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'All care, no responsibility'
Feedback and corrections greatly appreciated

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Acid-Base Summary

HCO3 = 24
PCO2 = 40
BE = -3 to +3

Metabolic

Acidosis Exp pCO2 =(1.5 x HCO3) + 8
Alkalosis Exp pCO2 = (0.7 x HCO3) +20
Observed > expected = concurrent respiratory acidosis
Observed < expected = concurrent respiratory alkalosis

Respiratory

Acidosis Acute: 1 for 10: HCO3 = (pCO2 - 40)/10 x 1
Chronic: 4 for 10: HCO3 = (pCO2 - 40)/10 x 4
Alkalosis Acute: 2 for 10: HCO3 = (pCO2 - 40)/10 x 2
Chronic: 5 for 10: HCO3 = (pCO2 - 40)/10 x 5
Observed > expected = concurrent metabolic alkalosis
Observed < expected = concurrent metabolic acidosis

Anion Gap

AG = Na + K - HCO3
Normal = 12
Low albumin falsely elevates AG - for every drop by 10 in albumin, drop AG by 3

Incr AGMA + met alkalosis + resp alkalosis = sepsis/salicylates
Major disturbance always in same direction as pH

Delta Ratio

$$\frac{AG - 12}{24 - HCO3}$$

<0.4	hyperchloraemic NAGMA
0.4 - 0.8	NAGMA + AGMA
0.8 - 2	AGMA
> 2	AGMA + metabolic alkalosis or chronic respiratory acidosis

A-a gradient

PAO2 = (FiO2 x 713) - (PaCO2 x 1.25)
A-a gradient = pAO2 – paO2
Normal A-a gradient = < (age/4) + 4

Hypoxic + Raised A-a gradient – V/Q mismatch, shunt, diffusion block (fibrosis)
Hypoxic + Normal A-a gradient - hypoventilation or low FiO2 (eg altitude)

Osmolar gap

Calculated serum osm = (2 X Na) + Ur + Glu + ETOH
Osmolar gap = measured - calculated
Normal osmolality = 270-290
Normal osmolar gap = -4 to +10

Raised osmolar gap:
- Alcohols - ethanol, methanol, EG
- Ketones - DKA, AKA, acetone
- Sugars - mannitol
- Lactate
- Proteins, lipids, excessively high ions (Mg, Ca, phos)

Corrected Na

Corrected Na = Na + $\frac{Glucose - 5}{3}$

Corrected K+

0.1 decr in pH - 0.5 incr in K

U:C ratio

U:C >100 - pre-renal failure

Lactic acidosis

Type A	Decr O2 delivery: shock, hypoxia, severe anaemia, CO poisoning
	Incr O2 demand: seizure, pyrexia, exercise, shivering
Type B1	Systemic disorders: leukaemia, lymphoma, thiamine def, pancreatitis, short bowel
	Decr metabolism: hepatic failure, renal failure, hypothermia, DM, sepsis
Type B2	Drugs/toxins: EtOH, toxic alcohol, Fe, salicylates, isoniazid, cyanide, CO, metformin
Type B3	Inborn errors of metabolism

AGMA

Ketones	DKA, AKA, starvation
Lactate	Type 1 (shock), Type 2 (metabolic)
Renal failure	
Toxins	Alcohols, salicylates, iron, cyanide, valproate, metformin, paracetamol

NAGMA

Chloride gain	Normal saline
Bicarb loss	GI: diarrhoea, fistulas
	GU: RTA, Addisons, acetazolamide

Cl retained when HCO3 lost to maintain electroneutrality

Most common causes - EDA:
Extra Cl - high K, urinary Na <10
Diarrhoea - low K, urinary Na <10
Adrenal insufficiency - high K, low Na, urinary Na >10

Low AG

Low albumin
High unmeasured cations (Ca, Mg, Li)
Falsely elevated Cl (bromide, iodide)
Nitrites
Myeloma

Metabolic Alkalosis

Most common causes: vomiting, diuretics, incr aldosterone

Chloride loss (saline responsive, Urine Cl <10)
- kidney reabsorbs HCO3 > Cl to maintain electroneutrality
- aka contraction alkalosis (fluid loss - decr renal perfusion - incr aldosterone - loss H/reabsorp HCO3)
  - GI: vomiting, NG suction
  - GU: diuretics
  - Skin loss: burns

Potassium loss (saline resistant), Urine Cl >10, often hypertensive)
- Syndromes: Cushings, Conns, Bartters
- Eating disorders
- Excess liquorice

Excess base (saline resistant, Urine Cl >10, normotensive)
- Antacids, milk-alkali, bicarb, citrate (dialysis, transfusion)

Respiratory Acidosis

1. Decreased respiratory drive - decr RR

CNS	CVA, tumour, encephalitis, haemorrhage, spinal cord lesion above C4
Drugs	Narcotics and sedatives, ETOH

2. Decreased chest wall movement - decr TV

Neurological	NM disorders, Guillain-Barre, Myasthenia gravis, demyelinating, tetanus, spinal trauma
Toxicity	Muscle relaxants, Organophosphates, fentanyl, spider+snake venom
Respiratory	Trauma, surgery, chest wall deformity, tension pneumo, pleural effusion, airway obstruction
Muscular	Electrolyte abnormality, myopathy, muscular dystrophy
Equipment	Increased dead space, improper connection

3. Obstructive pulmonary disease - incr dead space
COPD, asthma, pneumonia, very severe croup, angioedema, severe pulm oedema, inhaled FB, aspiration

Respiratory Alkalosis

Full compensation in pregnancy and at altitude
1. Stimulated respiratory drive

CNS	CVA, ICH, psychogenic, cerebral oedema, hepatic encephalopathy
Hyper-metabolic	Thyrotoxicosis, Pregnancy, early sepsis, DT, anxiety, pain, DKA and aspirin OD
Environmental	Hyperthermia, altitude related, exercise
Drugs	Aspirin OD, ammonia, progesterone, theophylline, CO, stimulants
Iatrogenic	Mechanical ventilation

2. Hypoxemia induced
Pneumonia, PE, asthma, Congenital heart disease, Chronic altitude comp, early altitude, pulm oedema

3. Compensation for metabolic acidosis

Use of Bicarbonate

1. Hydrofluoric acid toxicity
2. Correction of severe metabolic acidosis
3. Prolonged cardiac arrest (evidence unclear)
4. Cardiotoxicity secondary to fast Na channel blockade
5. Urinary alkalinisation in OD - enhanced elimination
6. Prevention of drug redistribution to CNS – incr unionized amount of drug - Salicylates
7. Severe hyperK
8. RTA

Electrolytes Summary

Hyponatraemia

Mild >125	Mild GI Sx (anorexia, N+V)
Moderate 120-124	Lethargy, confusion, muscle weakness
Severe <120	Decr LOC, seizures; brainstem herniation, cerebral oedema, osmotic demyelination

1. Hypertonic: Osm >295
Glucose, mannitol
2. Isotonic: Osm 275-295
aka pseudohyponatraemia: incr lipids, incr protein (myeloma, Waldenstroms)
3. Hypotonic: Osm <275
Due to: solute depletion or solute dilution

a. Hypovolaemic (most common):
Loss of Na > H20
Renal (urine Na >20)
Diuretics, osmotic diuresis
Addisons
Na losing nephropathy (RTA, CRF)
Extrarenal (urine Na <20)
Upper GI: vomiting
Middle GI: pancreatitis, bowel obstruction
Lower GI: diarrhoea
Others: sweat, bleeding, burns
Management: give N saline; correct at <0.5mmol/hr or <12mmol/day; aim to get Na >125

b. Euvolaemic:
SIADH
Hypothyroid
Water intoxication: psychogenic, iatrogenic (TURP syndrome)
Drugs: SSRI/TCA/MAOI, ecstasy, oxytocin, carbamazepine, NSAIDs, omeprazole
Test urine osmolality: <100mosm/L = primary polydipsia; >100mosm/L = SIADH or endocrine
Management: fluid restrict to 500-1500ml/day; consider ADH antagonist if SIADH

c. Hypervolaemic:
Incr H20 >> Na
ARF
CHF, cirrhosis, nephrotic syndrome
Management: fluid and salt restrict; diuresis (loop); dialysis

Hypertonic saline
Indications: coma, seizure, new onset profound decr LOC; not indicated if asymp
Give 25-100ml/hr (1-2ml/kg/hr) 3% saline via CVL
Can give more rapidly (500ml or 4-6ml/kg bolus over 10mins) if seizing
Endpoint: Sx resolved/Na incr by 8-20mmol/L/Na >125
Aim for correction of 1mmol/L/hr (max 10-14mmol/L/day)
SE: central pontine myelinosis (osmotic demyelination) if too rapid correction of chronic (>48hr)

SIADH

Hypotonic (<275) hyponatraemia (<130)
Inappropriately high urine osmolality (>100)
Elevated urine Na >20
Clinically euvolaemic
Normal cardiac, renal, adrenal, thyroid, liver function
Correctable with water restriction

Causes:
Malignancy (ectopic ADH) - lung (small cell, mesothelioma), GI, GU, lymphoma, sarcoma, thymoma
Pulmonary - pneumonia, COPD, lung abscess, TB
CNS - infection, abscess, AIDs, trauma, stroke
Drugs - cytotoxics, antidepressants, antipsychotics, desmopressin, oxytocin, vasopressin

Hypernatraemia (Na >150)

1. Iatrogenic, incapacitated
    - NaHCO3, hypertonic saline
    - Formula (infants), neglect (elderly)
2. Pure water loss (H20 > Na) - hypovolaemic
    - Renal = osmotic diuresis (glucose), diuretics
    - Extra-renal = diarrhoea, blood loss, third spacing
        - Rx: Normal saline resus then 1/2 normal saline
        - Water deficit (L) = 1L per 3-5 incr Na = (0.6 x kg) x ((Na-140)/140)
        - Give deficit + maintenance (1500ml/day in adults), with 50% over 24hrs, 50% over 48hrs
        - Correct for ongoing losses
        - Too rapid correction - cerebral oedema; correct at <0.5mmol/L/hr or 10-15mmol/L/day
3. Aldosterone excess - hypervolaemic
    - Primary: Conns, Cushings
    - Secondary: CCF, cirrhosis, nephrotic syndrome, dehydration
        - Rx: frusemide + free water. Dialysis if renal failure
4. Diabetes insipidus - euvolaemic
        - Rx: same as euvolaemic without fluid bolus. ADH or DDAVP

Symptoms occur with Na >158

Osm 350 – 375	Restlessness, irritability, thirst, anorexia, N+V
Osm 375 – 400	Tremor, ataxia
Osm 400 – 430	Hyperreflexia, twitching, spasticity
Osm >430	Seizures, death; subcortical and SAH

Na 150 – suggests dehydration
Na 170-190 – suggests DI
Na >190 – suggests incr Na intake

Children: if mod: paedialyte no more than 15ml/kg/hr
use 0.45% saline + 2.5% dex and replace over 48hrs
if severe: use 0.45% saline + 2.5% dex and replace over 72-96hrs

Diabetes Insipidus

Inability to concentrate urine - large amounts of severely diluted urine
Failure of:
- production of ADH (central DI: neoplasm, pituitary surgery, trauma, idiopathic)
- response to ADH (nephrogenic DI: hypercalcaemia, hypokalaemia, renal disease, lithium, sickle)

serum osmolality > 290 mosmol/L
serum [Na+] > 145 mmol/L
urine osmolality < 150 mosmol/L
Fluid deprivation test - should make less, more concentrated urine - does not happen in DI
Desmopressin test - if central will concentrate urine (kidneys respond normally), if renal remains dilute

Hypokalaemia

1. Artefact/spurious (drip arm)
2. Decreased intake
3. Redistribution (Intracellular shift)
    - Alkalosis
    - Insulin
    - Beta agonists
4. Increased loss
    - GI (urine K <20): D+V+NGT, malabsorption, fistula, villous adenoma
    - Renal (urine K >20): RTA, diuretics
    - Hyperaldosteronism
        - Primary: Conns, Cushings, Bartters
        - Secondary: volume contraction (incr RAAS)
    - NB: acidaemia + low K+ = doesn't fit - means profound whole body K+ deficit - explained by RTA

ECG: long PR, T flattening/inversion, U waves (can mimic prolonged QTc), ST depression, VF/VT, atrial arrhythmias

Hyperkalaemia

1. Artefact/spurious (old specimen, WCC >600, haemolysed, iv arm, incr plt, clotted)
2. Incr intake
    - K supplements

GI bleeding
Transfusion

3. Redistribution (ie. extracellular shift)
Acidosis
Tissue damage - trauma, crush, burns, rhabdo, tumour lysis, post-op, hyperthermia
Haemolysis
Drugs - digoxin OD, sux, ACEi, b blockers, insulin deficiency

4. Decr renal excretion
Renal failure
Addisons
K+ sparing diuretics, CA inhibitors, NSAIDs
RTA type 4

6-7: tall peaked T waves (>5mm)
7-8: QRS widening, small P waves
8-9: fusion of QRS complex with T wave - produces sine wave
>9: AV dissociation, VT, VT
10-12: VF, asystole, sinus arrest/brady, CHB

Management
Aims: membrane stabilisation, intracellular shift of K, removal of K from body
Ca Gluconate/chloride 10%: 10-20ml 10% Ca glu, 5ml CaCl 10% over 1-5mins
Beta-agonists, (Ca resonium), Insulin and dextrose, NaHCO3
Frusemide, Dialysis

Hypocalcaemia
1. Spurious: Hypoalbuminaemia or Hyperventilation → alkalosis → ↑protein binding (exchanges for H+)
2. Decr calcium absorption: Vit D deficiency/resistance, malabsorption, CRF
3. Incr calcium excretion: EtOH, diuretics, salt-wasting nephropathy
4. Endocrine: Hypoparathyroid, pseudohypoparathyroid (PTH resistance)
5. Shifts: alkalosis, rhabdo, pancreatitis (saponification)
6. Others: phosphate (enemas), citrate (transfusion, dialysis)

ECG: Prolonged QT (no U waves), heart block

Hypercalcaemia
3.0-3.5 mmol/L = mild symptoms: ECG CHANGES start
3.5-3.8 mmol/L = weak, lethargic, confused, polyuria, polydipsia
>3.8 = stupor/coma
> 4.0 = cardiac arrest

1. Spurious: Hyperalbuminaemia, Sample after venous stasis (tourniquet)
2. Malignancy (50%): Paraneoplastic eg PTHrP, bone mets
3. Hyperparathyroidism (25%): primary and tertiary
4. Vitamin D excess: ingestion, lymphoma, sarcoidosis
5. Milk-Alkali syndrome
6. Thyrotoxicosis
7. Thiazides

ECG changes:
ST depression, Short QT, Wide T wave
Bradyarrhthymias, BBB - 2nd degree block - 3rd degree block
Potentiates digoxin toxicity
Ca2+ > 4.0 - ARREST

Management
iv fluids (aim UO ~100ml/hr)
+/- frusemide (for fluid overload)
Bisphosphonates (interferes with osteoclast function, more potent than calcitonin, takes few days to work)
Calcitonin (incr Ca excretion, inhibit osteoclasts, works 4-6hrs, lowers Ca 0.25-0.5 mmol/L max)
Glucocorticoids (incr urinary excretion, decr calcium absorption)
Dialysis if oliguric

Hypomagnesaemia

1. GI: poor nutrition, malabsorption, diarrhoea, Crohns
2. GU: alcohol, diuretics, diabetes, nephrotoxic drugs, hypercalcaemia, Gittlemans and Bartters
3. Intracellular shift: adrenergics
4. Endocrine: hyperthyroidism, hyperparathyroidism
5. Pancreatitis

ECG: risk of AF and SVT after AMI, increases effects of digoxin toxicity, prolonged QT, risk torsades

Hypermagnesaemia

1. Decr excretion: renal failure
2. Incr intake: Rx pre-eclampsia, epsom salts, antacids, enemas
3. Release from cells: tumour lysis, rhabdo

>3.0: N/V/flushing
>4.0: decreased DTRs, drowsy, unsteady
>5.0: ECG changes (QRS widening, PR prolongation)
>6.0: stupor, hypotension, bradycardia
>10: absent reflexes, muscle paralysis
>15: heart block, apnoea

Management

Remove exogenous magnesium
Give calcium
iv fluids + frusemide
Consider dialysis if renal failure

Uses of magnesium

1. Torsades
2. Digoxin toxicity
3. Pre-eclampsia/Eclampsia
4. Asthma
5. AF
6. Irukandji Syndrome
7. Resistant hypokalaemia
8. Symptomatic hypomagnesaemia and Mg^{2+} < 0.5 mmol/L

1g = 4mmol = 8meq
1 Ampoule = 10mmol = 2.47g
Dose: 10mmol over 10-15mins for emergency indications
Faster for life-threatening arrhythmias

Hyperchloraemia

NAGMA
Usually due to excess saline

Hypochloraemia

Due to associated hyponatraemia

Hypophosphataemia

1. Intracellular shift (resp alkalosis, CHO/insulin, catecholamines/beta agonist, leukaemia, hungry bone syndrome)
2. Incr urinary excretion (alcoholism, hyperpara, acute volume expansion, diuretics, malignancy
3. Decreased intestinal absorption (alcoholism, malnutrition, malabsorption, phosphate-binding antacids)
4. Hypothyroidism
5. Severe sepsis, DKA, AKA, TPN

Hyperphosphataemia

1. Spurious (haemolysis, myeloma)
2. Incr intake: exogenous (enema), tumour lysis, rhabdo
3. Decr excretion: CRF, Vit D intoxication

Cardiology Summary

ACS

High Risk criteria for short term adverse outcomes in NSTEMI
Recurrent or prolonged pain
Enzyme rise
ECG changes (ST depression >0.5mm or TWI >2mm)
Haemodynamic compromise
Sustained VT
Known reduced LV function (EF <40%)
Previous CABG or stents within last 6/12
DM
CRF

TIMI Score - Risk stratification
1. STD >1mm
2. 2+ angina episodes in 24hrs
3. 3+ cardiac risk factors (HTN, DM, smoking, chol, FHx)
4. Raised troponin
5. Known coronary stenosis >50%
6. Age >65
7. ASA use in last 7 days

0: low risk (<2% 14 day event rate)
1-2: intermediate (5-10%)
3+: high (>10%)
6-7: very high (40%)

Pros: not dependent on physiological variables; validated; applicable to all; good performance in short term
Cons: doesn't weight RF's; can't be used in decision making in ED; 0 score still 2%; subjective variables

Cardiac markers
False +: sepsis, CRF, cardiac OT/trauma, myocarditis, TTP, large PE, muscle diseases (DMD), CCF, haemolysis

Management
High risk ACS/unstable angina/NSTEMI: aspirin + clopidogrel + LMWH +beta-blocker
Oxygen: If low SaO2
Nitrates: IV infusion 10mcg/min (to 200mcg/min)
CI: pre-load dependent states: RV infarction; AS, MS; hypotension, sildenafil

Antiplatelet Agents
Aspirin
Clopidogrel
ADP receptor antagonist - decr plt aggregation
300mg for thrombolysis; 600mg for PTCA; give to NSTEMI - 75mg/day
CI: emergency CABG within 5 days
G IIb/IIIa RA (eg. abciximab, eptifibatide) - only if for PTCA

Anticoagulants
LMWH 1mg/kg SC BD
Beta-blockers
Pros: Decr infarct size, reinfarction and mortality by 50%**;** Decr rate cardiac rupture**;** Decr risk ICH
Cons: Worsens Sx with large infarct/LVF, but still improves mortality
Trt: metoprolol 50mg PO BD – aim to start within 24hrs
CI: CCF, >70yrs, SBP <120, HR >110 / <60, PR >0.24, HB, active COPD/asthma, ETT planned
Ca channel antagonists Give if BBs contraindicated
ACEi Pros: Decr risk death/MI/CVA/LV dysfxn/short term mortality**;** prevent adverse cardiac remodeling

Acute reperfusion
Aim: to salvage penumbra
SE: reperfusion arrhythmias (Sinus brady, VEBs, nonsustained VT)

PTCA

Indications: Presentation <1hr available <60mins
Presentation 1-12hrs available <90mins
Presentation >12hrs haemodynamically unstable

Rescue angioplasty - <50% improvement STE within 90mins thrombolysis
cf thrombolysis: 1-2% absolute mortality advantage; Decr reinfarction rates 2-4%; 1% fewer ICH's

Thrombolysis

Tenecteplase bolus weight based ~ 0.5mg/kg (range 30-50mg)
Cons: not readily available; Expensive; Delay to trt; Requires IV contrast (CI in CRF); stent occlusion

Absolute contraindications

- Risk of bleeding
  - active bleeding or bleeding diathesis
  - significant head or facial trauma 3/12
  - suspected aortic dissection
- Risk of ICH
  - any prior ICH
  - ischaemic CVA 3/12
  - AVM, intracranial malignancy

Relative contraindications

- Risk of bleeding
  - current anticoagulation
  - non-compressible vascular puncture
  - recent major surgery <3/52
  - prolonged CPR >10mins
  - recent internal bleed <4/52
  - active peptic ulcer
- Risk of ICH
  - Poorly controlled HTN
  - Severe HTN at presentation >180, >110
  - Ischaemic stroke >3/12
  - Pregnancy

If bleed: stop infusion
10u cryo, 1u plt, protamine (if heparin on board; 1mg for every 100iu heparin given over past 15mins), 2u FFP, ?TXA

MI Complications

Early:

Arrhythmias, RV infarction; CCF, MR
Ventricular septal rupture (L-R shunt)
Myocardial rupture
Pericarditis
Papillary muscle rupture - MVR

Late:

LV aneurysm
Mural thrombus, DVT, PE
Dressler's syndrome

Inferior MI complications

Bradyarrhythmias - sinus brady, heart blocks
RV infarct causing cardiogenic shock
Papillary muscle rupture causing acute MR
Ventricular arrhythmias - VF, VT

STEMI Mimics

Aortic dissection
Prinzmetal's
Pericarditis, Myocarditis
Benign Early Repol
LV Aneurysm (anterior Q, STE)
Brugada Syndrome (RBBB & ant STE)
Raised ICP
Cocaine – vasospasm

