age 65
  • liquid-based cytology performed with minimally lubricated disposable plastic speculum
  • dyskaryosis may be *borderline* (5%), *mild* (5%), *moderate* (1%), *severe, glandular*
• Mild / moderate / severe may correlate with CIN I / II / III but histology still required
• **Colposcopy** if high-risk **HPV**, 3 consecutive borderlines, 2 milds < 6 months apart or above
Ovarian

- Majority **cystadenocarcinoma** (serous / mucinous); also **germ cell** in younger women
  - affects 2% of women over lifetime, mostly presenting late - aged > 60 years
- Risks - HRT (after 5yrs), nulliparity, early menarche / late menopause, HNPCC, BRCA
  - COCP relatively protective
- Symptoms (late, insidious) - abdominal pain / bloating / mass, fatigue, urinary frequency
- Investigations - **CA-125**, USS (abdomen / pelvis); **CT** if suggestive; AFP, hCG (germ cell)
- Staging - I (ovarian), II (pelvis), III (extra-pelvic), IV (distant mets e.g. hepatic)
- Management - **radical surgery** (debulk) with **chemotherapy**
- Prognosis - 5-year survival 35%

Endometrial

- Majority **oestrogen-dependent adenocarcinoma** (endometrioid); also mucinous / clear cell
  - affects 1% of women aged > 50 years; strongly associated with **unopposed oestrogen**
- Risks - nulliparity, late menopause, obesity, HNPCC, tamoxifen
  - COCP and combined HRT relatively protective
- Symptoms - **PMB**; less commonly IMB in younger patients
- Investigations - **TVUS** (> 5mm endometrial thickness), biopsy, hysteroscopy, MRI (mets)
- Staging - I (uterine), II (cervix), III (vaginal / nodal mets), IV (bladder / bowel / distant mets)
- Management - **TAH / BSO** if stage I (majority), **radiotherapy** if high recurrence risk
  - intermittent paracentesis may be required for recurrent ascites
- Prognosis - 5-year survival 90% in stage I, 75% stage II, 50% stage III, 20% stage IV

Renal

- Majority **renal cell** (clear cell) **carcinoma** associated with mutations in chromosome 3
- Risks - smoking, obesity, HTN, dialysis, renal transplant
- Symptoms - **haematuria**, **loin pain**, **loin mass**; may be varicocele, ankle oedema, pyrexia
  - paraneoplastic - polycythaemia (EPO), hypercalcaemia (PTH), abnormal LFTs
- Investigations - **CT**, CXR (‘cannon ball’ mets), skeletal survey
- Management - **partial nephrectomy** if small localised, **interferon** / TKI if metastatic
- Metastases - **lung**, bone, liver, pancreas

Wilm’s nephroblastoma

- Common childhood malignancy affecting aged < 5 years; 10% bilateral
- Symptoms - **abdominal mass**; may be pain, haematuria, UTI, HTN
- Investigations - USS (hydronephrosis), CT / MRI
- Management - **nephrectomy** with chemotherapy (vincristine / doxorubicin) often curative
- Complications - later osteosarcoma, breast cancer, lymphoma, melanoma, leukaemia
Bladder cancer

- Majority transitional cell carcinoma; in developing countries SCC due to schistosomiasis
- Risks - smoking, dyes / paints / solvent exposure, potentially coffee
- Symptoms - haematuria - usually painless and with no palpable mass
- Investigations - cystoscopy, IVP, urine cytology, CT, USS (latter may miss small tumours)
- Management - transurethral resection with intravesical chemotherapy if non-invasive
  - if invasive - cystectomy with ileal urostomy; radiotherapy if unfit for surgery
  - if metastatic - chemotherapy (cisplatin)
- Complications - UTI, urinary retention, hydronephrosis; erectile dysfunction in cystectomy

Acoustic neuroma

- Tumour of Schwann cells of vestibulocochlear nerve (CNVIII) - majority vestibular
- Symptoms - unilateral sensorineural hearing loss, tinnitus, vertigo, facial paraesthesia
  - also absent corneal reflex - useful to differentiate from Ménière’s disease
- Investigations - audiology, MRI
- Management - conservative if small (many do not grow)
  - microsurgery - risks of meningitis, cerebellar injury, stroke, epilepsy, hearing loss
  - radiosurgery - non-curative but limits growth; risks of CN / brain injury, glioblastoma

Brain

- Majority glioma (oligodendrogioma, glioblastoma); also meningioma
- Symptoms - high ICP, seizures, progressive focal neurology, sensorineural deafness
- Glioma - may appear as ‘ring enhancing’ lesion on CT / MRI; 30% 1-year survival
  - surgical resection if possible; radiotherapy prolongs survival
- Meningioma - benign dura mater tumours; often express somatostatin receptors
  - endovascular embolisation pre-surgery with systemic steroids and anti-epileptics