Anti-Arrhythmics

Class I - Na channel blockers
Ia - ECG: prolong QRS and QT
Procainamide, Quinidine
Ib - ECG: minimal
Lignocaine, Phenytoin
Ic - ECG: wide QRS; incr PR; more pro-arrhythmic than Ia
Flecainide

Class II - Beta-blockers
ECG: long PR, heart block
Beta-1 selective: atenolol; bisoprolol
Beta-1 > beta-2: metoprolol
Non-selective: propanolol (also has Na blocking)

Class III - Potassium channel blockers
ECG: prolonged PR, QRS, QT
Amiodarone, Sotalol

Class IV - Ca channel blockers
ECG: prolonged PR
Dihydropyridines (nifedipine, felodipine, amlodipine – vasodilation without negative inotrope, reflex tachy)
Verapamil, Diltiazem

Atrial Fibrillation

Causes of AF
Cardiac - HTN, valvular disease, IHD, CHF, cardiomyopathy, genetic, post cardiac surgery, sick sinus.
Non-cardiac: hyperthyroidism, sepsis, alcohol, OSA, COPD, stimulants

Management
Unstable - electrical synchronised cardioversion
Stable - treat underlying cause (ischaemia, electrolytes, sepsis)
- correct electrolytes
- fluids (unless CHF)
- rate vs rhythm control
    - need for cardioversion (stable vs unstable)
    - risk thromboembolism (>48hrs needs anticoagulation +/- TOE)
    - patient factors: preference, contraindications, comorbidities, likely precipitant, symptoms

Favouring rhythm control
Symptomatic
Young <65
Suspected lone AF
Precipitating condition resolved
No HTN
No previous failure of antiarrhythmics
Patient preference

Pros: improved QOL in active patients (able to exercise)
Cons: less likely to be effective if >65, late presentation, recurrent AF, valvular disease, cardiac failure

Chemical cardioversion
Pros: avoids procedural sedation, can be used to maintain SR (amiodarone)
Amiodarone 300mg iv over 1hr then 900mg over 24hr. CI: long QT, heart block
    Cons: thyroid, lung fibrosis, skin discolouration, drug interactions, long half life
Flecainide 150mg slow iv. CI: structural heart disease, heart block, sick sinus, previous MI
    Cons: cardiovascular collapse, QRS/QT prolongation, TdP
Sotalol: 80-160mg IV. CI: CrCl <40, proarrhythmic

Electrical Cardioversion
If: Symptomatic + young + lone AF + correct cause + <48hrs
1-5% risk embolism on cardioversion

Informed consent
Resus room, airway equipment prep
Connect chest pads AP
Supplemental high flow O2
Light sedation propofol 20-40mg
Support BP with fluid bolus/peripheral pressor
Analgesia - fentanyl 25mcg
Synchronised cardioversion 100J, incr by 50J up to 200J
Post sedation observation

Pros: most effective technique, ~90% success rate in uncomplicated patients, reduces ED LOS
Cons: risk of procedural sedation

Rate control

Metoprolol (2.5-5mg iv, titrate to HR <100). CIs: hypotension, APO, severe asthma, concurrent CCB
Cons: dizziness, fatigue; caution elderly (falls); can mask hypoglycaemia (caution DM)
Verapamil (1mg iv, titrate to 10mg/effect) CIs: hypotension, concurrent B, 2nd/3rd deg HB
Pros: preferred young patients, preferred asthma/COPD, less effective control HR in exercise
Cons: constipation; avoid after MI or HF, negative inotrope
Digoxin (0.5mg iv/po loading dose) CIs: 2nd/3rd deg HB, WPW
Cons: ineffective if shock, sepsis, hypoxia; may be no better than placebo, interactions, renal failure

Anticoagulation

No if: <48hrs (or if no thrombus on echo)
Yes if: >48hrs: for 24hrs prior if: acute, no thrombus/structural disease on TOE
for 3/52 prior and 4/52 after if chronic
Use Clexane if short term

CHADS2 score

Estimates risk of stroke with AF

CHF	(1)
HTN >140/90	(1)
Age >75	(1)
Diabetes	(1)
Stroke/VTE	(2)

CHADS2 = 2 means annual stroke risk 4%

0:	low risk - aspirin
1:	medium risk - aspirin or warfarin
2:	high risk - warfarin

CHA2DS2VASC score

CHF	(1)
HTN	(1)
Age >75	(2)
Diabetes	(1)
Stroke	(2)
Vascular disease	(1)
Age 65-74	(1)
Sex (female)	(1)

0 = nothing
1 = aspirin
2 = warfarin/dabigatran

VT vs SVT

Definitely VT:	Fusion beats, Capture beats, AV dissociation
Probably VT:	NW axis, Really long QRS >160ms, Concordance across chest leads
	RSR with taller L rabbit ear
	>35yrs, IHD, prev MI, CCF, HOCM, FH sudden cardiac death
Probably SVT:	RBBB

Differential diagnosis VT

SVT with BBB, SVT with aberrant conduction, pre-excited SVT, metabolic (hyperK), toxin-related, pacemaker

Management VT

Electrical cardioversion
Overdrive pacing
Amiodarone: 150mg IV over 5-10mins - rpt over 10-20mins if needed
Sotalol: 2mg/kg over 5mins
Na channel blocker (eg. TCA) - NaHCO3

Torsades

Causes

Prolonged QTc (esp if >500)
Female; bradycardia; recent conversion from AF; CCF; digoxin; severe hypoMg/K/Ca; IHD; hypothyroid; CRF

Management

Avoid class I anti-arrhythmics, amiodarone, beta-blockers; replace K
If sustained: DC cardioversion
If non-sustained:
1. correct cause
2. MgSO4 2g over 1-2mins - 1-2g/hr (shortens QTc)
3. isoprenaline (incr HR to 120 to overdrive pace); overdrive pacing
4. pacemaker

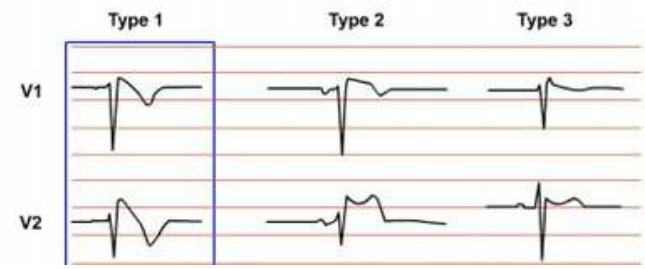
SVT

AVNRT - Microreentry
AVRT (orthodromic) - Less common; macroreentry
Associated with WPW and Lown-Ganong-Levine syndrome

Vagal manouvres
Adenosine: 6, 12, 18 (0.1mg/kg, 0.2mg/kg, 0.3mg/kg)
SE:; bronchoC; transient sinus arrest >4secs in 5%; blocks, V ectopy
CI: WPW, SSS, 2nd/3rd deg HB, long QT syndrome, decompensated heart failure, asthma
Interactions: decr adenosine dose if dipyridamole, carbamazepine, theophylline, caffeine
Verapamil: 5mg IV slowly - repeat if needed
Electrical: synchronised; 20-100J (0.5J/kg)
Radio-frequency ablation: decr recurrences <1yr from 60% - 5%; 1-2% risk of CHB

Brugada Syndrome

Autosomal dominant, sodium channelopathy
Long PR
Partial RBBB
STE in V1-3, downsloping ST segment
TWI V1-3
Short QT
Management: ICD, Avoid Ia and Ic, and Na channel blockers



Restrictive Cardiomyopathy

Most common causes: amyloidosis, scleroderma, carcinoid, sarcoid

HOCM

50% familial, autosomal dominant
Systolic murmur decr with passive leg raising
Classic: septal Q waves = large Qs in anterior, inferior or lateral
1. Nonspecific ST/T changes - T inversions, large Ts
2. LVH +/- LAA (left atrial abnormality)
3. Atrial arrhythmias - AF (poorly tolerated, decr filling)
4. PACs, PVCs

Dilated Cardiomyopathy (DCM)

Symptoms of biventricular failure, e.g. fatigue, dyspnoea, orthopnoea, ankle oedema.
Causes: Ischaemic, Non-ischaemic - most idiopathic, 25% familial, viral myocarditis, alcoholism, toxins (doxorubicin), autoimmune, pregnancy (peripartum cardiomyopathy)
Most common: LAH/LVH, LBBB, Reduced voltages, Abnormal Q waves V1 - V4 - "pseudoinfarction", AF

Wolff-Parkinson-White Syndrome

Accessory pathway
Orthodromic conduction (95%): narrow QRS; returns through accessory pathway
Antidromic conduction (5%): wide QRS; travels down accessory pathway; risk degeneration to VF
Short PR (<0.12)
Delta wave (depolarisation of free V wall)
Tall R wave in V1 (suggests lateral bypass tract)
QRS >0.1s; may get bizarre ST/T wave changes mimicking MI
Lown-Ganong-Levine: short PR without delta wave

WPW + AF with antidromic conduction
1. Irregularly irregular
2. Very fast rate (>200bpm) (bypass tract short refractory period)
3. Variable QRS morphology (wide, bizarre)
3. Fusion beats (AV nodal path and accessory pathway simultaneously)
Contraindicated drugs: Adenosine, **B**eta blockers, **C**alcium channel blockers, **D**igoxin
May block the AV node and cause unopposed conduction down accessory pathway -> VF
Amiodarone: 5mg/kg iv over 20mins, then 10mg/kg over 24hrs
Flecainide 2mg/kg IV over 30mins (if structurally normal heart and no IHD)
If in doubt: Irregular wide complex tachycardia - electrical cardioversion
Definitive management: catheter ablation of accessory pathway

Myocarditis

Causes
Viral
Autoimmune
Bacterial (Q fever, N meningitidis, M pneumoniae, C diptheriae, chlamydia, beta haem strep)
Parasitic (Chagas disease most common cause worldwide, toxoplasma)
Drugs (doxorubicin, ETOH, cloazpine, radiation)

Investigations
ECG - Tachycardia, low ECG voltages in 80%, ST/T changes, conduction disturbances, long QTc
CXR - Cardiomegaly, pleural effusions
ECHO - global decr contractility, decr EF, V dilation
Incr cardiac markers; incr ESR in autoimmune
Myocardial biopsy (50-70% sens)

Management
Supportive - CCF treatment; bed rest; inotropes, diuretics, vasodilators, ACEi, Treat arrhythmia
Mechanical support if hypoperfusion despite meds (ECMO, V assist devices)
Steroids/immunosupp if autoimmune

VSD

Most common cardiac defect
Moderate defect - incr RV pressure = pulmonary HTN
Large defects - CHF early in infancy - incr pulm artery pressure = pulmonary HTN - Eisenmenger syndrome

Pericarditis

Causes
Idiopathic
Viral: enterovirus, adenovirus, mumps, EBV, VZV, hep B, flu, HIV
Bacterial: Staph aureus, pneumococci, strep, legionella, salmonella
Ca: 25%
MI
Auto-immune: RA, SLE, Dressler's syndrome, sarcoid
Drugs: hydralazine, procainamide
Other: Serum sickness, trauma, irradiation, cardiac surgery, severe uraemia

Phase 1 – hrs to days:	Widespread non-regional concave STE in I, II, V5-6
	PR depression (most common in II)
	ST depression and PR elevation in aVR and V1
Phase 2 – days:	ST segments normalize
	PR depression
	Small T waves
Phase 3 – days to wks:	TWI in leads that prev had STE
	Low voltages; sinus tachy
Phase 4 – 1-3 months:	Normalisation; some T wave changes may be permanent

Management
Supportive; NSAIDs (not aspirin); relieve tamponade if needed
Bacterial: broad spectrum ABx, pericardial aspiration, HDU/ICU
Uraemic: dialysis
Autoimmune: immunosupp
Dressler's: steroids

Pericardiocentesis

Experienced personnel, resus equip, continuous ECG, imaging equip if being used
Check coagulation/platelets
Sit patient at 45 deg
Prep skin/LA
Connect ECG to needle or USS guidance
Left sub-xiphoid approach and aim to L shoulder at 15–20 deg to abdo wall
If ST elevation myocardium reached so slightly withdraw
16-18G needle (>5cm length needed)

Complications

Myocardial laceration/perforation
Coronary artery/vein laceration/perforation
Pneumothorax
Arrhythmias
Peritoneal puncture, abdominal viscera trauma

Pericardial Tamponade

Acute: Ruptured heart (post-MI); trauma; type A dissection; post-cardiac surgery; coagulopathy
Chronic: Metastatic Ca in 40%, idiopathic 15%, bacterial and TB 10%, uraemia 10%
Beck's triad = decr BP, incr JVP, incr HR
Narrow pulse pressure, Pulsus paradoxicus
ECG - Low voltages, Electrical alternans, STE and PR depression, incr HR
Echo - RA/RV chamber collapses at end diastole; Dilated IVC with lack of insp collapse

Heart Failure

Inability of heart to pump sufficiently to provide for metabolic demand of tissues
O2; sit up

NIV:	CPAP 5-10cm H20 or BiPAP 10/5. FiO2 start at 100%, aim sats >90%
	decreases VR - decr preload
	decreases need for intubation
	no change in hospital mortality or LOS
IPPV:	if CPAP fails; beware decr BP with induction
GTN:	infusion 50mg in 500ml, 3-30mcg/min, max 200, aim SBP <140
	venodilates, reduces LV afterload, corrects myocardial ischaemia
Diuretics:	Frusemide 40mg iv universal use but predominant effect ?venodilation

Identify and correct reversible factors - cardiac ischaemia - revascularisation

Cardiogenic shock

Hypotension (SBP <90) and hypoperfusion (lactic acidosis) secondary to dysfunction of heart
Early PTCA (preferred to thrombolysis)
IABP (weak evidence)
Dopamine/dobutamine (5-20mcg/kg/min)
NAd (2-20mcg/min)
Consider small fluid challenge

High output failure

Fever, thyrotoxicosis, AV fistula, Pagets, erythroderma, anaemia

HTN

Hypertensive emergency = evidence of end-organ dysfunction + DBP >130 or MAP >180

End-organ damage

Dissection
ACS/APO
ICH
Renal dysfunction
Encephalopathy/retinopathy

Causes

Acute-on-chronic HTN
Medication non-compliance/withdrawal
Renal disease
Phaeo
Sympathomimetics
Pre-eclampsia
Withdrawal from EtOH, benzos, clonidine, baclofen

Hypertensive encephalopathy
Severe HTN
Altered GCS, Blurred vision, Vomiting
Retinopathy

Investigations
CT head, CXR, ECG, U+E, urinalysis. Cotton wool spots, retinal haemorrhages, papilloedema

BP targets
Malignant HTN/hypertensive encephalopathy: reduce 25% over 1-2hrs, aim DBP 110
Ischaemic CVA: <180/105 if for thrombolysis, <220/110 if not for thrombolysis
Haemorrhagic CVA: treat if >180/100, aim 160/90
Dissection: aim SBP 100-120 and HR <60

Management

MI:	1. GTN	2. metoprolol or labetalol	
APO:	1. GTN	2. nitroprusside	
Intracranial:	1. labetalol	2. esmolol	
CVA/encephalopathy:	1. labetolol		
Dissection:	1. labetalol	2. esmolol	3. nitroprusside + beta blocker
Sympathetic crisis:	1. benzos	2. phentolamine	
Pre-eclampsia :	1. labetalol	2. nifedipine po	3. hydralazine

Labetalol
10mg over 2mins then 1-8mg/hr
CIs: bradycardia, heart block, decompensated CCF, active bronchospasm, concurrent CCB
Esmolol
500mcg/kg over 2mins; repeat q5min then 50mcg/kg/min, titrate to max 200
Pros: ultrashort acting, cardio selective beta 1 blockade, easily stopped - test dose in asthmatics
GTN
5-20mcg/min, incr q5min to max 200
CI: phosphodiesterase inhibitors, incr ICP
Venodilator, may cause hypotension with reflex tachy
Nitroprusside
0.5mcg/kg/min, incr by 0.5
CI: incr ICP, renal/hepatic failure
Always use with beta blocker - risk reflex tachy
Phentolamine
5-15mg iv then 0.5mg/min
Hydralazine
5-10mg iv over 5-10mins, then 5mg/hr
Nifedipine (po)
10mg po, repeat Q1h
Nimodipine (po)
60mg po q4h
Preventing vasospasm in SAH

Shock
Hypovolaemic > cardiogenic (likely if HR <30 / >150)
Obstructive (eg. tension pneumothorax)
Redistributive (eg. septic, neurogenic, anaphylaxis)
Classification

I	Blood loss <750ml; % loss <15 HR <100, BP Normal, CRT Normal, RR 14-20, UO >30ml/hr Fluid responsive
II	Blood loss 750-1500; % loss 15-30% HR >100, BP Normal, CRT Incrl RR 20-30, UO 20-30ml/hr Fluid responsive
III	Blood loss 1500-2000ml; % loss 30-40% HR >120, BP Decr, CRT Incr, RR 30-40, UO 5-15ml/hr Transient fluid responsiveness
IV	Blood loss 2000ml; % loss >40% HR >140, BP V low, CRT V incr, RR >35, UO <5ml/hr Incomplete fluid responsiveness

Endpoints (in septic shock)
UO >0.5ml/kg/hr
CVP 8-12
MAP 65-90
ScvO2 >70

Treat cause eg. MI, arrhythmia, blood loss, pneumothorax

A Be careful with PEEP/IPPV, sedatives
Consider vol resus before RSI

B Aim SaO2 >93%, paCO2 35-40
Aim to decr WOB

C Raise legs - if works, IVF bolus

IVF 20ml/kg IV bolus crystalloid - repeat at 15 mins if no response
Aim UO 0.5ml/kg/hr (1ml/kg/hr in children, 2ml/kg/hr in infants)

Vaspressors
Blood transfusion - Aim Hb >10
Immediate OT
If haemothorax >1500ml, IVC expiratory diameter <7mm in trauma, large amount FF on FAST in trauma, IVC incr <3mm post-fluid resus in trauma, leaking AAA, ectopic pregnancy

Hypotensive resuscitation
For uncontrolled haemorrhage and early intervention to control bleeding possible
Aim SBP 60-80, MAP 40 (higher in old, pregnant, HI)

Causes of 'unresponsive shock' (shock not responding to fluids)
1. Adrenal crisis 2. Neurogenic shock 3. Toxicological

Syncope

Transient LOC and loss of posture secondary to insufficient cerebral perfusion.

Causes
Reflex
Vasovagal
Situational – straining against a closed glottis (cough, micturition, defecation)
Carotid sinus syndrome
Breath holding attacks
Cardiac
Structural – valvular, AS (Stokes Adam attack – fixed CO with exercise), TS, MS, cardiomyopathy, pulm HT, CHD, myxoma, pericardial, PE, AMI, dissection
Arrhythmias
Pacemaker failure
Orthostatic Hypotension
Hypovolaemia – haemorrhage, Addisonian crisis, fluid loss (burns, D/V, third space, dehydration) Medication
Cardiac – BB, dig, CCB, nitrates, diuretics, anti-HT
Other – antipsychotics (phenothazines), anti-depressants, anti-Parkinsons
Party – cocaine, alcohol, sidenafil
Neurologic - TIA, migraine, SAH, Shy-Drager, subclavian steal syndrome
Psychiatric

Factors influencing disposition:
- any abnormality on hx/exam/Ix needing further investigation or treatment
- social support/living situation/followup/memory
- can ambulate and perform ADLs safely
- risk stratification

San Francisco Syncope CHESS Rule
Short term serious outcome risk (96% sens)
Any one = high risk

C: Congestive Heart Failure
H: Haematocrit < 30%
E: ECG abnormal
S: Shortness of breath
S: Systolic BP < 90mmHg at triage

Young person + Syncope
1. HOCM
2. Brugada
3. Long QT
4. Cardiomyopathy
5. Arrhythmia

Syncope cardiac DDx
Ischaemia
Tachyarrhythmias
Bradyarrhythmias
Outflow obstruction

Infective Endocarditis

Acute vs subacute
Mitral > aortic > tricuspid > pulmonary (tricuspid most common in IVDU)
Native valves L>R; IVDU R>L
Most common: staph aureus - Poor prognosis, rapid destruction, infects normal valves, high virility
Most common in abnormal valves: strep viridans
Others: Other strep, Staph epidermidis, Enterococcus and coag neg staph, HACEK (Haemophilius, aeromonas, cardiobacterium hominis, eikenella, kinginella), Fungi

Risk factors
Valvular heart disease (MVR; calcific AS, bicuspid aortic valve, RHD)
Poor dental hygiene, dialysis, DM, HIV, male, hypercoag state (SLE, malignancy)
IVDU

Duke Criteria
2 major, or 1 major + 3 minor, or 5 minor
Major:
B = blood culture +ve >2 times 12 hr part
E = Endocardial involvement from Echo
Minor:
F = Fever >38
E = Echo findings (not fulfilling a major)
V = Vascular findings
EE = Evidences from microbiological/immunology (2 evidences)
R = Risk factors/predisposing factors - drug abuse, valvular diseases

Symptoms
FROM JANE
Fever
Roth spots - Retinal haem with central clearing
Osler's nodes - Tender nodules on tips of fingers or thenar eminence, sterile
Murmur
Janeway lesions - Painless, haemorrhagic, palms/soles, contain bacteria
Anaemia
Nail (splinter) haemorrhages (>4)
Emboli - CVA, retinal artery emboli, PE, MI, splenic infarct, Mycotic aneurysm - SAH

Also:
New onset CCF (70%)
Microscopic haematuria, proteinuria
Finger clubbing
Hepatomegaly, splenomegaly
Chills, weakness, SOB > constitutional Sx > AP, CP, back pain

Investigations
Normal/incr WBC, Incr ESR, Haemolytic anaemia, +ive RF, +ive blood cultures
Urine: Haematuria
ECG: RBBB, LBBB, HB, PR depression
CXR: pneumonia, septic emboli findings, APO
Echo: TTE sens 65%; TOE sens 85%, spec 95%

Management
IV Abx for 2-6/52
Acute = benpen 60mg/kg + fluclox 2g Q4h + gent 5mg/kg OD
Prosthetic/IVDU = ceftriaxone (to cover HACEK) + vanc + gent
Valve replacement
Abx prophylaxis - amoxyl/clindamycin

Complications
Valvular damage - CCF
Myocardial abscesses - AV block
Immune complex disease
Thromboembolism - brain > lung, spleen, kidney, liver
Pericarditis, mycotic aneurysm, intracranial haemorrhage
Prosthetic valve problems - dehiscence, leak, stenosis

Rheumatic Fever

5-15yrs; high incidence in Maoris
Group A beta-haemolytic Strep (pyogenes); following pharyngitis; due to cross reactivity anti-strep abs
Affects connective tissue of heart, joints, CNS, SC tissues, skin
Endomyocarditis, valvulitis

Diagnostic criteria (modified Jones)
Evidence of recent strep infection + 2 major or 1 major and 2 minor
Major:
J: Joints (70%): migratory polyarthritis; esp large joints
O: (heart shaped "O") Carditis (66%): CCF, pericarditis, pancarditis, murmur,cardiomegaly, gallop
N: Nodules: subcutaneous nodules (Aschoff bodies) (1/12 after fever): wrist, elbow, knees
E: Erythema marginatum (10%): macular rash on trunk/ limbs
S: Sydenham's chorea (St Vitus' dance) = very late
Minor:
Fever >38
ESR or CRP >30
Arthralgia
PMH of RF
Prolonged PR
Rising titre of anti-strep abs

Investigations
Swab throat
Bloods: rapid strep test; ASOT (anti-streptolysin O titre); anti-DNAse B titres; ESR, CRP; anaemia; cultures
ECG: prolonged PR; pericarditis
CXR: cardiomegaly, CCF
Echo: if features of carditis

Management
Abx: benzylpenicillin 2.4g QID for 10/7
For carditis: bed rest; treat CCF and AF
For arthritis: NSAIDs, high dose aspirin (75-100mg/kg/day) for 1/52 then taper
For chorea: valproate, haloperidol

Pacemakers

Fixed rate - fixed rate regardless of patient's heart; risk of discharging on T wave; rarely used
Demand - Senses spontaneous cardiac activity
- Inhibited: pulse generator inhibited by spontaneous cardiac activity
- Triggered: pacemaker detects cardiac activity, discharges during absolute refractory period

1	2	3	4	5
Chamber paced	Chamber sensed	Response to sensing	Programmability	Anti-arrhythmic functions
0 none A atrium V ventricle D dual S single chamber	0 A V D S	0 none T triggered I inhibited D dual	0 none P simple M multi C communicating R rate modulation	0 none P pacing S shock D dual

Placing magnet over pacemaker will initiate AOO, VOO, DOO – allows treatment tachycardia

Pacemaker Problems
Pocket - infection, haematoma
Leads - separation: failure to capture, dislodgement - thrombosis/myocardial rupture/arrhythmia
Problems with sensing - undersensing, oversensing
Failure to capture (causes: electrode displacement, wire fracture, electrolyte disturbance, MI, exit block)
Output failure (causes: oversensing, wire fracture, lead displacement, interference)
Pacemaker-associated dysrhythmias
Pacemaker-mediated tachycardia (re-entrant loop with pacemaker sensing retrograde P wave as native stimulus, and pacing ventricle)
Rx: magnet or adenosine
Sensor-induced tachycardia (misfire if distracting stimuli: vibrations, fever, limb movement)
Rx: magnet
Runaway pacemaker (low battery/old pacemaker - paroxysms 2000bpm)
Lead displacement dysrhythmia (lead floats in RV, intermittently 'tickling' myocardium)
Pacemaker Syndrome (improper timing atrial/ventricular contractions - AV dyssynchrony)
Symptoms: fatigue, dizziness, palpitations, pre-syncope
Twiddler's Syndrome (accidental or deliberate manipulation or pulse generator - dislodges leads)

Indications for Temporary Pacing
Bradycardia unresponsive to drug therapy
3rd degree heart block
Mobitz type II second-degree heart block + haemodynamically unstable
Overdrive pacing
Asystole

AICD (automatic implantible cardiac defibrillation)
Causes of inappropriate shocks
1. SVT
2. muscle activity (shivering, diaphragm contractions); extraneous source - vibration
3. sensing "T" as "QRS" = double counting
4. sensory lead fracture/migration
5. unsustained tachyarrhythmia
6. ICD - PPM interaction
7. component fracture

Transcutaneous Pacing
place pads in AP position (black anterior, red posterior)
connect ECG leads
set pacemaker to demand
turn pacing rate to > 30bpm above patients intrinsic rhythm
set mA to 80
start pacing and increase mA until pacing rate captured on monitor
if pacing rate not captured at a current of 120-130mA -> resite electrodes and repeat
once pacing captured, set current at 5-10mA above threshold
Complications: failure to pace and failure to capture; discomfort

Overdrive Pacing
Overdrive pacing = pacing the heart at a higher rate than the native heart rate
Overdrive pacing vs cardioversion
can use in digoxin toxicity
doesn't require GA
avoids complications of DC shock (myocardial depression)
pacing available post electrical version (in case of bradycardia or asystole)

Valvular Heart Disease
Commonest cause chronic valve disease = Rheumatic heart disease
Commonest cause acute valve dysfunction = Endocarditis
Commonest congenital cause AR = Bicuspid aortic valve

AR
Collapsing pulse (Water-hammer pulse), Corrigans pulse (rapid upstroke/downstroke)
De Musset's sign - head noding in time with HR
Quincke's sign - pulsation of capillary bed in nail

Traube's sign - pistol shot bruit over femoral artery
Duroziez's sign - systolic and diastolic murmurs over femoral artery
ECG/CXR: LVH, strain
Causes:
Chronic: Valvular (Rh, bicuspid), Aortic root dilation (Marfans, RA, syphilis)
Acute: Endocarditis, Marfans, Dissection

MS
Other signs: Signs Pulm HTN, emboli (systemic, brain), restrictive lung disease, AF, Mitral facies
ECG/CXR: LA enlargement, Pulm HTN - RA & RV enlargement - RAD; incomplete RBBB
Causes: Rheumatic heart disease

AS
Other signs: LVF = late sign, syncope
ECG/CXR: LVH, R or LBBB, CCF
Severe: Valve area < 1cm^2; Gradient > 50mmHg
Causes: Degenerative calcific (older). Calcific (younger) +/- congenital bicuspid valve, Rheumatic

MR
Other signs: LVF, Signs Pulm HTN
ECG/CXR: LA enlargement, LVH; AF common
Causes:
Rheum heart disease = commonest
Myxomatous degeneration, MVP, Rheumatic, Cardiomyopathy, CTD (Marfan's, RA, AnkSpond), Congenital

Acute MR
Causes: AMI (dysfunction/pap muscle rupture), endocarditis, trauma, surgery
Clinical: APO, Hypotensive, New Systolic murmur, 1st week post AMI (often Inferior)
Treatment = COMPLEX
Inotropes to support BP 1st
Then afterload reduction to unload the heart & empty lungs eg nitroprusside
IABP; Surgery

Mitral Valve Prolapse
Young, thin female,
Murmur: Late high-pitched systolic, Can sound like MR
HS: Early-mid systolic click
Causes:
Myxomatous degeneration. Assoc with: ASD, HOCM, Marfan's

TR
Other signs: Pulsatile, tender liver; pleural effusions, ascites, peripheral oedema
Causes: RV failure, infective endocarditis (esp IVDU), RhHD, Ebstein's anomaly, COAD with pulm HTN
Mainly asymptomatic

PS
Pulse: Normal or decr if CCF/low output
JVP: Giant a-waves (RAH)
Apex: RV Heave
Murmur: Loud ESM, Max @ Pulm area
Incr by insp, decr by exp
HS: Ejection click
ECG: RBBB
Causes:
Associated congenital defects: Noonan's/tetralogy/congenital rubella
Acquired : carcinoid syndrome, acquired sub/supravalvular stenosis(rheumatoid, bioprosthetic valves)

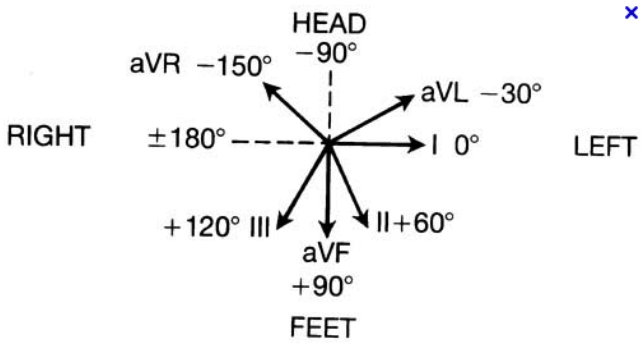
	Site	Timing	Radiation	Character	Accentuation	Other
AR	Aortic area	Early diastolic	LLSE	Decresc	Exp, forward	Wide PP, S3, eponymous signs
AS	Aortic area	Systolic	Carotids	Ejection	Exp	Slow rise pulse, narrow PP

MS	Apex	Mid-late diastolic	None	Low-pitch rumble	Left lat, exp, exercise	Loud S1, opening snap, small PP
MR	Apex	Pansystolic	Axilla/LLSE	Blowing	Valsalva, exp	Parasternal impulse, S3, AF common
VSD	LLSE	Pansystolic	None	Localised		Thrill
TR	LLSE	Pansystolic			Insp, forward	Big V waves, RV heave, pulsatile liver
HOCM	Apex, LLSE	Late systolic LLSE Pansystolic apex			Loud valsalva Soft squatting	S4, double impulse apex, jerky carotid

Left sided murmurs incr with expiration (Lex)
Right sided murmurs incr with inspiration (Rinse)

ECG

Axis
Normal = -30 to +90
LAD = -90 to -30
RAD = +90 to +180
Extreme axis deviation = +180 to - 90 (I, II, aVF negative)



PR interval: 0.12 – 0.2s
QRS interval: 0.06–0.10
QT interval: <0.44s QTc = QT/sqRR

QRS PROLONGERS = Na channel blockers
Flecainide, TCA's, Carbamazepine, Phenothiazines, Antihistamines, Propanolol, LA's

QTC PROLONGERS = K channel blockers
Flecainide, TCA's, Carbamazepine, Phenothiazines, Antihistamines, amiodarone, sotalol, SSRI, methadone, lithium, Erythromycin, tetracyclines, omeprazole, ondansetron

Benign Early Repolarisation

ST ELEVATION
- Greatest in precordial leads (V2-V5)
- Usually < 2mm
- Minimal in limb leads
- Usually < 0.5mm

ST MORPHOLOGY
- Upward concavity of initial ST segment
- Notching or slurring of terminal QRS

T WAVES
- Symmetric, concordant, large
- *J point:* junction of QRS and ST segment; often notched; best seen in V4-5
- Often notching of downstroke of QRS
- *R waves:* tall in L precordial leads; R shift of transition zone

1st degree heart block

Causes: Beta-blockers, Ca channel antagonists, digoxin, inf MI, incr vagal tone, AV disease, myocarditis, RF

2nd degree HB

Mobitz I/Wenckebach
Causes: Inf MI, digoxin, incr vagal tone, myocarditis

Mobitz II
Complications: CVA, Stokes-Adams attack, sudden cardiac death

3rd degree heart block

Causes: Degenerative; inf MI, ant MI, myocardial fibrosis

Dental, ENT, Ophthalmology Summary

Dental anaesthesia

Maxillary - tooth and adjacent buccal mucosa
Inferior alveolar nerve block - mandibular premolar/molar teeth to midline, lower lip/chin/tongue
- mouth open wide, enter at opposite side of mouth, needle at apex of buccal fat pad in pterygotemporal depression, insert 20-25mm until contact ramus of mandible, aspirate, inject 2ml, wait 10mins for effect

Alveolar Osteitis aka dry socket

Incr risk: smokers, female, prev episodes, poor oral hygiene
2-3/7 post extraction, severe pain, foul odour, trismus, afebrile, white necrotic bone in socket
Management: irrigate socket, regional anaesthesia, remove necrotic debris, zinc oxide/eugenol paste, analgesia, dental review

Periapical Abscess

1. Abs: uncomplicated: Pen or Clindamycin; complicated: Pen/Metronidazole
2. Analgesia
3. I+D if abscess
4. Chlorhexidine 0.1% rinses q2-3h if I + D
5. Surgical referral, if complicated infxn (Ludwig's, Lemierre's Syndrome)
6. Dentist f/u 1-2/7, Complicated – Oral Surg ASAP

Dental Trauma

Avulsed tooth
Dental emergency - call dentist
"time is tooth": if tooth reimplanted within 30mins has 90% chance survival
Handle by crown only - rise w/ saline - Replace and ask patient to bite on gauze - Splint
If unable place in transport medium: Saline, Milk
Antibiotics
Fractures
Consider XR, Consider ADT
Ellis Class I - Through enamel of crown
Ellis Class II - Through enamel and dentin (yellow/pink appearance)
Painful and temperature sensitive
Tx: Cover tooth with CaOH; Soft food diet
Ellis Class III - Through enamel, dentin and pulp (pink appearance, blood often visible)
Pulp necrosis risk =10-30%. Severe pain, temperature sensitive
Tx: Dental emergency - contact on call Dentist

Otitis Media

Causes:
Pneumococcus, Hib, moraxella catarrhalis, anaerobes
85% improve without Abx, decr duration of fever by 1/7, NNT 9-15 (number to harm 8)
Indications for immediate Abx: indigenous, immunosup, difficult FU, <2yrs with bilateral disease, TM perf
Abx: Amoxicillin 15mg/kg TDS PO or azithromycin
Complications:
Middle ear effusion, Perforation, conductive hearing loss, cholesteatoma, mastoiditis, intracranial abscess

Otitis Externa

Causes: pseudomonas > staph aureus > proteus > fungal (aspergillus)
Management:
- combined steroid/Abx ear drops
- cipro top if trt failure/TM perf/T tubes
- systemic Abx if: fever and systemic Sx - fluclox
- ear toilet (wick)
- Keep dry; Daily review until improvement
Malignant OE: invasive form - pseudomonas
- RF = DM, immunosupp
- do CT; give gent 5mg/kg OD + ceftazidime 2g TDS or cipro 400mg BD, admit

Nasal Foreign Body

Positive pressure technique - Instrument technique without sedation (+/- restraint) - OT by ENT
Topical vasoconstrictors (reduce oedema - loosens FB, decr bleeding) - nebulised adrenaline, phenylephrine
Cyanoacrylate tissue glue; Balloon catheter

Peripheral Vertigo

Nystagmus usually present - initially towards affected ear, never vertical
HINTS - Horlzontal head impulse test, Nystagmus and Test of Skew:
- if all present, almost completely excludes stroke as cause
  - negative vestibulo-ocular reflex (unilateral head impulse test)
  - fixed direction horizontal nystagmus
  - absent vertical ocular misalignment (skew) using alternative cover test

Dix-Hallpike manoeuvre: Sitting position, support head and rapidly lie supine to 30 deg below horizontal
Head straight, then 45 deg to left, then 45 deg to right
Peripheral vertigo: Nystagmus - after 2-20sec, duration <1 min, unidirectional, fatigue with repeat tests
Central vertigo: Nystagmus - immediately, non-fatiguing, multi-directional, duration >1min

BPPV

Rx: prochlorperazine 12.5mg IV, 5-10mg orally tds; promethazine10-20mg orally tds
Epley manoeuvre: (for right ear) - sit upright, head to right, rapidly move supine with head hanging to right.
Rotate head to left, maintain 30 sec. Then roll onto left side so nose faces floor, maintain 30 sec
Rapidly return to sitting facing left. Repeat until no nystagmus

Labyrinthitis

Unilateral hearing loss (called vestibular neuronitis if hearing normal), nystagmus at rest, positive Hallpike

Sinusitis

50% bacterial (H. influenzae, strep, moraxella), rest viral from URTI
Nasal decongestants. ABx if >5d symptoms: amoxicillin 15mg/kg tds x10d or azithromycin 500mg od x 3d
Cx: Osteomyelitis of frontal bone, meningitis (sphenoid), brain abscess, orbital cellulitis

Croup

Parainfluenza virus, RSV, rhinovirus
XR: subglottic narrowing steeple sign

Epistaxis

Keisselbach's plexus (Little's area) - most anterior bleeds, over anterior nasal septum.

Management

1. Resuscitation
   - universal precautions
   - iv access, fluids or blood, FBC/coags/G+H if significant
   - O2, ECG if elderly and significant bleed or underlying CVS/resp condition
   - sit upright, pressure of nostrils, ice
2. Establish site of bleeding
   - blow nose, suction
3. Stop bleeding
4. Treat cause
   - BP control, treat coagulopathy

Methods of stopping bleeding:

Local pressure (easy, minimally invasive but not for posterior, requires cooperative patient)
- cotton pledgets soaked in topical vasoconstrictors (cophenylcaine, adrenaline, cocaine) + LA
- tranexamic acid, Ab cream, po Abs if packing

Cautery (easy, definitive but not posterior, risk septal perforation)
Ant/post pack Rapid Rhino (ongoing tamponade, effective for large bleeds but pain/necrosis/infxn)
Angio/embolisation (definitive Rx for massive bleed, less invasive than surgery but limited availability, risk CVA/bleeding)
Surgical control (definitive, last resort but more invasive, skill/resource availability)

Discharge if

- stable
- bleeding stopped with simple measures and does not recur 1-2hrs observation
- definitive treatment has occurred
- adequate social supports and followup
- discharge advice (bending/straining/blowing nose/aspirin/hot drinks)

Admission: elderly**,** coagulopathy, posterior packs

Nasal packing
Anterior - expanding nasal sponge (nasal tampon) - use dry but coat in chlorsig
Posterior - epistat catheter/Brighton balloon, rapid rhino (soak first), foley catheter
Complications: anosmia, pack falling out, breathing difficulties, aspiration clots, migration of pack - airway obstruction, pressure necrosis or perforation septum

Bacterial tracheitis

Staph aureus > Strep pneumo, H influ, strep pyogenes, morazella, anaerobes; often 2Y to viral URTI
2-7/7 post URTI - suddenly worsens over 8-12hrs
Sx: insp/exp stridor, productive cough, raspy voice; NO drooling / effect of positioning / dysphagia; toxic
XR: subglottic narrowing, irregular tracheal margins
Mng: sedation, intubation, bronchoscopy; cefs and clindamycin (?add in vanc)

Retro-pharyngeal abscess

Usually polymicrobial; S pyogenes, S aureus, S viridans, anaerobes, G-ive rods, staph bacteroides,
Complications: airway obstruction, mediastinitis, jugular venous thrombosis, carotid artery compression or rupture, cervical osteomyleitis, SC abscess
Mng: Abx (cefoxitin 2g IV), steroids may help decr oedema and prevent progression; I+D; may need trachy

Epiglottitis

H influenza (25%), H parainfluenza, strep pneumoniae, grp A strep, staph aureus; Candida in immunocomp
Management
To resus; close monitoring; early ORL involvement; consider transfer if needed; bedside radiology
Avoid upsetting, minimal handling; IV access after airway; sit up; humidified O2; adrenaline nebs (0.5ml/kg 1:1000 diluted to 5ml with N saline); intubation required in 25% adult cases; if not intubated, observe in ICU
Induction: gaseous or awake intubation; experienced anaesthetist; surgical back up for tracheostomy
Abx: ceftriaxone/cefotaxime 25mg/kg (up to 1g) for 5/7 (may need to add in vanc)
Steroids

Pharyngitis

Viral: 80-90% cases; rhinovirus, adenovirus, coronavirus, herpes virus 1, infectious mononucleosis, CMV
Grp A strep pharyngitis: uncommon <2yrs; found in 25% children >8yrs
Centor criteria:
If 2-3 criteria, do rapid strep test; if 3-4 criteria, trt
1. Tonsillar exudate 2. Tender ant cervical adenopathy 3. No cough 4. Fever
Complications: can cause RF and post-strep glomerulonephritis, peri-tonsillar abscess, retropharygneal abscess, mediastinitis, erosion of carotid sheath - haem
Penicillin 10mg/kg BD 10/7 (roxi 4mg/kg (max 150mg) BD if pen allergy; augmentin if fails to respond
Admit if: systemic toxicity, inadequate PO intake, airway obstruction, immunosupp, severe pain

Peritonsillar abscess/Quinsy

Causes: polymicrobial; S pyogenes, S aureus, anaerobes, Grp A beta-haem strep, H influenza
Rx: IV penicillin + metronidazole, or clindamycin; drainage with 19G needle ½ way between base of uvular and alveolar ridge, inserted <1cm (ICA is lateral and post to post tonsil); needle vs I+D equally as good
Admit if: large, incompletely drained

Post-tonsillectomy haemorrhage

Management: sit up, NBM, 1:100,000 local adrenaline injection if clear bleeding point, 1:10,000 adrenaline soaked gauze pads, neb adrenaline (5mg in 5ml), cauterise with silver nitrate; direct pressure; OT; penicillin
Correct coagulopathy

Ludwig's Angina

Usually polymicrobial, from mouth flora – Strep, Staph, anaerobes, G-ive rods
Complications: Airway obstruction, sepsis, extension into retropharyngeal space/mediastinum/carotid sheath/mandible
Management
A: sit up; early trachy / fibreoptic airway (50% failure rate for RSI)
Metronidazole 500mg (12.5mg/kg) IV BD + benpen 1.2g (30mg/kg) IV Q6h or clindamycin 450mg (10mg/kg) IV Q8h if penicillin allergy. OT if fluctuant / abscess / gas in tissues

Eyelid diseases

Meibomian cyst (aka chalazion) = chronic inflammation of meibomian gland (firm, nontender nodule)
Rx: warm compresses 1-2/52, I+D if doesn't settle, Abs if ruptured
Stye: external hordeolum. Acute bacterial infection of glands of Zeis - usually Staph. Red, tender swelling.
Rx: warm compresses, topical Abs

Hypertensive retinopathy
Silver wiring and AV nipping
Cotton wool spots, flame haemorrhages and disc swelling more typical of malignant hypertension