Testicular

- Majority germ cell (seminoma, Leydig / Sertoli cell); lifetime risk 1 in 200
  - associated with mutation of chromosome 12, X chromosome TGCT1
- Risks - cryptorchidism, FH, Kleinfelter’s, infertility, low birthweight, breech delivery, hernia
- Symptoms - testicular swelling (may be painful), trauma, hydrocele, gynaecomastia
- Investigations - USS; AFP, hCG, LDH, CT (staging); assess contralateral testis for CIS
- Staging (Royal Marsden) - I (local), II (nodes below diaphragm), III (above), IV (distal mets)
- Management - ideally inguinal orchidectomy with testicular prosthesis, sperm salvage
  - consider chemotherapy (always if stage II or above) - BEP (cisplatin-based)
- Complications - infertility, treatment toxicity - neutropenia, alopecia, deafness, AVN
- Metastases - bone, liver, lung, brain (choriocarcinomas have worst prognosis)
Thyroid

- Majority papillary thyroid carcinoma (PTC) - small, local invasion, mets to lung and bone
- Also follicular (low iodine), medullary (CEA / calcitonin secreting), anaplastic (aggressive)
- Symptoms - thyroid nodule (hard, non-tender), hoarseness (RLN involvement)
- Investigations - USS, FNA, TFTs (often euthyroid), calcitonin (MTC); CT / MRI, PET (mets)
- Management - thyroidectomy with radioiodine ablation; monitor thyroglobulin, consider T4
- Metastases - lung, bone, liver, brain

Bone

Myeloma

- Clonal plasma cell expansion - high levels of single immunoglobulin (paraproteinaemia)
  - usually IgG; affects elderly men (Afro-Caribbean > Caucasian)
- Symptoms - bone pain (esp. back), pathological fractures, cord compression, anaemia
  - also dehydration, nausea, constipation, bleeding, hyperviscosity syndrome
- Investigations - FBC, U&E, ESR / plasma viscosity, calcium, Ig; BMA, CXR / skeletal survey
  - electrophoresis - serum and urine - Ig type / Bence-Jones protein
- Prognosis - β2 microglobulin / albumin levels (high albumin / low B2 better prognosis)
- Management - chemotherapy, high-dose steroids, allogenic stem cell transplantation
  - bisphosphonates and painkillers (avoid NSAIDs; consider anti-neuropathic agents)
- Complications - hypercalcaemia, anaemia, osteoporosis, renal impairment, amyloidosis

Osteosarcoma

- Malignant tumour of long bone metaphyses - mostly knee or proximal humerus
  - tends to affect children aged 15 - 20 years, more often boys; associated with Paget's
- Symptoms - pain with activity, limp, swelling; metastases - lung

Ewing’s sarcoma

- Rare childhood tumour of neuroectoderm causing swelling of long bones / chest / skull
- Symptoms - local pain and erythema, malaise, fever, paralysis, paraesthesia, incontinence
- Management - chemotherapy; surgery usually required, consider adjuvant radiotherapy

Multiple endocrine neoplasia (MEN)

- MEN-I - parathyroid (95%), gastrinoma / insulinoma, prolactinoma, lipoma
  - autosomal dominant mutation of chromosome 11
  - causes hyperparathyroidism, Zollinger-Ellison, hypos, amenorrhoea, acromegaly
  - surgery often indicated e.g. pancreatoduodenectomy, trans-sphenoidal surgery
- MEN-II - MTC, phaeochromocytoma, parathyroid hyperplasia; 2B - Marfanoid, SUFE
  - mutation of chromosome 10
Cancer complications

Chemotherapy side effects

- Commonly myelosuppression, hair loss, sterility, delayed healing, nausea, vomiting
- Extravasation of cytotoxics may result in skin necrosis, blistering, amputation

Superior vena cava obstruction (SVCO)

- May be extramural (extrinsic compression), intramural (tumour) or intralumenal (thrombus)
  - majority due to lung cancer; also lymphoma, pericarditis, goitre / thyroid ca., aneurysm
  - SVC drains head, neck, upper limbs, upper thorax
- Symptoms - dyspnoea, dry cough, chest pain, facial / arm oedema, dizziness, nausea
  - exacerbated by bending over, lying down, raising arms; relatively relieved by standing
- Investigations - sputum cytology, supraclavicular lymph node biopsy, bronchoscopy
- Management - endovascular stents; consider steroids, chemoradiotherapy, anticoagulants

Tumour lysis syndrome

- Most commonly within 5 days of treatment of haematological malignancy
- Symptoms - weakness, ileus, arrhythmias, seizures, AKI
- Investigations - lactate / LDH (high), uric acid (high), U&Es (high K / Ph), calcium (low)
- Prophylaxis - sodium bicarbonate IVT, acetazolamide, allopurinol

Leukostasis

- High WBC associated with acute leukaemias - leucocytes act as thromboemboli
- Symptoms - fever, respiratory distress, stroke / focal neurology, MI, retinal haemorrhage
- Management - chemotherapy (high risk of tumour lysis syndrome)

Hyperviscosity syndrome

- Most commonly due to raised serum Ig e.g. myeloma, leukaemia, RA, polycythaemia
- Symptoms - lethargy, headache, seizures, blurred vision, haemorrhage, RTA, cardiac failure
- Management - plasmapheresis, venesection (polycythaemia), chemotherapy