Pupil Abnormalities
Argyll-Robertson (prostitutes pupil) – bilateral small pupils, accommodate but don't react (neurosyphilis)
Holmes-Adie – unilateral dilated pupil, accommodates but doesn't react (viral inflam parasymp ganglion)
Horners – partial ptosis, miosis, anhidrosis, enophthalmos
Brainstem = stroke, tumour
Chest = lung cancer
Carotid artery = trauma, dissection
RAPD - Relative afferent pupillary defect (Marcus-Gunn pupil)
= damage to optic nerve or extensive retinal injury (neuro-retinal dysfunction)
– absent direct response but positive consensual response – swinging flashlight
Causes:
- retina: CRAO, CRVO
- optic nerve: neuritis, ischaemia, compression, glaucoma

Papilloedema
Raised ICP, Malignant HTN, Brain tumour, Normal pressure hydrocephalus

Corneal ulcers
Bacterial superinfection; pseudomonas in contact lens wearers; other RF = DM, immunocomp
White/grey spot on cornea; central lobulated mass with surrounding fluorescein uptake; hypopyon (soupy = Pseudomonas, solid = staph/strep)
Ophthalmology review, fortified top Abx

Corneal Erosion
Abrasion without history of trauma; can be infective; more in low humidity and high altitude; due to weakness of corneal BM; Sx onset on wakening; 50% have adherant flap of cornea
Urgent opthalmology reviw, topical NSAIDs, debride flap, N saline drops for 3/12 to prevent recurrence

Traumatic Iritis
Occurs after days; photophobia, deep eye pain; cells and flare in ant chamber; cycloplegics/steroid drops

Ocular FB
Hx: type of FB (organic vs inorganic), velocity of impact
Exam: VA. size/site/nature FB, depth penetration. Cornea/AC/iris/pupil/lens. Evert lids
Mx: topical anaesthesia, removal under slit lamp, rust ring removal, topical Ab +/- cycloplegic for comfort
Avoid contact lenses until healed; review 24-36hrs; ophthalmology review if can't remove FB, worsening Sx, recurrent Sx, rust ring overlying pupil; rust ring may require removal over a few days
FB penetrating cornea - ophth referral

Penetrating trauma
Hx: velocity/type of projectile, eye protection, previous trauma/surgery
Sx: decr VA, pain on eye movt, diplopia
OE: collapsed globe; decr VA, loss of red reflex; shallow ant chamber; prolapsed tissue; irregular pupil; coloured spot of choroid visible on sclera; chemosis; visible laceration; small subconjunctival haem; decr Iop; cloudy lens; Seidel test, subconjunctival haem
Ix: CT; USS (high sens and spec)
Mng: shield; antiemetics; avoid topical meds; IV cephalothin and gent; ADT, keep NBM, bed rest, sit 30deg

Retrobulbar haematoma
Blood accumulates behind globe - proptosis, ischaemia of ON (fixed dilated pupil), visual loss
Mng: urgent lateral canthotomy

Ruptured globe
Ophthalmological emergency
Exam: decr movt, slit lamp, blood in anterior chamber, lacerations, red reflex
CT scan for orbital wall fracture if indicated
Non-urgent referral within 3 days if the above findings are negative.
Urgent referral to ophthalmologist if intraocular haemorrhage, ruptured globe or orbital wall fracture

Eyelid lac

An eyelid laceration is a potential penetrating eye injury until proven otherwise.
Imaging if possible FB or #
Superficial: 6/0 non-absorbable, ROS 5d. Abs/ADT.
Refer if: full thickness, globe as well, palpebral ligament, lacrimal apparatus, tissue loss, lid margins, ptosis, tarsal plate involved, levator palpebrae, within 6-8mm of medial canthus (canalicular system)

Hyphaema

Blood in anterior chamber
Ix: full eye assessment, fundoscopy, facial #s. Decr VA in50%
Admit if >25% or over visual axis (=washout), anticoagulants, single eye, decr VA, poor compliance
Mx: bed rest, head up 30 deg, shield, limit activity, avoid anticoagulants, analgesia, antiemetics, mydriatic, acetazolamide or timolol if incr IOP; dilate pupils - cycloplegics - cyclopentolate 0.5% 1 drop OD
Complications: rebleed (day 3-5), visual los, incr IOP, synechiae, permanent staining cornea, AACG

Ocular burns

Chemical Burns
Alkali more harmful
Management of concurrent injuries
Eye irrigation - pH optimum 6.5 – 8.5 acceptable, goal neutral pH 7.4
Evert eyelid – clear debris
Topical antibiotic drops, cycloplegics and mydriatics.
Urgent ophthalmology consult and review if any visual acuity loss or corneal opacification
Thermal burns
Analgesia, Mydriatic agent, Urgent ophthalmological consult
Flash burns
Arc eye/snow blindness
Intense pain, red eyes usually bilaterally, blepharospasm and tearing
Check VA, widespread superficial epithelial defect staining with fluorescein
Rx: topical antibiotic QID and cycloplegic; analgesia

Orbital Cellulitis

Infection of soft tissues behind orbital septum
More common in children: 7-12 years orbital, younger pre-septal
Associations with DM, sinusitis
Causes
Orbital: H influenzae (non-immunised); strep pneumoniae; staph aureus; G-ives; anaerobes
Periorbital: Staph aureus
Orbital cellulitis secondary to: haematogenous seeding or direct extension from ethmoid sinus
Preseptal cellulitis secondary to: contiguous spread from skin
Assessment
Hx: headache, sinus Sx, fever, pain
OE: decr eye mvmt, chemosis, proptosis, decr VA, pupil dilation, RAPD, painful ophthalmoplegia
(Periorbital: no proptosis, normal extraocular eye movts)
Management
Periorbital/preseptal: PO augmentin or cephalexin; if unwell - cefotaxime or ceftriaxone + fluclox
Orbital: iv fluclox + cefotaxime / ceftriaxone; urgent ophthalmology review; may need decompressive OT
Complications
Cavernous sinus thrombosis, Frontal bone osteomyelitis, meningitis, subdural empyema, epidural abscess

Red Eye

Traumatic	- blunt trauma, penetrating trauma, corneal FB
Atraumatic	- conjunctivitis (allergic, viral, bacterial)
	- keratitis (bacterial, fungal, HSV, contact lens)
	- scleritis/episcleritis
	- iritis
	- endophthalmitis
	- cavernous sinus thrombosis
	- glaucoma

Conjunctivitis

1. Allergic: cold compresses, OTC topical vasoconstrictors, histamine-blocking eye drops, oral antihistamines
2. Viral: (usually adenovirus) cold compresses, artificial tears, topical decongestants.

3. Bacterial: Purulent: strep; chlamydia; gonococcal, pseudomonas (contact lens - topical fluoroquinolone)
Tx=topical Abs, check for STI (systemic Abs - azithro)

Herpes zoster ophthalmicus

Sight threatening condition
Hutchinson sign = herpes pustules at nose tip and is predictive of ocular involvement. Dendrites on exam.
Can cause keratitis, scleritis, uveitis, acute retinal necrosis
Usually monocular; vesicular rash in V nerve (cornea involved if tip of nose involved as nasociliary)
Rx: analgesia, po acyclovir 800mg 5 times a day 1/52, iv if sight threatened; ophth review within 24hrs

Keratitis

Whiteness, cells and flare in ant chamber; hypopyon if severe; unilat blurred vision, mild headache
Causes:
1. Infection
- viral (HSV, zoster, adenovirus)
- bacterial (Staph, chlamydia, pseudomonas - contact lens)
- amoeba (acanthamoeba - contact lens = serious infection)
- fungal (contact lens)
2. Allergic - kerato-conjunctivitis
3. Photo-keratitis - Welders eye/Arc eye, snow blindness
4. Exposure - with coma
5. Trauma - corneal ulcer
Ix: corneal scraping. Mng: top cipro; top steroids once infection under control

Iritis (anterior uveitis)

Causes: ~50% idiopathic. Inflammatory/traumatic/infectious.
Trauma; HLA B27/seronegative spondyloarthropathies: RA, IBD, Reiters, Collage vascular disease; TB, sarcoid
Hx: sudden, severe, aching pain, red eye, photophobia, decr VA
OE: Ciliary Flush = injection maximal around limbus (ie peri-limbic erythema)
Photophobia (consensual), mild-mod decr VA, small/normal + irregular pupil, usually unilateral
Anterior chamber - WBC (cells) & protein (flare), post synechiae, hypopyon
Cornea - keratitis, keratic precipitates, oedema
Mng: ophth; top/PO steroids if severe and no evidence of corneal infection; dilate pupil

Episcleritis

Episclera = thin membrane over sclera and beneath conjunctiva
Benign, self-limiting inflammatory condition
RA, PAN, lupus, IBD, sarcoid, Wegener's, gout, HSV, syphilis
Painless; isolated area; unilateral; NSAIDs; usually settles

Scleritis

Most common immune cause: RA. Most common vasculitis cause: Wegener's
Hx: Severe dull eye pain, photophobia, may have decr VA
O/E: Sectional redness, blue tinge (deep episcleral plexus vascularly engorged); vessels non-blanching with vasoconstrictor, scleral oedema, nodules
Rx: analgesia, NSAIDs, TOP steroids, cycloplegics; refer ophth <24hrs

Acute Angle-Closure Glaucoma

"Compartment syndrome of the eye"
Incr risk: older, Asian, long sighted, anticholinergics, FHx, DM, pupil dilators (beta agonists, antihistamines)
Clinical findings
Severe unilateral ocular pain
Blurred vision, halos
N/V
Red eye, cloudy cornea, moderately dilated, non-reactive pupil, conjunctival injection
IOP >40 mm Hg
Elevated IOP with shallow anterior chamber
Treatment

Incr outflow aqueous humour	Pilocarpine 4% q5min for first hour then qid
Block production aqueous humour	Acetazolamide 500mg iv/po + Timolol 0.5% 1 drop q2h
Reduce volume vitreous humour	Mannitol 1mg/kg iv

Surgical - laser iridotomy.
Supportive: Analgesia, Antiemetic, Avoid anticholinergics

Sudden Visual Loss

Exam

VA, fields, RAPD and pupil reactivity, extraocular movts, red reflex, fundus, slit lamp incl ant chamber
IOP (normal 10-20 mmHg)

Retinal Artery Occlusion

Ocular emergency. Causes: thrombotic (most common - GCA, vasculitis), embolic (carotid/heart)
OE: decr VA, RAPD; pale optic disc; cherry red spot (fovea against white infarcted retina), ?carotid bruit

Management

Digital massage; hypercarbia; topical beta-blockers/acetazolamide decr IOP; O2; Steroids if GCA. Hyperbaric

Retinal vein occlusion

Infarction not ischaemia
Causes: vasculopaths - hyperviscosity, HTN, glaucoma, atherosclerosis, DM
Thunderstorm retina, dilated retinal veins, cotton wool spots, disc oedema, RAPD if severe

Retinal detachment

Associations: myopia, cataracts removal, vitreous diseases, trauma
Exam: decr VA, abnormal red reflex, +/- detached retina, field defect

Vitreous haemorrhage

Trauma; DM (neoV); coagulopathy; post vitreous detachment (shaken baby); retinal detachment
Red reflex poor or absent, no RAPD

Optic neuritis

Idiopathic; MS; temporal arteritis; HTN; atherosclerosis; viral (measles, mumps); syphilis, TB: sarcoidosis
Assessment: decr vision; unilat; eye pain, esp on adduction (90%); Uhthoff's phenomenon; central scotoma; RAPD; optic disc oedema in 50%; small haemorrhages over disc

Ischaemic Optic Neuropathy

Most often caused by GCA
Usually not complete loss of vision, RAPD common. Symptoms of waking, don't worsen
Fundoscopy: Papilloedema with splinter haemorrhages at disc margin
Mx: steroids, refer, biopsy

Third Nerve Lesions

Central (midbrain) Stroke, Tumour, Demyelination

Peripheral

Compressive = pupil involvement
- PCOM aneurysm
- Tumour (nasopharyngeal)
- Meningitis/CNS abscess
- Superior orbital fissure syndrome (Tolosa-Hunt)

Ischaemic = pupil sparing
- Arteritis, Diabetes, HTN, Migraine

Dermatology Summary

Rashes

Lesion - Single small diseased area
Rash - Eruption of skin; more than single lesion

Macule - Circumscribed area of change without elevation
Papule - Solid raised lesion < 1 cm
Nodule - Solid raised lesion ≥ 1 cm
Plaque - Circumscribed elevated confluence of papules ≥ 1 cm
Pustule - Circumscribed area containing pus
Vesicle - Circumscribed fluid-filled, < 1 cm
Bulla - Circumscribed fluid-filled, ≥ 1 cm
Petechiae - Small red/brown macule ≤ 1 cm that does not blanch

Nikolsky sign: dislodgement of epidermis by lateral finger pressure

Type of Rash
Diffuse erythema - Staph SSS, staph/strep TSS, necrotizing fasciitis
Mucosal lesions - EM major, TEN, SJS, pemphigus vulgaris
Vesicles/bullae - pemphigus, pemphigoid, nec fasc, disseminated gonococcus
Petechiae/purpura - Meningococcemia, necrotiz fasciitis, vasculitis, DIC, RMSF, endocarditis

Symptoms
Hypotension - Meningococcemia, TSS, RMSF, TEN, SJS

Hand and Foot rashes
Hand Foot and Mouth
Syphilis, gonoccoaemia, HSV, HIV seroconversion
Erythema Multiforme
Mercury/Arsenic Poisoning
Guttate Psoriasis
RMSF
Reiter's

Petechial/Purpuric Rash

Febrile/toxic:	palpable: meningococcaemia, disseminated gonococcal, endocarditis, RMSF, HSP
	non-palpable: DIC, TTP, purpura fulminans
Afebrile/non-toxic:	palpable: autoimmune vasculitis
	non-palpable: ITP

Vesiculobullous Rash
Febrile:
- diffuse: varicella, DIC, smallpox, disseminated gonococcal disease, purpura fulminans
- localised: nec fasc, hand foot and mouth

Afebrile:
- diffuse: bullous pemphigoid, pemphigus vulgaris
- localised: contact dermatitis, herpes zoster, dyshidrotic eczema, burns

Pruritic Rash
With skin disease: drugs, scabies, insect bites, eczema, dermatitis, urticaria, lichen planus, pityriasis rosea, dermatitis herpetiformis
Without skin disease: jaundice, CRF, lymphoma, myxoedema, thyrotoxicosis, Ca, drugs

Erythema nodosum
Causes: idiopathic, strep, drugs (penicillin, sulphur, OCP, iodide), sarcoid, TB, leprosy, IBD, Ca
Delayed hypersensitivity reaction
Panniculitis (inflammation of fat)
Looks like a bruise - anterior tibia
Most common 20-50yr females
Rx: treat underlying, symptomatic

Cellulitis
Common pathogens; strep pyogenes, Staph aureus, Clostridium perfringens, Haemophilus influenzae
Animal bites: Pateurella multocida
Human bites: Eikenella corrodens

Blistering Rashes

Herpes simplex/zoster
Ix: Tsanck smear of vesicular fluid
Rx: Acyclovir 200mg 5x/day for 5/7 (400mg 5x/day for 10/7 if zoster and within 72hrs onset)

Eczema herpeticum
Primary herpes with active dermatitis
Rx: high dose IV acyclovir; ICU if disseminated; ABx if secondary infection

Impetigo
Children
Facial vesicles rupture → honey crust
Staph - bullous; staph/grp A strep - non-bullous
Contagious
Rx: topical mupirocin (small area) vs systemic cephalexin or 15mg/kg fluclox QID PO

Erysipelas
Sharply demarcated cellulitis with raised borders
Strep (GAS)
Rx: antibiotics

Molluscum Contagiosum
Dome-shaped fleshy papule, Central umbilication
Children (daycare), Adult (STD), think HIV
Rx: benign, self-limited, refer

Pityriasis
HERALD PATCH → Christmas tree rash pattern to trunk; rash can be pruritic
Prodromal flu-like illness
Rx: self-limited

Bullous Pemphigoid
PemphigoiD = Deeper
Elderly
TENSE/FIRM bullae
NO MUCOSAL INVOLVEMENT
NEGATIVE NIKOLSKY
Rx: steroids

Pemphigus Vulgaris
PemphiguS = Superficial
Cause: antibody to ketatinocyte adhesion molecules; penicillamine, ACEi, B cell lymphoma
Older adult/elderly
Flaccid bullae → break easily & crust
YES MUCOSAL INVOLVEMENT
POSITIVE NIKOLSKY
Ix: biopsy
Rx: steroids; azathioprine/cyclophosphamide if ineffective; maybe gold, plasmapheresis, intragam

SSSS (Staph Scalded Skin Syndrome)
NO MUCOSAL INVOLVEMENT
Kids <6 years old
Cause: staph aureus - epidermolytic toxins A and B
Fever, +NIKOLSKY, painful erythema, flaccid bullae
Phase 1: tender erythroderma (like sunburn)
Phase 2: exfoliation beginning on D2
Phase 3: desquamation on D3-5 (bullae, sloughing)
Ix: culture of swab/tissue
Mng: fluclox 2g (50mg/kg) Q6h; no steroids, fluids, skin care (very fragile)

TSS (Toxic Shock Syndrome)
Fever + Hypotension + Erythroderma
≥3 organ systems involved
Desquamating erythroderma (incl palms and soles)
YES MUCOSAL INVOLVEMENT
Cause: colonization with toxin-producing Staph aureus/grp A strep pyogenes
- tampons, burns, cellulitis, sinusitis, wounds
Rx: early recognition, remove focus of infection, treatment of sepsis
Mortality 5-15%

Necrotising Fasciitis
S/S: pain out of proportion, hemorrhagic
Bullae, crepitance, rapid progression, dirty dishwater discharge
Tx: surgery, Empiric: Meropenem 1g TDS + clindamycin
- can use antitoxins if clostridium; debridement; HBO
Type 1 bacteria = polymicrobial (DM)
Type 2 bacteria = GAS/MRSA

Risk factors: obesity, immunocomp, DM (in 20-70%), alcoholism (in 25-50%), steroid use
Rx Fournier's gangrene: ceftriaxone 2g IV + metronidazole 500mg IV + gentamicin 5mg/kg

Erythema multiforme - SJS - TEN
Continuum - Immune complex mediated hypersensitivity, multi-system disorder
FIXED lesions, symmetric, non-pruritic
TARGET LESIONS, +NIKOLSKY, painful
YES MUCOSAL INVOLVEMENT
Palms/Soles
Drug causes:
Antibiotics: cephalosporins, penicillins, sulphonamides
Anticonvulsants: phenytoin, carbamazapine, lamotrigine
Anti-inflammatories: NSAIDs
Antacids: omeprazole

Erythema multiforme
Cause: 50% infections (herpes simplex, mycoplasma), drugs, Ca, idopathic
Maybe MM involvement (EM minor = no MM involved, EM major = 1 MM involved)

SJS
Mortality 10-15%
Cause: drugs most common cause
Prodromal flu-like symptoms
<10% BSA

TEN
25-35% mortality
Cause: drugs, immunisation, HIV, leukaemia, lymphoma
Prodromal illness - full thickness epidermal necrosis - painful tender erythroderma
>30%BSA

Management
Identify and remove trigger
Supportive care, resolution 3-6/52
Saline packs, saline mouthwashes
Admit burns unit, burns dressings
Avoid steroids. ?IVIG

Rheumatology, Immunology Summary

Rheumatological Emergencies

Airway and Breathing

Cricoarytenoid obstruction - RA
Resp muscle weakness - Polymyositis, dermatomyositis
Pleural effusions - All rheum diseases; often exudate
Pulmonary haemorrhage - Goodpasture's, SLE, vasculitis
Pulmonary fibrosis - Ank spond, slceroderma, rarely RA

Cardiovascular

Pericarditis - SLE (with flareup), RA
Accelerated atherosclerosis - Always consider IHD in SLE/RA & chest pain
AMI - PAN & Kawasaki's
Rheumatic fever
Valvular Heart Disease - Seronegative Spondyloarthopathies
Aortic Regurgitation/aneurysm - Relapsing polychondritis, Ank spond
Myocardial fibrosis - Scleroderma

C-Spine

Atlanto-axial instability - RA
Fracture with minor trauma - Ank Spond
Transverse myelitis - SLE

Ophthalmological

Temporal arteritis
Sjogren's yndrome
Scleritis - RA/Vasculitis (& IBD)

Renal

ANY rheumatic disease can cause kidney damage (& treatments - NSAIDs)
GN - SLE, Wegener's, Scleroderma

Immunosuppression from drugs and disease

Ddx Painful Joint

Non-inflammatory:

- Trauma
- Infection
- OA
- Aseptic necrosis
- SLE

Inflammatory:

- Crystal arthropathy (gout/pseudogout)
- Spondyloarthropathy ("spine and joint", sero negative, HLA B27) - Ank spond, psoriatic, reiters
- Connective tissue disease - RA, SLE, PM/DM, Sjogrens, Systemic sclerosis

Atypical joint pain - Acute viral arthritis, Sarcoidosis, PMR, Post-streptococcal: rheumatic fever, HSP

Oligoarthritis (2-3 joints)
Reiters
Ank Spond
Gonococcal
Rheumatic fever
Lyme disease

Polyarthritis (>3 joints)
RA
SLE
Chronic OA
Viral arthritis

Migratory Polyarthritis

Rheumatic fever
Bacterial endocarditis
HSP
Septicaemia (Staph, Strep, Meningococcus)
Lyme disease
Cefaclor hypersensitivity

Gout

Negatively birefringent monosodium urate crystals
Serum uric acid not helpful:>0.42 in 80% acute gout/5% normal population
<0.45 effectively excludes gout as diagnosis
Imaging: chronic gout – punched out lesions, sclerosis, tophi
Rx: dietary changes, ice, rest, NSAIDs, steroids, joint steroid injections
Colchicine (if NSAIDs CI/normal GFR. 0.5mg-1mg/hr up to 8mg/24hrs or diarrhoea/improvement)
Prophylaxis: Delay until 2-3wks after acute attack resolves. Allopurinol 300mg OD

Pseudogout

CPPD disease - Calcium pyrophosphate deposition
Tophi absent, normal serum uric acid
Crystals rhomboid shaped (positively birefringent)
Chondrocalcinosis on plain xray – linear calcification in articular cartilage
Rx: NSAIDs, intra-articular steroids

Septic Arthritis

Usually monoarticular (most commonly knee)
Usually haematogenous spread of bacteria (also from bite, trauma or iatrogenic source)
Consider N. gonorrhoea in sexually active young adults
RFs: Age > 80, DM, RA, prosthetic joint, recent joint surgery, skin infection, cutaneous ulcers, IVDU, ETOH

Organisms

Neonates: Staph, GBS, Gram negative, candida
<5 years: Staph, strep pneumo, Hib (decr post vaccine)
>5 years to adults: Staph, strep, gonococcal (usually polyarthritis)
Foot – staph, pseudomonas
IVDU: staph, gram negative bacilli

Investigations

Arthrocentesis → Gram stain, culture, leukocyte count (WCC >50,000) and differential (PMNs 75%)
Blood cultures, CBC
Xray: soft tissue swelling; look for osteomyelitis
Flucloxacillin + Penicillin
Add Gent for IVDUs and kids <5 years

Joint Aspiration

18-21G needle
Knee - flex 30deg, medial approach 1cm inf to femoral condyle
Shoulder -inf/lat to coracoid process, directs posteromedially to glenoid
Wrist - distal to radial border on ulnar side of ECRL and ECRB
Ankle - antlat, just med to TA tendon
Elbow - lateral, just distal to head of radius
Complications: infection rate 1:10,000; damage to articular cartilage

Joint Fluid analysis

	Clarity	Colour	WBC	Neuts	Culture	Crystals	Conditions
Normal			<200	<25%			
Non-inflam		Yellow	<200-2000	<25%			OA, trauma, RhF
Inflam	Cloudy	Yellow	2000-50,000	>50%		Depends	Gout/CPPD, RA, SLE, spond
Septic	Cloudy	Yellow	>50,000	>85%	Positive		Organisms

Prosthetic joint infection

Coag-neg staph (35%), staph aureus, strep, gram neg bacilli, enterococci
Aspirate – WCC >1700 or >65% neuts
Long term Abx; ?surgical revision

Vasculitis

Large vessel:
- Takayasu arteritis, Giant Cell arteritis

Medium vessel:
- Polyarteritis nodosa, Kawasaki disease

Small vessel:
- Churg-Stauss, Wegener's, HSP, Hypersensitivity vasculitis

Presentations:
- Mononeuritis multiplex (take out vessels that supply nerves, in multiple places)
- Palpable purpura
- Pulmonary-renal involvement (haemoptysis + haematuria/renal failure)

Giant Cell Arteritis

Aka temporal arteritis
Chronic granulomatous inflammatory disease of large blood vessels
50% have PMR
Ix: CRP/ESR (always >50), normochromic normocytic anaemia, leucocytosis, abnormal LFTs
Temporal artery biopsy
Rx: prednisone 40-60mg/day, iv methylpred if recent visual loss, aspirin reduces thrombotic complications

Kawasaki Disease

(Mucocutaneous lymph node syndrome)
Fever, cutaneous/mucosal changes and vasculitis of small & medium blood vessels incl coronaries
Most common cause of acquired heart disease in developed countries
85% affected children are under 5
Aetiology unknown ? infective agent

Diagnostic criteria:
Fever (generally ≥39.5) of unknown origin for ≥5d
And 4 from 5 of:
- Mucous membranes: (pharyngitis, strawberry tongue)
- Eyes: conjuctivitis
- Polymorphous rash
- Extremities (oedema, desquamation)
- Cervical lymph nodes >1.5cm

Other features:
Cardiovascular: pancarditis, aortic or mitral incompetence
Respiratory: pneumonitis, coryzal, otitis media
Gastrointestinal: hydrops of gallbladder, jaundice, diarrhoea
CNS: aseptic meningitis, cranial nerve palsies
Musculoskeletal: arthritis, arthralgia
Other: anterior uveitis

Investigations:
Bloods: WBC, platelets, LFTs, ESR/CRP. Mild anaemia
ECG, CXR (Signs of heart failure), Echo (LV fn, valves, coronary), angiography or MRA

Treatment:
IVIG 2g/kg, steroids, bed rest
Aspirin 2+ months as antithrombotic
Follow up echo

Complications:
~20-25% of untreated → coronary aneurysms
Reye's Syndrome from aspirin use

Sarcoidosis

Multisystem chronic inflammatory idiopathic condition characterised by non-caseating epithelioid granulomata at various sites, esp lungs and thoracic cavity.
Asymptomatic: diagnosed on routine CXR (50%)
Non-specific symptoms: fever, fatigue, cachexia
Erythema nodosum & polyarthritis.

Hypercalcaemia and hypercalciuria
Arryhthmias
Bloods: FBC, ESR↑, U&Es, ↑Ca, LFTs, ACE (↑ in 60%)
Imaging: CXR/CT - bilateral hilar lymphadenopathy + interstitial disease.
Biopsy LNs

Anaphylaxis

Anaphylaxis – IgE dependent - type 1 hypersensitivity
Anaphylactoid – not IgE dependent
Multisystem severe hypersensitivity reaction of sudden onset (or rapidly progressive).

Rapid onset of 2 of the following after exposure to likely allergen:
- mucocutaneous signs
- respiratory compromise
- cardiovascular compromise
- persistent gastrointestinal symptoms.

Management
Attach monitoring, vital signs, ECG, iv access
Remove allergen
Airway: Consider suction, intubation, adrenaline 1:1000 5ml neb
High flow O2
Adrenaline 0.3-0.5mg (0.3-0.5ml of 1:1000) [child 10mcg/kg or 0.01ml/kg 1:1000] IM stat
If resistant to adrenaline (beta–blockers), 1-2mg glucagon IV over 5min
IV fluids
Salbutamol 5mg [2.5mg<20kg] if bronchospasm only
Steroids (?may ↓delayed/biphasic reactions)
Antihistamines for skin manifestations. H1±H2 blockers

Observation for at least 6hrs and admit if:
Asthmatic component to their anaphylactic reaction
Previous history of biphasic reactions
Possibility of continuing absorption of allergen
Poor access to emergency care

On discharge:
Prescription & education on EpiPen (adult 300µg 1:1000, child<20kg 150µg 1:2000)
Medic alert bracelet
Consider 3 day course of antihistamines and oral steroids.

Drug Allergies
Type 1: immediate onset (IgE mediated) eg penicillin
Type 2: Delayed onset (IgG cell destruction) eg haemolytic-like reaction
Type 3: Delayed onset IgG (Drug-immune complex) eg serum sickness and vasculitis
Type 4: Delayed onset (cell mediated) eg SJS

Endocrinology Summary

Adrenal Insufficiency

Primary

Mineralocorticoid + glucocorticoid deficiency
- Low Na
- High K and Ca
- NAGMA
- Mild hypoglycaemia
- Shock (reduced vasomotor tone and hypovolaemia)

Causes:
- Addison's disease (80%) - autoimmune
- Bilateral adrenal haemorrhage (sepsis, newborn Vit K def)
- CAH
- Drugs (etomidate, fluconazole)
- Infection (TB, viral)
- Ca (primary; lung and lymphoma secondary)
- Infiltrative (sarcoid, haemochromatosis)

Secondary

Glucocorticoid deficiency - compensatory increased aldosterone - euvolaemia, low K
- Normal or high Na
- Normal or low K
- Mild hypoglycaemia
- Hypotension/shock

Causes:
- HPA axis suppressed due to longterm steroids
- Hypopituitarism

Investigations

Cortisol: within 1hr of waking; <200 = insufficiency; 200-500 = needs ACTH stimulation test
ACTH stim test: Synacthen IM - cortisol >550 normal. ACTH: high = primary; low = secondary

Management

If uncertain diagnosis: Dexamethasone 4-8mg IV stat - 4mg QID
If known Addisons: hydrocortisone 200mg IV stat - 100mg QID

CAH

Girls - virilisation at birth
Boys - salt-losing form = Addisonian crisis age 1-2/52; non-salt-losing = early virilisation

Adrenal Excess

Cause: Iatrogenic (steroids)
- Pituitary adenoma (Cushing's disease)
- Adrenal adenoma/Ca/hyperplasia
- Ectopic CRH (Pancreas, bronchial carcinoid, thymic Ca)
- Ectopic ACTH (Oat cell Ca lung)

Moon face, buffalo hump, obesity, striae, hursutism, atrophic skin, OP, HTN, peripheral oedema, DM, psych

Investigations
- HTN, Hyperglycaemia
- Hypokalaemia
- Metabolic alkalosis
- Cortisol: at 00:00 >200 = Cushings
- Dex supp test: cortisol/ACTH at 09:00; dex 1mg at 11pm; normal decr to <50% baseline level

Aldosterone Excess

Primary

Conn's syndrome

Investigations
- High Na, low K/Ca
- HTN
- Metabolic alkalosis (chloride resistant/volume overloaded)

Ddx
- Liddle syndrome
- Renin-secreting tumour – rare, in JGA
- Excess Liquorice

Management

Adrenal adenoma – spironolactone then surgery
Adrenal hyperplasia – spironolactone
Treat HTN (ACEi, thiazides, Ca blockers)

Phaeochromocytoma

Catecholamine-producing tumour of chromaffin cells in adrenal medulla
Ix: 24hr urine - total catecholamines, VMA and metanephrines
Plasma free metanephrines, TFTs, BSL. CT/MRI or PET
Ddx: Anxiety disorder, carcinoid tumour, EtOH withdrawal, labile hypertension, drug abuse

Management

Hypertensive crisis:

Phentolamine 2-5mg IV
Alpha blockade with phenoxybenzamine PO once controlled
Then beta blockade to control reflex tachycardia

Hyperparathyroidism

PTH increases calcium absorption - Incr Calcium

Presentation

Bones, Stones, Groans, Thrones – polyuria, Psychic overtones
Short QT

Management

Surgery
Treat hypercalcaemia

IV fluids (aim UO ~100ml/hr)
+/- frusemide
Bisphosphonates
Calcitonin (short lived)
Glucocorticoids

When to treat hypercalcaemia

< 3 no treatment
3-3.5mmol/L treat if symptomatic
> 3.5 treat

Hypoparathyroidism

Decr PTH causes decr calcium, Incr phosphorus levels
Muscle cramps, tetany, tingling finger/toes, Seizures, Chvostek sign (facial nerve), Trousseau sign (BP cuff)
Rx: calcium, vitamin D

Hypopituitarism

Causes:
1. Mass lesion - Pituitary tumours, Non-pituitary tumours: meningiomas, brain tumours, mets
2. Bleed (pituitary apoplexy)
3. Hypothalamic disease
4. Ischaemia and infarction: Sheehan's syndrome (post-partum), CVA, SAH
5. Infiltrative processes: sarcoidosis, histiocytosis X, haemochromatosis
6. Infections: cerebral abscess, meningitis, encephalitis, tuberculosis, syphilis
7. Iatrogenic: irradiation, neurosurgery

Presentation

Deficiency of:

ACTH: Adrenal Insufficiency; TSH: Hypothyroidism; Gonadotropin: oligomenorrhoea, infertility
GH, Prolactin: inability to lactate postpartum – may be only sign of Sheehans
ADH: DI rare

Features due to underlying cause:

SOL: headaches or visual field deficits
Large lesions involving the hypothalamus: polydipsia, SIADH

Hyperthyroidism

Primary Graves (toxic diffuse goitre), Toxic multinodular goitre, Toxic adenoma
Central Pituitary adenoma
Thyroiditis De Quervains, post-partum, radiation
Drug-induced Lithium, iodine, amiodarone, thyroxine
Ectopic thyroid tissue
Metastatic thyroid tissue

TSH <0.1; incr T3/4; thyroid autoab's; normochromic anaemia, incr WBC, mild incr Ca, decr alb, incr AST/ALP

Thyroid storm

Life-threatening, hypermetabolic state: mortality untreated 90%
Diagnostic criteria: sudden onset
- fever (>37.8)
- tachycardia - incr HR out of proportion (120-200)
- CNS disturbance (altered LOC, seizures)

CCF (high output)
Incr T3,4; decr TSH; K+, ECG, Graves autoantibodies, thyroid USS/NM

Management

ABC (O2 as consumption incr; IVF with dextrose; DCC for arrhythmias, likely resistant to drugs)
Block new hormone synthesis
- propylthiouracil (200-600mg po bd)/carbimazole (10-45mg po bd)
- iodine - block release hormones (after PTU)

Block systemic effects
- beta blockers: propranolol
- glucocorticoids – prevent conversion T4-T3

Treat precipitant – stop meds, sepsis/infection, trauma/surgery, iodine contrast, seizure
Supportive: fluid status, electrolytes, glucose, decr fever (not aspirin), cooling
Others: dialysis, plasmapheresis, charcoal haemoperfusion
Disposition: ICU
Ddx: sepsis, heat stroke, malignant hyperthermia, NMS, phaeo, sympathomimetic ingestion

Hypothyroidism

Painless causes

Hashimotos – autoimmune, chronic (1st world)
Drugs (amiodarone, lithium, iodine)
Post-partum thyroiditis
Iodine deficiency (3rd world)
Infiltrative (lymphoma, sarcoid, TB, amyloidosis)
Idiopathic

Painful causes:

Subacute thyroiditis – de Quervains
Infectious

Incr TSH, decr T3/T4; anaemia, thyroid autoAbs in Hashimotos
Rx: T4 – thyroid hormone +/- iodine. Thyroxine 75-150mcg/day (half dose in elderly)

Myxoedema coma

Life-threatening decompensation with multi-organ involvement - 50% mortality
Same triggers as thyroid storm
Decr LOC, decr T, seizures, decr RR, decr BP, decr HR, hypoG, hypoNa, paralytic ileus, megacolon, retention, ankle oedema, CCF, hoarseness, glottic oedema, low voltage ECG (long QTc, flat/inverted T waves)

Management

ABC – volume replacement, correct electrolytes, vasopressors, warming
Treat cause; ICU
Definitive care: T3 25-50mcg IV bolus - 10-20mcg TID
or T4 300-500mcg IV bolus - 50mcg IV/day
Hydrocortisone 100mg QID; as impaired glucocorticoid response to stress

Diabetic Ketoacidosis

Na	correct for glu: Na + ((Glu – 5.5) / 3)	average Na deficit 5-10mmol/kg
K	correct for pH: decr pH 0.1 = incr K 0.5	average K deficit 3-5mmol/kg
Osmolality	osm: (2 x Na) + Glu + Ur	increased

Management

Aim decr BSL by no more than 5/hr, decr osm by 1-2/hr; endpoint: ketones cleared, normal AG

Fluids

Kids 10-20ml/kg to start → replace deficit over 48hrs
when BSL <15 change to D4S

Electrolytes:

NO INSULIN until K+ checked

If K <3.3 give 40mmol KCl and no insulin until >3.5
If K >5.0 give insulin and NS, no KCl
Add 20-30mmol K to 1L saline in 2nd hour and once UO established and K <5

Insulin:
Start 1hr after initial fluids, only if K>3.4
0.1 iu/kg/hr (max 6iu/hr) - decr to 0.05 iu/kg/hr when BSL <12 and acidosis improving

Treat complications (NBM, NGT if ileus, consider heparin – risk VTE)
Treat precipitants
HCO3: if pH<7, HCO3<5, life-threatening hyperK, coma, haemodynamic compromise unresponsive to fluids
Endpoint: pH >7.1, HCO3 >10
Admit ICU if: In children: <2yrs, pH <7.1, altered LOC, need arterial line, severe hyperosmolar dehydration
Cerebral oedema
0.5-1g/kg mannitol or 3ml/kg 3% saline over 30mins
Give half maintenance fluids; admit PICU; neurosurg review; CT; hyperventilate if ETT

DKA vs HHOS

DKA	**HHOS**
BSL >14	BSL >33
pH <7.3	pH >7.3
HCO3 <15	HCO3 >15
Ketones +++	Ketones -/+
Osmolality varies	Osmolality >320-350
AG >12	AG <12
H20 deficit 5-10L (10%, 100ml/kg)	H20 deficit 8-12L (20-25%)
Resus with N saline	
0.1iu/kg/hr insulin (max 6u/hr)	0.05iu/kg/hr insulin (max 3 u/hr)
Aim BSL 9-14	Aim BSL 14-18
Use N saline unless Na >150	Use 0.45% saline after boluses over
Replace over 48hrs	Replace over 48-72hrs
Cerebral oedema	Cerebral oedema uncommon
Mortality 5-15%	Mortality 15-45%

Hyperglycaemic Hyperosmolar State

Management
Nurse head up, NBM, NGT (if ileus), heparin important, treat underlying cause
IVF: Adults: N saline bolus until haemodynamically stable
→ use 0.45% saline to replace over same period as onset
If corrected Na low → use N saline
When BSL <15 → use 0.45% saline + 5% dex
K replacement similar to DKA; Insulin 0.05U/kg/hr
Prognosis
Complications: DVT/PE, ARDS, cardiogenic shock, DIC, MOF, rhabdo/ARF, cerebral oedema

Hypoglycaemia

Causes
1. Diabetes treatment (insulin/sulfonyureas) }
2. Alcohol intoxication (decr gluconeogenesis) } most common in ED
3. Sepsis (decr gluconeogenesis + incr response to insulin) }
4. Liver disease
5. Starvation
6. Toxic ingestions

Symptoms
1. CNS: altered GCS, lethargy, confusion, agitation, coma
2. ADRENERGIC: anxiety, N/V, palpitations, sweating, tremor

Treatment
1. iv dextrose: 1g/kg (50ml of 50% = 500mg/ml = 25g), change to infusion 10%
2. oral replacement: complex CHOs
3. Glucagon: 1mg im or iv (will not work if depleted glycogen – alcoholics, elderly)
4. Octreotide: for sulfonylurea OD and recurrent low BSL
5. Thiamine
6. Hydrocortisone – consider in refractory hypoglycaemia

Thiamine deficiency (Vitamin B1)

Chronic EtOH (poor dietary intake)
Extreme diets
Dialysis
Poor nutrition
Wernicke's encephalopathy (AMS, ataxia, ocular dysfunction eg nystagmus)
    Rx: thiamine 500mg iv/day
Korsakoffs psychosis (STML, unaware of condition, irreversible)
High output cardiac failure (Wet beriberi)
    Chronic thiamine deficiency

Niacin deficiency (Vitamin B3)

Pellagra
Due to lack in diet or carcinoid syndrome
In green leafy veges, fish, grains
4D's: diarrhoea, dermatitis, dementia, death

Cobalamin deficiency (Vitamin B12)

Animal products only. Stored in liver – takes years to run out
Must be able to absorb from gut
Causes:

- Decr GI absorption (Crohns)
- Decr intake (vegan, EtOH, elderly)
- Genetic
- Meds (PPIs)

Clinical manifestations:
Megaloblastic anaemia
Neuro symptoms: demyelination, paraesthesia, ataxia, clonus, paraplegia
Psych: memory loss, depression, psychosis
Ix: oval macrocytic RBCs, hypersegmented neutrophils, may develop into pancytopaenia
Low B12, Antibodies to intrinsic factor (pernicious anaemia)
Rx: parenteral B12 (im or sc) – daily 1/52 then weekly for a month then monthly forever +incr diet

Folic acid deficiency

Animal products, green leafy veges, fortified foods
Causes: poor nutrition, EtOH, elderly, infants on goats milk, drugs (phenytoin)
Clinical manifestations: similar to B12 but NO NEURO sx. Occurs faster than B12 (months)
Sx mainly due to anaemia
Ix: oval macrocytic RBCs, hypersegmented neutrophils, decr serum folate
Rx: oral folic acid + diet changes

Vitamin D deficiency

Facilitates calcium absorption from gut
Clinical manifestations: Kids – Rickets, stunted growth. Adults – osteomalacia (bone/muscle pain)
Rx: po Vit D, sunlight, braces/surgery

Vitamin C deficiency

Scurvy
Clinical manifestations: rough/haemorrhagic skin, gum disease, poor wound healing

Haematology and Oncology Summary

Anaemia

Bleeding: traumatic, non-traumatic; acute or chronic
Decr production: megaloblastic, B12/folate def, aplastic, myelodysplasia, marrow disease, CRF
Incr destruction (haemolytic): congenital, spherocytosis, eliptocytosis, G6DP def, sickle cell, acquired autoimmune, MAHA, mechanical trauma, infections, PNH

MICROCYTIC Anaemia

MCV <80
RDW = red cell distribution width, measure of degree variation in cell size, normal <15%

1. Fe def
Causes: GI / GU blood loss; Malabsorption, Pregnancy; Dietary
Incr: TIBC, transferrin, RDW
Decr: Ferritin, Fe, Hct
2. Thalassaemia
Incr: retics, erythroblasts (haemolysis); HbF
Normal: RBC, RDW
Decr: MCH, Hb
Poikilocytosis, anisocytosis, nucleated RBC's, basophilic stippling, target cells
3. Sideroblastic
Cause: Hereditary, Lead poisoning
Incr: RDW
Normal: Fe binding capacity, ferritin
Sideroblasts in BM
4. Multiple myeloma
Incr: globulins
5. AOCD
Causes: Hypothyroidism; vit C def
Normal: ferritin, RDW
Decr: RBC

MACROCYCTIC Anaemia

MCV >100
Megaloblastic (B12/folate deficiency) - high RDW
or non-megaloblastic (alcohol/liver disease/hypothyroidism/pregnancy) - normal RDW

1. Vit B12 def
Decr intake (vegan) or decr absorption (pernicious anaemia, stomach resection, PPI, giardia)
Complications: peripheral neuropathy, SACD, dementia, psychosis
IF ab's; Hypersegmented neutrophils; Stippling of red cells; Howell Jolly bodies; Schilling test
2. Folate def
1. decr intake
2. decr absorption - coeliacs
3. incr demand - alcoholism, pregnancy/lactation, dialysis
4. drugs - sulfasalazine, methotrexate, phenytoin, metformin
3. Other
Alcoholism; chronic liver disease; hypothyroidism; congenital cyanotic heart disease; myelodysplastic

NORMOCYTIC Anaemia

MCV 80-100

1. Acute blood loss
2. Haemolysis
Causes:
- Elliptocytosis
- Spherocytosis
  - Spherocytes, Coombs negative
- G6PD def
- PK def
- Sickle cell

HbS - haemolysis + activation of thrombosis
Triggers: hypoxia, acidosis, 2,3,DPG, vascular stasis, infection, dehydration, altitude, cold
Vasoocclusive crises, Haematologic crises, Aplastic crises - ppted by parvovirus B19
Sickle cells; Howell Jolly bodies
Rx Crises: hydration, O2, analgesia, antibiotics for infection, transfusion, treat underlying

Acquired autoimmune cold or warm haemolytic anaemia (extravascular haemolysis)

Microangiopathic haemolytic anaemia (intravascular haemolysis)
DIC, TTP, HUS, prosthetic heart valves, malignant HTN, pre-eclampsia, Wegener's, snake bite
Irregularly fragmented RBC's, Helmet cells, schistocytes

RBC mechanical trauma (intravascular haemolysis eg valves)

Infections: CMV, coxsackie, EBV, haemophilus, herpes simplex, HIV, malaria, measles, mycoplasma

Drugs: antimalarials, arsenic, bites, copper, lead, LA, nitrates, sulfonamides, ceftriaxone

Haemolytic disease of the newborn

Sx: splenomegaly, jaundice, gallstones

Haemolysis triad: decr haptoglobins, incr LDH, incr unconj bili
Also: incr retics, Incr urobilinogen, faecal stercobilinogen, Heinz bodies

3. Renal failure
Normal retics and RDW

4. Chronic disease
Normal retics and RDW; Incr: ferritin; Decr: Fe, transferrin, TIBC

5. Mixed (iron + B12 def)

6. Aplastic anaemia
Decr retics, WBC, plt; Hypocellular BM

Blood Products

Cryoprecipitate
Factor 8, Factor 13, vWF, fibrinogen (no factor 9)
Dose 0.1U/kg
Indication: fibrinogen deficiency (<1g/L), Plus: bleeding, invasive procedure, trauma, DIC

Fresh Frozen Plasma
Contains ALL coagulation factors + fibrinogen
Dose 10-15ml/kg
Indications: TTP, warfarin reversal, liver failure, DIC, massive transfusion

Platelets
1U incr plt by 5
Indications: bleeding, massive transfusion, surgery if plt <50, bone marrow failure if plt <10

Prothrombinex
1 vial = 500 units each of factors II, IX, X (no 7)
INR reversal within 15mins

Warfarin reversal
1. Stop warfarin
2. Vit K 5-10mg iv
3. Prothrombinex 25-50 IU/kg
4. FFP 150-300ml

End point: INR <5.0 and bleeding stops

INR <5.0	omit next dose
INR 5.0-9.0	no bleeding: cease warfarin, daily INR
	no bleeding but high risk: Vit K 1mg po, 6/24 INR
INR >9.0	no bleeding: Vit K 2.5mg po
	no bleeding but high risk: Vit K 1mg iv, consider PTX/FFP

Coag Problems

APTT Prolonged: heparin; haemophilia; lupus anticoagulant; vWD
INR Prolonged: warfarin; liver disease; malabsorption; factor VII def; APL
APTT + INR Prolonged: severe liver disease; DIC; factor X / V def; haemorrhagic disease of newborn
Bleeding time Prolonged: failed plt function (eg. Aspirin, NSAIDs, uraemia)

Haemorrhagic disease of newborn
Vit K def – maternal medications (anticonvulsants, rifampicin, isoniazid, warfarin)

Haemophilia A
Factor VIII def - long APTT; normal PT and thrombin clotting time
<25% mild, <6% mod, <1% severe – spontaneous jt + muscle bleeding; XS bleeding after minor trauma
RICE and splint; DDAVP; may need surgical decompression
VIII replacement - CNS haem (75iu), other bleeds (50iu)
DDAVP: if mild bleeding and level >5%; 0.3mcg/kg over 30mins

vWD
Type I – III (III most severe)
Post-procedure bleeding
Long APTT; normal PT; long bleeding time
DDAVP; cryo; vWF concentrate; tranexamic acid

DIC
Acquired syndrome of diffuse inappropriate intravascular coagulation with secondary fibrinolysis
- ARF, ARDS, ALF, altered LOC, CCF, bleeding
Hepatic failure
Obstetric (Amniotic fluid embolism, eclampsia, placental abruption, septic abortion)
Trauma (crush, burns, rhabdo, fat embolism, hyper/hypothermia)
Malignancy
Immune (Transfusion reaction, anaphylaxis, transplant rejection)
Sepsis (meningococcal, pneumococcal, pancreatitis)
Shock (Blood loss) and snake bite
Incr: FDP, D dimer, LDH, PT, APTT, PR
Decr: platelets, antithrombin, protein C, fibrinogen, CF's, Hb (haemolysis)
Management
ABC, Treat cause; supportive care
Transfusion: RBC, FFP, Plt (if <50 + bleeding, or <10-20), Cryo (if fib <100)
Protein C: in severe sepsis; Factor VIIa: but risk of clots
Heparin: if organ survival threatened by thrombus; use low dose INF

Massive Transfusion
>50% patient's blood vol at once or 100% patient's blood vol over 24hrs (approx 8 units)
1. PRBC: O neg stat
2. FFP: give 1:1 with PRBC; aim INR and APTT <1.5x normal
3. Plt: give 1:5 with PRBC; aim plt >75

PRBC : FFP : plt 5 : 5 : 1-2
In kids: 15ml/kg FFP; 10ml/kg PRBC

Neutropenic sepsis
G+ve: coagulase-neg staph, staph aureus, strep, enterococci
G-ve: Pseudomonas, E.Coli, Klebsiella Fungi, viruses
Commonly indwelling line infections, respiratory or urological sepsis.
Management
Reverse barrier nursing
Resuscitate if hypovolaemic or septic shock
Full history and examination
Send cultures
Antibiotics - broad spectrum tazocin 4.5h q6h IV + gentamicin 5mg/kg IV (± vancomycin if shocked/MRSA)
Diagnose underlying cause for the neutropenia and treat if possible
Treat complications e.g. DIC, organ failure
Consider G-CSF to ↑ANC in severe cases.

Platelet Problems
Thrombocytopenia
10-30 = petechiae, <10 = marked incr risk bleeding esp ICH
1. Pseudo/spurious - clotting/clumping in tube
2. Decr Plt production: marrow infiltrate, viral, drugs (heparin, sulfur, alcohol), radiation, B12/folate def
3. Incr Plt destruction: ITP, TTP, HUS, DIC, viral, drugs (heparin)
4. Plt loss: haemorrhage, haemodialysis, ECMO, valves
5. Splenic sequestration: sickle cell, cirrhosis
6. Decr Plt function: uraemia, liver disease, DIC, vWD, antiplt Abs, myeloproliferative (leukaemia)
7. Dilutional: massive transfusion
8. Pregnancy

Rx: plts only for incr consumption if potential life threatening bleeding / plt <5, aim 20-50 (60-100 if OT)

Causes of Purpura
Platelet defects (DIC, MAHA, HUS/TTP, ITP, HELLP, aspirin/NSAIDs)
Coaguopathies (congenital - vWD, haemophilia, haem disease newborn OR acquired - liver failure, drugs)
Drugs (warfarin, anticoagulants, antiplatelets)
Vasculitis (septic or immune - HSP)

Causes of Petechiae
Thrombocytopenia - platelet dysfunction (congenital, myeloproliferative, fat embolism, aspirin/NSAIDs)
Small vessel disease - infection (SBE, vasculitis, meningococcal, measles); drugs (steroids); scurvy; Cushings syndrome; polyarteritis nodosa; HSP

Causes of Ecchymoses
Thrombocytopenia
Coagulation disorders- Vit K deficiency/anti-coagulants; liver disease; Haemophilia; vWD; DIC

Thrombophilia
APC resistance (factor V Leiden), Prothrombin gene mutation, Protein C and S def, AT III def, APL syndrome

Thrombotic Microangiopathies

	Platelets	Haemolysis	Renal Failure
ITP	Decr	No	No
TTP	Decr	Yes	No
HUS	Decr	Yes	Yes

ITP
Acquired, Auto-immune, Good prognosis
Purpura or petechiae, mucosal bleeding - exam otherwise normal (no lymphadenopathy, organomegaly)
Normal bone marrow
No other identifiable cause for ↓ PLTs
Well 5 yr old, post viral Sudden onset petechiae and purpura esp on legs, epistaxis, menorrhagia if plt <20
Chronic form in adults - Rx: splenectomy
Rx: avoid antiplatelets, minimise bleeding (activity), transfuse if plt <10 or plt <20 + bleeding, pred 1mg/kg

TTP
Non-immune, Poor prognosis, Neuro Sx
Platelet aggregation - haemolysis + platelet consumption/microvascular occlusion
30-40 years, triggered by pregnancy; infection (E coli, Shigella), drugs (OCP, clopidogrel), Ca, chemo
Fever
Anaemia (haemolytic; Coomb's negative; severely fragmented RBC;)
Thrombocytopenia
Renal failure
Neuro Sx
Anaemia, Plt <50, schistocytes; Haemolysis - incr LDH/bilirubin/retics, decr haptoglobin; Coombs negative
Coags - normal
Urine - RBC, red cell casts, proteinuria
Rx: Supportive - iv fluids, resp support, RBC for severe anaemia; FFP; plasma exchange, pred, splenectomy

HUS
Microangiopathic, Renal Sx, Good prognosis
?spectrum of TTP, but more renal impairment and bloody diarrhoea
<4yrs; most common preventable cause of renal failure in children
Deposition of fibrin in walls of vessels - intraV consumption of plt
Triggered by E coli 0157:H7, Shigella, yersinia, campy, salmonella; strep pneumonia, EBV, varicella, Ca
FATRN + GI Sx (bloody diarrhoea; hepatomegaly)
Ix: decr haptoglobin; incr LDH; mild incr bil (unconjugated); normal coag; test stool for WBC and Shiga toxin
Rx: careful fluid and electrolyte mng; immunoperfusion; plasma exchange if severe; 50% need dialysis

HSP
Not plt prob - normal platelet count
4-6yrs
Allergic small vessel vasculitis, follows URTI, IgA mediated; assoc w infection, drugs, vaccines; Grp A strep
Palpable purpura on buttocks and legs (extensor surface)
AP (+N+V+D; blood in stool), Migratory polyarthralgia, Renal failure; oedema
Ix: haematuria and proteinuria in 90%; urine, FBC (plts normal), U+E
Complications: nephritic/nephrotic syndrome, ARF, HTN; intussusception (5%); bowel perf
Rx: Usually resolves in 3-4/52; supportive; monitor BP and urine for 6/12; IVF if ill; NSAIDS; pred 1mg/kg

Transfusion Reaction

Immediate

1. Immunological
    - Acute haemolytic transfusion reaction
        - ABO-incompatability (often admin error)
        - Rare
        - Sx: rigors, fever, flank pain, tachycardia, dyspnoea, hypotension, oliguria, DIC
        - Mx: steps 1-6 (below) + diuresis
    - Febrile non-haemolytic transfusion reaction
        - Patient Abs to donor HLA
        - Common
        - Sx: fever, chills, rigors, headache
        - Mx: exclude other causes (haemolysis, sepsis, TRALI), antipyretic
    - Allergy/anaphylaxis
    - Transfusion related acute lung injury (TRALI)
        - Donor Ab to patient leucocytes - complement activation - pulm vascular damage
        - Sx: fever, tachycardia, hypotension, hypoxia, cough, NCPO. Can be fatal
2. Non-Immunological
    - TACO
    - Bacterial contamination
    - Transfusion related equipment problem - Air embolus, hypothermia

Delayed

1. Immunological
    - Delayed haemolytic transfusion reaction (4-14 days)
        - Due to undetected Ab in recipient at time of cross match
        - Sx: fever, jaundice, unexplained drop in Hb. Usually benign course
    - Alloimmunisation/Post-Transfusion Purpura
        - Alloimmunisation to platelet-specific antigens
        - Sx: sudden, dramatic, self-limiting thrombocytopenia 7-10/7 post transfusion
        - Mx: IVIg
    - Graft vs Host disease
        - Sx: fever, rash, LFTs, pancytopenia; Usually fatal
        - Mx: supportive care
2. Non-Immunological
    - Iron overload
    - Transfusion associated infectious disease
        - Viruses - HIV/HCV <1 in 1 million; HBV 1:500,000
        - Parasites - plasmodium

Management

1. Consult/hospital guidelines
2. Stop transfusion
3. Check vital signs, new iv line, resus (hypotension = anaphylaxis, TRALI, infection or haemolysis)
4. Check right blood to right patient
5. Notify medical officer and Transfusion service
6. Send blood and urine samples (different arm) plus blood pack and line (Coombs, FBC, XM, coags)

Assess severity:
- mild (temp incr <1.5C, no rash or shock) - restart at slower rate
- mod (temp incr <1.5C, rash but no shock) - antihistamine + antipyretic, restart after 30min
- severe (shock, haemolysis) - cease, resus, send bloods

Respiratory symptoms + hypotensive – TRALI or anaphylaxis (treat like pulmonary oedema or anaphylaxis)
Respiratory symptoms + hypertensive – TACO (treat like CHF)

Oncology Emergencies

SVC Syndrome

Headache, dyspnoea, chest pain, hoarse voice, epistaxis, syncope, distended neck veins
Pemberton's sign - elevate arms - facial plethora
If severe: proptosis, glossal/laryngeal oedema, altered LOC
CXR - mediastinal mass/widening, right pleural effusion 25%
Rx: Elevate head of bed, O2, treat primary cause (?anti-tumour therapy), Angioplasty/stenting temporary

Hypercalcaemia

Most common in squamous cell Ca, related to PTH-rp
Mx: iv fluids (forced saline diuresis), bisphosphonates

Spinal Cord Compression
Pain, weakness, sensory level, sphincter dysfunction
Mx: dexamethasone, surgery, radiotherapy

Effects of chemotherapy
Nausea and vomiting
Renal failure - ensure hydration
Cardiac - arrhythmias, CCF, venous thrombosis, ACS
Neutropenia
Tumour lysis syndrome
    Incr uric acid/potassium/phosphate, lactic acidosis, hypocalcaemia
    ARF, tetany, arrhythmias
    Mx: pretreat with allopurinol; iv hydration, alkalinise urine, dialysis
Typhilitis
    Necrosis of caecum after treatment for acute leukaemia
    Sx: watery diarrhoea, PR bleeding, bacteraemia
    Mx: broad spectrum Abs, NGT, surgery if not improving

Pancoast's Syndrome
Usually SCC lung - apical tumour with local extension involves C8, T1, T2 nerves
+ destruction of 1st and 2nd ribs

Paraneoplastic Syndromes
Endocrine - hypercalcaemia (PTHrp), hyponatraemia (SIADH), ectopic ACTH, carcinoid, hypoglycaemia
Neuromuscular - Eaton Lambert syndrome, peripheral neuropathy, polymyositis
Connective tissue - clubbing, HPOA
Haematological - thrombosis, DIC, anaemia
Renal - nephrotic syndrome, glomerulonephritis
Skin - dermatomyositis, acanthosis nigricans

AML: most common acute leukaemia in adults; 65 median age
ALL: most common form in children
CML: Philadelphia chromosome
CLL: slowly progressive, most common leukaemia in adults
Hodgkin Lymphoma: Bimodal, Most common malignancy 15-19, Survival >90% low-risk pts
    Painless, firm, lymph nodes, "B" symptoms: fever, night sweats, wt loss; Reed - Sternberg cells
Non-Hodgkin Lymphoma: children >5yr old or older adults
    Lymphadenopathy, Hepatosplenomegaly, "B" symptoms, GI Bleeding, intussusception, N/V
Multiple myeloma
    Plasma cell tumour
    Bence Jones proteins - free kappa or lambda light chains
    Sx: back pain, pathological fractures, anaemia, hypercalcaemia, bleeding, recurrent infections
    XR: mets punches out lesions

Differential diagnosis elevated WCC
CML
Leukaemoid reaction (infection)
Myelofibrosis with myeloid metaplasia

Pancytopenia
Haematological disease - aplastic anaemia, myelodysplasia/fibrosis, leukaemia, myeloma
Drugs - chemo, immunosuppressants eg MTX, colchicine, chloramphenicol
Infections - parvo B19, EBV, HIV, TB, overwhelming sepsis
Radiation
Vit B12/folate deficiency
Hypersplenism

Environmental Summary

Diving Medicine

Problems of descent

1. Mask and external ear squeeze
2. Middle ear squeeze - TM ruptures
3. Inner ear barotrauma
4. Dental squeeze
5. Nitrogen narcosis
6. Immersion induced pulmonary oedema

Problems of ascent

1. Pulmonary barotrauma
2. Arterial gas embolism (AGE)
    - Failure to exhale - alveolar rupture - gas into brain, LA, LV, aorta, CA's
    - Sx occur 5-20 mins after ascent; may get spontaneous recovery then relapse
    - NS: FND, confusion, altered LOC, seizures, headache, visual changes
    - CV: haemoptysis, CV instability, arrhythmia, MI)
    - Diagnosis is clinical; CXR may show intravascular air; CT/MRI, CK
3. Sinus squeeze
4. Alternobaric vertigo: unequal ear equalisation; vertigo during ascent
5. Shallow water blackout: syncope secondary to hypoxia after hyperventilating off CO2; LOC during ascent

Decompression illness

Decompression illness = decompression sickness (venous) or AGE (arterial)
Decompression sickness

- Inert gas, esp N, bubbles form in blood and tissues on ascent
- Onset may be delayed - 50% within 1hr, 90% within 6hrs
- Vestibular (the staggers), Pulmonary (the chokes)

Management

Supine , 100% O2, IVF
Treat arrhythmias (usually refractory to standard treatment)
Mannitol if impending cerebral herniation
Transport at sea level
HBO - 100% O2 at 2.8atm
Flying after diving: delay at least 12hrs after single non-decompression dive; 18hrs after multiple dives

SOB post diving

Decompression illness/AGE
PTX
PE
Bronchospasm
Pneumonia

ED indications for HBO

Air or gas embolism
Decompression illness
CO poisoning
Nec fasc
Chronic refractory osteomyelitis

Drowning

Immersion syndrome: sudden cardiac arrest after cold water immersion - due to massive vagal response
Examination: pulm oedema, T, ECG, injuries (HI, C spine), repeat neuro exam; look for precipitating cause

Conn and Modell classification

Performed at 2hrs following initial immersion
Category A = GCS 14/15 = 10% neuro intact survival, Category C3 = GCS 3 = <20% survival

Orlowski scale
<3 = 90% chance good recovery, >3 = 5%
- age <3
- submersion >5mins
- no CPR >10mins
- coma on arrival
- pH <7.1

Management
A: Intubate +/- C spine immobilisation
B: beta agonist for bronchospasm; high flow O2, PPV
C: IVF resus ; monitor electrolytes; invasive monitoring
D: treat seizures; maintain normoG; rewarm
Abx if infection
Correct electrolyte abnormality/coagulopathy
No steroids

Electrocution

Injury MORE LIKE CRUSH THAN BURN - damage BELOW skin is greater than skin injury
Trimodal: toddlers, adolescents vs high voltage, electrical workers
High risk >1000V
1Amp - VF, resp arrest, burns, >10Amp - asystole
Resistance: bone > fat > tendon > skin (25x decr if wet) > muscle > BV > nerves

Mechanism of Injury
1. Electrical:
    - CV: vascular spasm, thrombosis, arrhythmias
    - NS: seizure, decr LOC, motor/CN deficit, SC inj, tinnitus, autonomic dysfunction
    - MS: muscle contraction and necrosis (CK) - compartment syndrome and rhabdo
    - Keraunoparalysis – intense vascular spasm - cool/blue/pulseless limb
    - RS: resp depression
    - GI: ileus, perf, stress ulcers
    - GU: renal ischaemic inj, myoglobinuric ARF
    - Haem: coagulation disorders
    - Eye: cataracts, corneal burns, retinal detachment
    - Ear: sensorineural hearing loss; TM rupture
2. Thermal burns
3. Trauma: blunt, crush, blast

Investigations
Urine myoglobin, UEC, LFT, CK, Trop, coags
ECG, Imaging: PRN for 2º injuries

Management
ECG monitoring: if >1000V, seizures, init ECG changes, LOC, pregnant or ?transthoracic current
Otherwise obs 6h ± cardiac monitoring and reassess.
Supportive: Fluids – replace losses (Parkland formula). Analgesia. ADT
Treat secondary injuries: consult burns unit; manage like crush injury
Fetus less resistant: accidental electric shocks include uterus, therapeutic shocks do not

Lightning Injury

	AC	**Lightning**
Duration	0.3-2secs	10micro – 3millisecs
Voltage	Up to 200,000	Billions
Tissue damage	Deep	Superficial
Cardiac rhythm	VF (low V), asystole (high V)	Asystole
Renal/rhabdo	Common	Rare

Type of Strike
Ball, Direct strike: most serious injuries, Contact injury, Side flash, Ground current, Blast injury, Flashover

Assessment
Same as electrical injury +
Skin: and exit points; linear burns (along sweat), punctate burns, Lichtenberg figures, thermal inj
ECG: less AF, but more asystole
Delayed: cataracts, myoglobinuria
After cardiac arrest - return cardiac automaticity but persistent resp paralysis

Management
Mass casualties - reverse disaster triage
Assume spinal injury
Airway may be difficult if burns
Resp arrest may persist after ROSC
Aggressive prolonged CPR indicated
Neuro & ophthlamic followup

Radiation Injury

Acute Radiation Syndrome
1. prodromal phase, up to 48 hours (anorexia, N, V, weakness, fever, conjunctivitis, erythema)
2. latent period, hours to weeks
3. manifest illness period - bleeding and infection
4. death or recovery, up to 10 weeks

Haemopoietic syndrome: 1-10 Gy
Bone marrow suppression
Latent period 2-20 days then fall in WCC and platelets - bleeding, infections, aplastic anaemia
Gastrointestinal syndrome: > 10 Gy
Severe N, V, bloody diarrhoea, ileus; septicaemia and vascular collapse, 50% mortality
Cardiovascular syndrome: > 15 Gy
Fluid leakage into tissues
Neurovascular syndrome: >30 Gy
Incapacitation within minutes ; N/V/D, cardiovascular collapse; confusion, seizures, coma; death in 48 hrs

Investigation
Triage based on early clinical symptoms and lymphocyte counts at 48 hrs
Management
PPE, decontaminate
Supportive: fluid/electrolyte balance, nutritional supplements, antiemetics
Control of infection
Platelet transfusion, cytokines and colony-stimulating factor; ? BMT
Survival from cardiovascular, neurovascular syndromes, severe gastrointestinal syndrome unlikely
Survival from haemopoietic syndrome and lower-dose gastrointestinal syndrome possible
Long-term incr risk haematological malignancies within 2 years, solid tumours > 5 years

Exercise-Induced Illness

Causes of collapse
Exercise assoc collapse
Heat: exhaustion/stroke
CV: MI, AS, arrhythmia
Metabolic: hypoG, electrolyte
Intracranial: seizure, ICH
Causes of sudden death
<35yrs: IHD, acute myocarditis, HOCM, arrhythmogenic RV cardiomyopathy, WPW, Brugada, long QT
>35yrs: IHD
Heat stroke, head/spinal trauma, asthma

Heat-Related Illness

Spectrum heat cramps → heat exhaustion → heat stroke
Risk factors
- Environment: temp, humidity, exercise
- Extremes of age
- Alcoholics
- Cardiovascular medications – β-blockers, CCB and vasodilators
- Medical: DM, hyperthyroid, Parkinsons, spinal cord injury, infection, IHD, epilepsy, antichol/serotonin
- Dehydration (diuretics)

Mechanisms of heat transfer
Radiation, Conduction, Convection, Evaporation + behavioural

Heat stroke
T >40 + CNS dysfunction + MOF
Mortality 10-50%
Classical heat stroke: high environmental temp + impaired heat loss
Exertional heat stroke: strenuous exercise in hot environment

Ddx
Infectious (sepsis, malaria, typhoid, tetanus)
Endocrine (thyroid, phaeo, DKA)
Neuro (CVA, status, dystonia, akathesia, tardive dyskinesia, Parkinsons, meningitis, encephalitis)
Tox (withdrawal, rapid withdrawal Parkinson meds, anticholinergic, stimulant, serotonin, NMS, MH)

Assessment
Heat exhaustion: no neuro Sx
Heat stroke Sx: neuro abnormalities + hot dry skin; look for cause
Tachycardia + tachypnoea + hypotension
Ataxia, delirium, seizures
Bedside Ix: BSL, ECG - arrhythmias, ABG - lactic acidosis, resp alkalosis
Lab Ix: U+E, Coags - DIC, LFTs - incr AST/LDH, CK - rhabdo, FBC - WCC 30-40, low plts, urine myoglobin
Imaging: CXR - ARDS

Management
Time critical emergency
Up to 80% mortality
Need rapid resus and cooling to prevent MOF and death
Early intubation and paralysis if temp not controlled
Avoid sux. Treat coagulopathy. Aware risk APO (high output failure)
Monitor UO. Sedatives/paralyse to decrease shivering (benzos, NDMRs, chlorpromazine)
Rhabdo - fluids +/- frusemide/mannitol, bicarb, dialysis

Cooling
Aim rapid cooling to <39 then stop to avoid overshoot
Remove from heat source, remove all clothing
Support circulation and organ function; prevent irreversible tissue damage and death
Evaporative: 0.3 deg/min
    Pros: effective cooling, readily available, practical, well tolerated
    Cons: can cause shivering, difficult to maintain electrodes
Ice packs: 0.04-0.08 deg/min
    Pros: practical, can be added to cooling measures
    Cons: limited cooling efficacy, poorly tolerated
Cold water IVF:
    Pros: available
    Cons: risk APO, electrolyte abnormalities
Ice water immersion: 0.15-0.25 deg/min
    Pros: effective, easy at events, widely available, fast, safe;
    Cons: can cause shivering/peri vasoC, poorly tolerated, impractical
Gastric or peritoneal lavage: 0.5 deg/min cooling
    Cons: invasive; labour intensive; may lead to water intoxication
Cardio-pulmonary bypass:
    Pros: fast and effective
    Cons: invasive, no readily available, set up is labour intensive, required anticoagulation
Cooling blankets:
    Pros: easy
    Cons: limited cooling efficacy, impedes use of other cooling methods

Poor prognosis
Duration/degree hyperthermia most important
Core T >41.1; AST >1000; prolonged coma; hypotension not responsive; oliguria; ETT; ARF/hyperK; coags

Complications of heatstroke
CNS - encephalopathy, oedema, seizures, delirium, coma
Cardiac – myocardial injury, arrhythmia (long QTc, AF, SVT, RBBB), circulatory failure
Metabolic - hyperglyc, hypoK/hyperK, hyperCa - hypoCa, hyperP, lactic acidosis
Renal – ARF, Rhabdo
Respiratory – ARDS, resp alkalosis
GIT – pancreatitis, hepatitis, gut ischaemia
Haem – DIC, thrombocytopenia, incr WCC

High Altitude Medicine

Risk factors: Hx same, obesity, CV/RS disease, rate of ascent, sleeping altitude, cold temp**.** NOT age/fitness
AMS: >2500m; headache, fatigue out of proportion, insomnia, anorexia, N+V, SOB, oliguira
HACE:>3500m, cerebral oedema - altered LOC, impaired mental, truncal ataxia, 3/6 CN palsy; coma
HAPE: consider alternate diagnosis; NCPO - non-productive cough, SOB; incr HR, incr RR, cyanosis, creps

Management

Descend
Hydration, O2, HBO (if unable to descend/temporising measure) - Gamow bag
Dexamethasone: AMS/HACE; 8mg
Acetazolamide: AMS/HACE; 250mg BD PO; cause HCO3 diuresis so allow more hyperventilation
Nifedipine: HAPE; 10mg SL
Symptomatic: analgesia, antiemetics, beta-agonists; CPAP in HAPE

Hypothermia

Increased heat loss: Exposure, water immersion, burns, Vasodilation - alcohol, drugs, sepsis; DM, neonates
Decreased heat production: incre age, Endocrine, Nutritional - hypoglycemia, anorexia, Inactivity
CNS dysfunction: drugs – sedatives, alcohol, opioids, TCA; CNS trauma, Neoplasm, Encephalopathy

Severity

Mild: 33-35 - can shiver
Moderate: 28-32 - can't shiver – decr LOC, HR, RR, TV
Severe: < 28˚C - coma, fixed pupils

System Effects

CVS - sinus brady, AF, ↓BP. Risk VF<28, asystole<25
Resp - ↓RR → hypercarbia & acidosis, apnoea, APO
CNS - loss of motor skills, ↓LOC, rigidity, pupil dilation & areflexia below 28
Renal - cold-induced diuresis, ARF
Endocrine - hypoglycaemia, hypokalaemia, hyperkalemia late from cell lysis, metabolic acidosis
Haem - coagulopathy, DIC
Gastro - ileus, gut thrombosis, pancreatitis

Investigations

Seek and treat cause and complications
Bedside: Low-reading thermometer, BSL, ECG, ABG
Lab: FBC - signs of sepsis; U&Es, LFTs, lipase, Coags, ethanol, tox screen, CK, TFTs - myxoedema
ECG: T wave inversion, PR/QRS/QT prolongation, muscle tremor artifact, brady, AF, blocks, VF, asystole
Osborn (J) waves <33 degrees: deflection just after QRS, seen in SAH, dig toxicity, MI, hyper K
CXR – cause or aspiration; CT brain – focal neuro deficit or IC event; X-rays - trauma

Management

Remove any wet clothes, prevent further cooling, handle gently, consider cause
Rewarming
CPR contraindicated if: lethal injury, airway blocked by ice, chest wall compressions impossible
Resus until temp 30-32 deg
VF arrest – try single DC shock if fails continue CPR and retry once temperature >30 degrees
Treat arrhythmias: Cardiac drugs, pacing and defibrillation not usually effective <30ºC.
Check glucose, thiamine in alcoholics
Consider sepsis (Abs), adrenal (steroid)
Prevention of further secondary insults

Rewarming techniques

Endogenous: warm environment/clothing - 0.5-2 deg/hr
Passive external: remove wet clothes, warm dry environment, cover with blankets - 0.5-2 deg/hr
Active External - 2 deg/hr - Warm blankets, Bair hugger
    Pros: readily available, practical, well tolerated
    Cons: ineffective in poor perfusion, cause peripheral vasodilation and venous pooling - shock
Active Internal or core - up to 10 deg/hr
    Warmed humidified inhaled oxygen 40 deg (1.5 deg/hr)
    Pleural and peritoneal lavage (2-3 deg/hr), Gastric or bladder lavage
    Haemodialysis, Bypass 7-10 deg/hr, ECMO
    Pros: fast and effective; Internal organs preferentially rewarmed; Less peri vasoD

Complications of Rewarming

Rewarming vasodilation - hypoperfusion
Arrhythmia
Metabolic acidosis, Electrolyte abnormalities
Core temperate afterdrop and rewarming acidosis

Non-salvageable

K >10, T <10deg, pH <6.5, large intracardiac thrombus on echo, severe coagulopathy

Frostbite

Frostnip: Shortlived superficial freezing reversible with rewarming, no residual swelling.
Frostbite: Superficial (1st & 2nd deg) – hyperaemia, oedema, clear blisters
Deep – full thickness, underlying tissue necrosis, bloody blisters
RF: low temp, repeated warming/refreezing, moisture, PVD< neuropathy, DM, beta blockers, footwear

Classification

First degree - numbness, erythema, swelling, desquamation
Second degree - blisters
Third degree - tissue loss entire thickness of skin
Fourth degree - tissue loss incl deep structures

Tissue Sensitivity

Least to most: Cartilage - ligament - blood vessel - cutis - epidermis - bone - muscle - nerve - bone marrow

Management

Pre-hospital:

- Prevent further cold injury, hypothermia, dehydration
- Dry, cover, remove constrictive clothing, warm drinks
- Prevent refreeze
- Analgesia
- Immobilise and elevate
- No EtOH/smoking

In ED:

- Immediate rewarming unless risk of refreezing
- Ideally active (40-42ºC circulating water), don't rub or massage
- Analgesia. ADT. ABx if infected
- Blister removal controversial
- Surgery - later, demarcation

Complications

Wound infection, tetanus, gangrene, sensory loss, tissue loss, amputation.

Hymenoptera – bees, wasps, ants

Massive envenomation

Vomiting, diarrhoea, Shock, MOF, myocarditis, hepatitis, haemoglobinuria, rhabdomyolysis
Death likely if >20stings/kg
Treat as per anaphylaxis, severe + adrenaline 0.1mg iv (adults)

Marine Envenomation

Box Jellyfish (Chironex fleckeri)

Tropical (Northern) waters
Major sting = >50% involvement of a limb. Total length of wheals >6m likely to be lethal
Immediate severe pain, linear, cross-hatched welts
Systemic envenomation after few mins - ↑↓BP, ↑HR, impaired cardiac contraction, arrhythmias & collapse
If cardiac arrest – immediate CPR + 6 amps Box Jellyfish antivenom IV stat
Vinegar to inactivate undischarged nematocysts. Avoid PIB, fresh H_2O
Ice pack, Analgesia iv ± Mg ± 1 amp antivenom
Fluids resus with NS
3 amps antivenom IV in 100ml NS over 20min
Inv for alternate diagnosis: ECG (e.g. ACS), FBC, UEC, CK/Trop, CXR. Micro nematocyst ID

Bluebottle Jellyfish

Hot water (45°C) for 20min better than ice. PO analgesia. Avoid PIB & vinegar. ADT

Irukandji Syndrome

Carukia barnesi ± other jellyfish, in tropical waters.
Delayed distressing symptoms from sting & occ fatal
Toxin: Neural Na+ channel modulator → catecholamine shower
Sting often not felt. Minimal local signs. ~30-120min:sense of impending doom, agitation, dysphoria, N/V, diaphoresis, back/limb/abdo pain. ↑BP & ↑HR.
Severe envenoming → cardiomyopathy, cardiogenic shock, APO & ICH
Vinegar. Avoid PIB. Analgesia: titrate iv
Ongoing HT: GTN infusion starting at 1-4mcg/kg/min or phentolamine. ? benzos
Inv for alternate diagnosis

Stonefish/ Stingray
Immed sev pain + local swelling, bruising & puncture wounds ± spine FBs
Hot water 45°C for 30-90min. Avoid PIB. Analgesia.
Resus rarely required
Antivenom if pain refractory. 1 amp/2 wounds in 100ml NS IV over 20mins
Inv: XR/USS is retained FB suspected.
Wound toilet, ADT +/- antibiotic prophylaxis

Blue-Ringed Octopus
Venom includes tetrodotoxin (resp failure from paralysis)
Circumoral paraesthesia, nausea, dizziness, malaise.
Rare: rapidly progressive flaccid descending paralysis
PIB
Resus: O2. Intubation & ventilation if resp failure. Fluids, pressors for hypotension
Wound care + ADT

Cone Snail
Numerous neurotoxic peptides
Weakness, inco-ordination & visual dist, speech and hearing
Local pain, swelling & numbness
Rare: respiratory muscle paralysis
Management same as Blue-Ringed Octopus

Generic Jellyfish Assessment
Suspect if: unexplained collapse on beach, near drowning
1st aid: retrieve from water - help ASAP - protection of rescuers - BLS/ALS as required
Tropical areas – trt all with vinegar (inhibits nematocyst discharge of box jellyfish)
Non-tropical areas – heat (45deg for 20mins) rinse with seawater
Remove remaining tentacles
Antivenom if indicated, MgSO4
Discharge: observe 2hrs if not envenomated; observe 6hrs after AV if envenomated

Symptoms in water
Box jellyfish (immediate severe pain, agitated)
Blue bottle, stonefish (immediate intense pain)
Symptoms on leaving water
Irukandji syndrome (delayed onset 30mins, initial sting not felt, tentacles not visible)
Blue-ringed octopus (rapidly progressive descending flaccid paralysis – collapse on beach)
Sea snake

Marine Poisoning

Puffer fish
Tetrodotoxin - blocks Na channels of nerves and muscles; toxin not destroyed by cooking
Onset <1hr
Paraesthesia, N+V+D, bulbar weakness, flaccid paralysis, fixed dilated pupils, resp failure, arrhythmia, coma
Mng: charcoal effective, gastric lavage if <3hrs; supportive trt (may need ETT, IVF, pressors, pacing)

Ciguatera poisoning
Coral trout, spanish mackerel, barracuda, flowery cod
Neurotoxin (ciguatoxin); not inactivated by cooking; binds to Na channels
Onset 4-6hrs; N,V,D,AP, paraesthesia, cold allodynia, myalgia, rash, unusual taste, electric shocks, burning
Mng: supportive; IVF, antihistamines, analgesia

Scromboid poisoning
Tuna, mackerel
Toxin: metabolic products of bacterial degradation - allergy like reaction
Onset 20-30mins, allergic like reaction - flushing, headache, dizziness, swelling, D+V, abdo pain, urticaria
Mng: treat as allergy, usually self-limiting

Paralytic shellfish poisoning
Paralytic shellfish toxin, saxitoxin - similar to tetrodotoxin but more potent

Seawater-associated infections: Vibrio - fluoroquinolone
Freshwater-associated infections: Aeromonas - fluroquinolone, third generation cephalosporin,

Snake Bites

Clinical examination

Bite site
Neurological: cranial nerves, limb weakness, resp muscle weakness
Haematological: evidence of abnormal coagulation

Increased risk of severity

1. LOC
2. Multiple bites
3. Alcohol
4. Fast onset of symptoms
5. Brown worse than Tiger

Investigations

- Coagulation studies (VICC)
- FBC and film (blood loss, haemolytic anaemia)
- Biochem (renal failure)
- CK (rhabdo)
- Spirometry (neurotoxicity)
- Snake Venom Detection Kit (SVDK)
  - Used to determine which monovalent antivenom, not if envenomed
  - Take swab early but don't use SVDK unless signs/symptoms of envenomation

Clinical syndromes in snake bite

Local effects (pain, swelling, bruising)
Major toxin syndromes

- Venom-induced consumption coagulopathy (VICC) - Brown, Tiger, Taipan
  - INR high, aPTT prolonged, Fibrinogen low, D-dimer high
- Neurotoxicity - sea, death adder, Tiger, Taipan
  - Descending flaccid paralysis - eye muscles then bulbar muscles then respiratory/limb
- Myotoxicity - tiger, taipan, black, sea
  - Myalgia, Rhabdo, incr K, ARF
- Anticoagulant coagulopathy
  - Black snakes
  - aPTT moderately abnormal, elevation of INR > 1.3
  - D-dimer and fibrinogen normal
- Microangiopathic haemolytic anaemia
  - may lead to ARF
- Systemic symptoms
  - Non-specific systemic symptoms: N/V, abdominal pain, diarrhoea, diaphoresis and headache

Management

First Aid - PIB, Mark site of bite
Weakness affecting resp muscles may req BVM
iv hydration to prevent ARF
ADT
Need hospital with staff able to assess and treat anaphylaxis, lab for INR 24hrs, AV stocks

1. Establish clinical/lab evidence of envenoming (bloods and neurological exam)
2. Determine most likely snake
3. Cut hole in PIB and swab
5. If well and labs normal, remove PIB in critical care area
6. If deteriorates, replace PIB
7. If no symptoms 1 hour after PIB removal admit for observation
8. Repeat bloods and neuro exam at 1hr/6hr/12hr post bite
9. If at any time any suggestion of envenomation give antivenom
   - full resus facilities available
   - IV in 500ml N saline and give over 20-30mins
   - advice re: serum sickness
10. Observe all patients for at least 12 hours

Absolute indications for Antivenom

Reported sudden collapse, seizure or cardiac arrest
Abnormal INR
Any evidence paralysis, ptosis, ophthalmoplegia

Relative indications for Antivenom
Systemic symptoms (vomiting, headache, abdominal pain, diarrhoea)
Leukocytosis
Abnormal aPTT
CK > 1000

Risks of antivenom
Anaphylaxis
Serum sickness - prednisone 25mg OD for 5/7

Determining appropriate antivenom
Local knowledge of snakes in ar**ea -** Snake experts/snake handlers
Observation of specific clinical syndromes
Most parts south/central-eastern Australia one vial of each of brown and tiger snakes

Management of immediate reactions to antivenom
1. Stop antivenom infusion
2. Lie patient flat, high-flow O2, support airway
3. 1 L normal saline
4. im adrenaline
5. Consider cautious iv infusion adrenaline 1 mg in 100 mL by infusion pump: start at 0.5 mL/kg/h, titrate
6. Bronchospasm - salbutamol
7. Upper airway obstruction - nebulised adrenaline.
8. Seek advice from Poisons Centre

Snake	Local Sx	Coagulopathy	Neurotox	Myotox	Nephrotox	Life threat
Brown	No	Early			Yes	Hypotension, VICC
Tiger	Mild	Early	Late	Late	Yes	Hypotension, VICC, late paralysis
Black	Severe	Anti-coag		Late	Yes	None
Taipan	Mild	Early	Early	Early (mild)	Yes	Hypotension, VICC, paralysis (early), seizures. Most deadly
Death	Mod	No	Early			Desc flaccid paralysis, hypotension
Sea	No	No	Yes	Yes	Yes	

White Tailed spider
3 types of reaction:
1. severe local pain <2 hrs
2. Local pain and erythema <24hrs
3. Persistent red painful lesion 5-12/7 with itch
Does NOT cause necrotising arachnidism
Management: ice, analgesia

Necrotic Arachnidism
Necrotic lesions or ulcers that occur following a spider bite, result of venom effects
Following bites from recluse spiders

Spider Bites

	Red Back	Funnel Web
	Small, shiny. All of Australia	Big, hairy. NSW and Sth QLD
Venom	Alpha-latrotoxin; causes massive release of Ach and catecholamines at nerve endings in ANS - depletes Ach at NMJ - paralysis.	Most toxic known; bites usually witnessed; contains neurotoxins - spontaneous repetitive firing and prolongation of AP's - NT release from somatic and ANS - NM and autonomic excitation
Bite	No initial pain, delayed pain 5-10mins. Often no bite mark.	Severe, immediate local pain
Envenomation	**Lactrodectism** Pain, Sweating + piloerection mild HTN, tachycardia Non-specific: headache, N/V, lymphadenopathy	Rapid <30mins - 2hrs. Autonomic storm. N/V, headache, abdo pain, MOF. Coagulopathy Autonomic: sweating, salivation, piloerection, lacrimation CVS: HTN+tachy OR hypotension+brady, APO Neuro: fasciculations, spasms, agitation, coma Child: sudden collapse, salivation, vomiting
First aid	No PIB. Ice, analgesia	PIB
Refer to ED if...	refractory pain, systemic envenomation, unclear diagnosis	All
Management	Ice, analgesia. 2 vials iv/im redback AV.	PIB, Lab tests to exclude alt diagnoses and complications Potential life threats: - Respiratory failure - Hypotension or hypertension - Pulmonary oedema - Coma ABC, O2, ?ETT, treat NCPO, care with iv fluids (risk pulm oedema), treat HTN and CV collapse, atropine. Admit ICU if AV given
Indications for antivenom	1. Systemic symptoms 2. Refractory pain	1. All with systemic envenomation 2. Cardiac arrest – iv undiluted 4-8 amps
Discharge	No sx 2hrs after bite	No sx after 6hrs obs No sx 12hrs post antivenom
Pitfalls		Misdiagnosed as: acute abdo, AMI, dissection

Gastrointestinal Summary

LFTs

Increased Bilirubin

- Unconjugated
  - Haemolysis
  - Drugs
  - Gilbert's syndrome
- Conjugated
  - Chronic liver disease

Liver enzymes

AST: ALT =1	Ischaemia (CCF and ischaemic necrosis and hepatitis)
AST: ALT >2.5	Alcoholic hepatitis
AST: ALT <1	Paracetamol OD with hepatocellular necrosis
	Viral hepatitis, ischaemic necrosis, toxic hepatitis

Other tests for diagnosis

Viral serology, Auto-Ab screen, Immunoglobulins, ferritin and transferrin saturation, α-fetoprotein, copper/caeruloplasmin, α1-antitrypsin
USS

Ascites Causes

Liver cirrhosis
Malignancy - Ca colon, Ca ovary(Meigs), Hepatic tumour, Lymphoma
CCF
TB
Pancreatitis
Constrictive pericarditis, Venous obstruction – e.g. Budd-Chiari, Renal failure, Myxoedema

Paracentesis

Diagnostic - exudate vs transudate, ?infection, cancer, etc.
Therapeutic or palliative

Procedure

Pre-procedure: FBC, coags,
Preparation – equipment, explain to patient
Aseptic technique
Choose site: lower flank (lateral to inf. Epigastric vessels) or midline 2cm below umbilicus (beware bladder)
20-60ml for diagnostic tap or drain over 4-6 hrs for therapeutic tap.

Analysis

Protein & LDH – for exudate vs transudate
Serum ascites-albumin gradient (SA-AG) = (serum albumin conc) - (ascitic albumin conc)
<11g/l = Ca, pancreatitis and TB; ≥11g/l = cirrhosis, CCF, nephrotic syn
WCC, Amylase (↑in pancreatic), Culture, Cytology

Spontaneous Bacterial Peritonitis

E coli; Grp D enterococci, other staph; staph aureus, klebsiella; pseudomonas, anaerobes
Paracentesis: WCC>500, PMN>250, pH<7.35, Blood-ascites pH gradient>0.1
Abx: ceftriaxone 2g IV OD or cefotaxime 2g IV TDS; in dialysis intraperitoneal ceftazidime and cephazolin
Other: mng hepatic encephalopathy; IV albumin 1.5g/kg may help decr renal failure

Cirrhosis

Jaundice, Spider naevi, Bruising, Palmar erythema, Finger clubbing, telangiectasias, Petechiae, Hair loss, Ascites, Gynaecomastia, Enlarged spleen, Testicular atrophy or amenorrhoea, Asterixis

Complications

Portal hypertension
Ascites
Encephalopathy
Hepatorenal syndrome
Hepatocellular carcinoma

Prognosis
Child-Pugh classification system
Class A or B 5-years survival rate 70% - 80%
Class C 1-year survival 50%
Criteria: serum albumin, serum bili, INR, ascites, encephalopathy (each 1-3 points)

Hepatic Failure

Hepatic encephalopathy graded from 0 to 4: subclinical to coma
Management
Treat ↑ICP: mannitol/hypertonic NaCl, head elevation, low norm pCO2
Treat poisoning eg. NAC
Lactulose - reduce ammonia production
Treat coagulation deficits
Monitor glucose and electrolytes
Liver transplantation

Hepatitis

Causes
Drugs and toxins - EtOH, paracetamol, aspirin, paraquat, CCl, idiosyncratic - fluclox, halothane, amiodarone
Infection - viral, post-viral (Reye's), non-viral (lepto, toxo, Q fever, mycoplasma)
Vascular - shock, portal vein thrombosis, Budd Chiari
Depositions - Fe, Cu, fatty liver, NASH
Malignancy - primary or secondary
Autoimmune
CHF

Hepatitis A
Faecal-oral
IgM-anti HAV = acute infection; 3/52 post-exposure
IgG-anti HAV = past infection and immunity
HAV RNA = in stool/plasma for asymp period
Hepatitis B
Parenteral
Active: HBsAg, HBeAg, IgG-anti HBcAg, Hep B DNA
Previous resolved: Anti-HBsAg, Anti-HBeAg, IgG-anti HBcAg
Carrier: IgM-anti HBcAg
Vaccinated: Anti-HBsAg
Contact - antiHBsAg if non-immune. Vaccinate
Hepatitis C
Parenteral
HCV RNA = acute, detectable 1st within 1-2/52 exposure
IgG-anti HCV = chronic; +ive by 3/12 usually
No vaccine / post-exposure prophylaxis available

Jaundice

Prehepatic (unconjugated aka indirect) - Gilbert's syndrome, haemolysis
Hepatic (unconj) - hepatitis (viral, alcoholic, auto-immune, drug induced, congenital)
Intrahepatic cholestasis - PBC, PSC, drugs
Extrahepatic cholestasis - CBD stone, pancreatitis, cancer GB/pancreas, bile duct stricture

Liver Transplant

Early (<5 days) complications
Primary graft failure
Bleeding, arterial/venous thrombosis, bile leak
Renal failure
Lung: effusion or infection
Late complications
Rejection: acute -7-14/7 post-op, treat with iv steroids
chronic - 6/52 to 9/12 - need biopsy to confirm
Immunosuppression; Infections: PCP, candida, CMV, malignancy (lymphoma)
Biliary strictures
Osteoporosis, Nutrition, De novo cancer
Recurrence primary disease

Fever in transplant patient
Biliary - stricture and cholangitis
Pneumonia - PCP, bacterial, fungal
UTI
Hepatitis - acute or recurrent
CNS infection - esp fungal
Viral - CMV, herpes, varicella

Gastroenteritis

Campylobacter (commonest), Rotavirus (commonest in children), Non-typhoidal salmonellosis, Norovirus, Giardia, Cryptosporidium, E. coli O157:H7, Shigella

Stool: Microscopy and culture; parasites, antigen testing (Rotavirus), PCR (C Diff)
Treat/prevent dehydration, Prevent spread. Hand washing. Public Health Notification
ABx do not shorten most GE, but may prolong carrier stage. Used in severely ill, esp immunocompromised.

Complications

Dehydration, electrolyte derangement
HUS - E. coli O157:H7
Reactive features e.g. arthritis, carditis, urticaria, erythema nodosum, conjunctivitis, Reiter's syndrome.
Toxic megacolon rare
Guillain-Barre
Poor absorption of drugs - OCP

Pre-formed toxin: Bacillus cereus, Staph aureus
Post-formed toxin: E Coli , Clostridium perfringens, C botulinum, Vibrio cholera, C difficile, giardia

Vibrio cholera - rice water diarrhoea
C. diff - pseudomembranous colitis
Enteroinvasive (cause bloody diarrhoea) - salmonella, shigella, campylobacter, E coli, yersinia

Traveller's Diarrhoea

Bacteria (80%)	E coli, Salmonella, Campylobacter, Shigella
Protozoa	Giardia, Cryptosporidium, Entamoeba histolytica
Viral	Rotavirus, norovirus

Immunocompromised: cryptosporidium, CMV
Reiter syndrome: arthritis, conjunctivitis, urethritis = Salmonella, Shigella, Campylobacter, Yersinia

IBD

Crohn's Disease
Focal, asymmetrical, transmural and occasionally granulomatous inflammation
Bowel: Strictures → obstruction, fistulae, perforation, haemorrhage, colonic Ca
Any part of gastrointestinal tract
May be skip lesions
Ulcerative Colitis (UC)
Without skip lesions
Large bowel
Extraintestinal disease IBD
Joints - Seronegative arthropathy, ank spond
Skin - Erythema nodosum or pyoderma gangrenosum
Eyes - Uveitis, iritis, or episcleritis
Haem - VTE, anaemia, neutrophilia
Renal stones (oxalate), gall stones
Primary sclerosing cholangitis
Management
Resus; Fluids
If toxic megacolon: Urgent surgical review
Non-obstructive colonic dilation with fever + abdo distension + severe AP + shock
Aminosalicylates – mesalazine (5ASA), azathioprine
Corticosteroids
Antibiotics only if high suspicion of infection – e.g. ampicillin + metronidazole.
Treat any extraintestinal complications
Regular screening for colon Ca

Lower GI Bleed

Bleeding from GIT distal to ligament of Treitz

Causes

Diverticular disease
Colitis - Infective, IBD, ischaemic, radiation
Angiodysplasia
Neoplasms
Fissure & haemorrhoids
Coagulopathy
In children: Meckel's, HSP, Peutz-Jeger, polyposis, intussusception, IBD, swallowed maternal blood, infection

Peptic Ulcer Disease

Duodenal ulcer (H pylori) > gastric ulcer (NSAIDs)
Helicobacter pylori detection: Serology – ELISA; Urease detection - CLO test; Faecal antigen test, biopsy

Management

Modification of behaviour:↓EtOH, ↓smoking, ↓stress. Possibly ↓coffee
Drugs – eg NSAIDs/aspirin with food, COX2 inhibitors
Antacids
PPI
H2 antagonists
Cytoprotectants: chelate to proteins at base of ulcer - bismuth or sucralfate
H.pylori eradication: Triple therapy PPI + dual ABx or bismuth.
eg amoxicillin 1g+clarithromycin 500mg+omeprazole 20mg PO bd x 7d. Cont PPI x 4-8wks.

Complications

Bleeding, Perforation; Penetration to other viscera e.g. pancreas
Scarring → gastric outlet obstruction
Malignancy (GU>>DU)

Upper GI Bleed

Bleeding from GIT proximal to the ligament of Treitz.

Causes

Peptic ulcer disease
Gastritis/oesophagitis/duodenitis
Varices
Mallory-Weiss tear
Malignancy
EtOH, NSAIDs, smoking
Non-GIT bleeding: epistaxis, aorto-enteric fistula

Indications for urgent endoscopy

Age >55
Unexplained weight loss
Early satiety
Persistent vomiting or anorexia
Dysphagia
Anaemia or GI bleeding
Abdominal mass
Jaundice

Management

Source control
- Octreotide 50mcg bolus then 50mcg/hr inf
- Omeprazole 80mg stat then 8mg/hr inf

Other complications of liver disease
- Hypoglycaemia 50mls 10% dex
- Thiamine100mg iv stat
- Treat hepatic encephalopathy

Definitive treatment in OT

Indications for OT

Active bleeding not controlled on endoscopy, Recurrent bleeding
Perf
Failure of conservative mng
Blood transfusion >5u, refractory shock

Variceal Bleed

Definitive Rx: endoscopy (sclerotherapy/injection, banding)
Octreotide 50mcg bolus then 50mcg/hr inf
Terlipressin: vasopressin analogue; 2mg Q6h for 1st day
Correct coagulopathy:
- Aim INR <1.5, PT <1.5x normal, Plt >50, temp >35, pH >7.2
- Vit K 10mg iv
- FFP 4 U
- Prothrombinex 50 IU/kg

Antibiotics: norfloxacin (po), ciprofloxacin (iv)
Balloon tamponade (temporising measure only - Sengstaken-Blakemore / Minnesota tube)
Restrictive transfusion
Transjugular intrahepatic portosystemic shunt (TIPS) - creates portosystemic shunt
Angiography
OT**:** partial gastrectomy

Rockall risk assessments score for patients with nonvariceal bleeding

Score/Variable	**0**	**1**	**2**	**3**
Age (y)	< 60	70—79	>80	—
BP	None	Tachycardia	Hypotension	—
Comorbidity	No major	—	CHF, IHD, any major	Renal/liver failure, mets
Diagnosis	Mallory-Weiss, no recent bleed	All other diagnoses	Upper GI cancer	—
Endoscopic signs recent bleed	None or spot	—	Clot, vessel, or spurting	—

Low risk group – score ≤ 2 4.3%→ risk of rebleeding and 0.1% mortality
Medium risk group – scores between 3-5→ intermediate risk of bleeding and 2.0 – 7.9% mortality
High risk group – score ≥ 6 → high rates of rebleeding and mortality rates of 15.1 – 39.1 %

Infectious Diseases Summary

Tazocin: Piperacillin + Tazobactam
Broad spectrum penicillin + anti-pseudomonal; 4.5g iv Q8H

Meropenem
Ultra-broad spectrum beta lactam from carbapenem group, resistant to beta lactamases
Wide activity - Gram-negative rods, Pseudomonas, anaerobes and many Gram-positives
Inactive against MRSA, Mycoplasma, Chlamydia
500mg Q8H

Body Fluid Exposure
Risk 0.3% HIV, 3% for HCV, 5-30% HBV

Triage category 2 (definite HIV exposure) or 3 (uncertain exposure)
First aid: Allow bleeding: soap & water or rinse eyes/mouth
Obtain Med.Hx, risk factors & blood test consent from source & exposed individuals
Risk assessment - serology from patient HIV, Hep B/C; breach of skin, blood on needle, depth penetration
Method of transmission – IV>deep IM>SC>superficial>mucosal>intact skin
Volume of inoculum, high viral load
Test: Source: HIV, HepC, HepB (HBsAg)
Exposed: HIV Abs, HepC, HepB
Check HBV immune status
If not immunised or sAb level low: HBV Ig 400IU im+ HBV immunisation course (0, 1/12, 6/12)
HIV Starter Pack: zidovudine + lamovudine
4 week course; SE: nausea, headache, rash, fatigue
ADT
Followup 6/52, 3/12, 6/12
Barrier contraception, standard precautions with double gloving, Counselling
Documentation & reporting, investigate why occured

Infection Control
Preventing infection – universal precautions, PEP, sterilising, aseptic technique, isolation
Avoid subverting host defences – reduce invasive procedures, limit immunosuppressants, appropriate Abs
Bolster host defences – immunisation, good nutrition

Strict isolation: Highly contagious or virulent orgs – SARS, Avian flu, pharyngeal diphtheria, viral haemorrhagic fevers, disseminated HZV/VZ
Contact isolation: Highly transmissible but not by airborne droplet – neonatal conjunctivitis/HSV, VZ, multi-drug resistant bacteria, cutaneous diphtheria
Respiratory precautions: Hib/Meningococcal meningitis, mumps, measles, pertussis, TB
Enteric precautions: HepA, GE, parasitic infection

Immunisation
Passive - hep A, polio, measles, tetanus, HepB Ig
Active - DPT, MMR, Hib, Hep B, pneumococcus, N meningitidis, cholera, typhoid, TB, yellow fever, salmonella, VZV, rabies, plague
Hepatitis B - 0, 1 and 6 months three injections**,** Check Ab levels two - six months after last dose

Febrile Traveller
Malaria > resp > diarrhoea > dengue, Typhoid fever, Hep, HIV, STDs, meningococcus
Fever onset within 2/52 return: Malaria, dengue, typhoid fever; viral haemorrhagic fever
Causes of Fever >7/7: Malaria; typhoid/paratyphoid
Causes of Fever and Haemorrhage: Malaria**;** Dengue**,** Viral haemorrhagic fever**,** Meningococcus, Lepto

Causes of Diarrhoea
Dysentry: enteroinvasive E coli, Shigella, Salmonella, Campylobacter, Entamoeba
Bacteria (>80%): salmonella, campylobacter, E coli, shigella, yersinia, cholera
Viruses: rotavirus, adenovirus
Parasites: giardia, crypto, entamoeba histolytica

History
Countries visited
Prophylaxis/immunisation
Occupation, hobbies, activities
Risk behaviours: sex, food preparation, tattoos, nets/bites
Fever patterns
System-specific symptoms

Examination
Tropical disease specific - hepatosplenomegaly, nodes, rashes, jaundice
General system-specific findings
Focal findings eg murmur, neck stiffness
Risk factors - tattoos, injection sites

Investigation
FBC+ diff, LFTs, thick and thin films, blood culture, MSU
Others guided by hx: hep serology, ECHO, flu test
Stools: ova and parasites, bacterial culture, WBC, blood, microscopy, cysts
CXR: TB, typhoid fever, malaria

Dengue
Dengue virus - dengue fever, dengue haemorrhagic fever (esp SE Asia), dengue shock syndrome
Aedes mosquito
Incubation 4-10/7 (super short)
DHF/DSS: on 2nd infection; Ag/ab complexes - complement activation, consumptive coagulopathy
High fever, Headache; conjunctival erythema, N+V, macular rash; 'Breakbone fever' (pain back, joints, legs)
Serology – dengue IgM/G seroconversion
Bloods – decr plt, decr WBC, haemoconcentration, acidosis, incr Ur, incr LFT's
CXR – pneumonia, pleural effusion
Treatment supportive

Enteric fever (typhoid and paratyphoid)
Salmonella typhi/paratyphi
Faecal - oral; Incubation 5-21/7
High fever, relative bradycardia, headache, myalgia, diarrhoea, confusion, rose spots, hepatosplenomegaly
Anaemia, neutropenia, incr/normal/low WCC, +ive Widal test; ELISA
Blood/stool/urine culture, CXR: pneumonia
Treatment: supportive, cipro, infectious precautions

Malaria
Classic history: cyclical fever, shaking chills, history of travel to endemic area, abdo pain, anaemia
4 species: P. falciparum, P. ovale, P. vivax, P. malariae
Vector is female anopheles mosquito, infects RBCs
P. falciparum most dangerous (cerebral malaria, herniation, pulmonary oedema, DIC, ARF, hypoG)
Workup: thick and thin blood smears; rapid Ag test, PCR
Supportive care; admit all Falciparum and sick patients; exchange transfusion if high parasite load
Uncomplicated falciparum: Doxycycline + quinine
Vivax / ovale / malariae: Chloroquine + primaquine
Severe malaria: IV quinine
Prophylaxis: chloroquine 250mg weekly for 1/52 before and 4/52 after/doxy/malarone
Chloroquine resistance: E Africa, Thailand, Vietnam, Philippines, PNG

Viral haemorrhagic Fever
Ebola – direct contact with body secretions, inc needlestick; Africa
Incubation 10-21/7
Ebola Management Protocol
Early liason with pre-hospital
Immediate triage to negative pressure room with private toilet/shower
Immediate notification of infection control and MOH to supervise procedures
One nurse/doctor assigned to care for each patient
Strict PPE application/removal as per EVD guidelines
Limit testing to absolutely necessary, avoid aerosol risks
Rapid egress from ED to isolation ward in ID/ICU

HIV

Primarily infects CD4 helper T cells
Acute HIV infection - Resembles typical viral syndrome: fever, fatigue, rash, headache
Fever in HIV patient: think HIV, PCP, mycobacteria, cryptococcal, CMV, herpes, drugs, lymphoma
CD4 <200 = AIDS defining condition
<500: TB, zoster, HSV, Kaposi's sarcoma
<200: HIV encephalopathy, candidiasis, PCP (pneumocystis jiroveci)
<100: toxoplasmosis, histoplasmosis, cryptococcus
<50: progressive multifocal leukoencephalopathy, CMV, CNS lymphoma, invasive cervical Ca
Herpes zoster IS NOT AIDS defining illness

Investigation

ELISA: HIV ab test; seroconversion takes 3-7/52
Western blot: HIV ab test
Viral Ag tests: likely to be +ive before serology; positive 1-2/52

Management

PEP Antiretrovirals: zidovudine + lamivudine for 4/52 if low risk, add in lopinvair and ritonavir if high risk
PCP: humidified O2, cotrimoxazole/pentamidine/dapsone
Cryptococcal: amphotericin
MMR, BCG, polio, VZV are live attenuated viruses – avoid if HIV

Protozoa, Parasitic and Tick Borne Infection

Toxoplasmosis

Toxoplasma gondii (protozoa) - cats, pork
If immunocompromised - encephalitis, focal brain lesions, +/ retinitis
Ring-enhancing lesions on CT

Syphilis

Treponema pallidum (spirochete)
Primary Syphilis - painless genital chancre; regional LAD
Secondary Syphilis - 210 weeks later, may involve almost anything. Rash (palm/soles), kidney, liver, CNS
Tertiary Syphilis - Years later; Gummatous lesions in skin, bone, viscera, CV, neurosyphilis
Argyll Robertson pupils: (aka prostitute pupils) small pupils that constrict to near object (accommodate) but do not react to bright light
Diagnosis: VDRL or RPR
Treatment: PCN G 2.4 million units IV x1
Jarisch Herxheimer reaction: PCN spirochete destruction → fever, toxicity

TB

Chronic granulomatous disease caused mostly by Mycobacterium tuberculosis, Gram +ve
Primary - Usually asymptomatic / mild flu, no cough, not infectious
CXR shows apical lesion, pleural effusion; sputum +ive for Ziehl-Neilsen staining AFBs
Secondary/Reactivation - from dormant TB when host cell resistance decreased
Cell-mediated immunity → Delayed hypersensitivity to Ag's
Detected by Mantoux test
becomes +ive 4-8/52 after exposure
false -ve: viral infection, sarcoid, malnutrition, Hodgkin, immunosupp, overwhelming TB
false +ve: infection with atypical mycobacteria
LP: incr lymphocytes + monocytes, incr protein, decr glucose

Treatment

Notifiable disease
Standard "short course" 6/12 trt: I+R+P+E (stop E as soon as confirmed TB sens to other drugs) for 2/12, then I+R for 4/12
Indications for steroids: lobar collapse secondary to LN, meningitis, renal, adrenal, moribund

ED Guidelines for epidemics/pandemics:

- Clinical characteristics of pandemic flu and its initial management
- Alert criteria and responses
- Isolation and transfer to designated flu hospitals
- Physical infrastructure and equipment to manage infected patients
- Staff PPE
- Education, training, audits, exercises, surveillance, prophylaxis, stockpiling

Viral Infections

HHV 1-2: Herpes simplex 1 and 2
HHV 3: Varicella Zoster
HHV 4: Epstein Barr

HHV 5: CMV
HHV 6-7: Roseola
HHV 8: Kaposi's Sarcoma (AIDS)

Herpes Simplex Virus (HSV)
HSV1 - Mouth, stomatitis
HSV2 - Anus, genitalia
Ix: Immunofluorescence, Viral culture vesicle fluid, PCR
Treatment: STD counselling; mng partners; mng other STD's
Primary genital: acyclovir 400mg PO TDS 5/7
Long term suppression: >6 episodes/yr; acyclovir 200mg BD 6/12

Varicella Zoster Virus (VZV)
Herpes virus 3

Shingles
Reactivation of dormant varicella zoster virus
Herpes Ophthalmicus: trigeminal nerve eruptions (CNV) can involve eye
Ramsay Hunt zoster oticus (CNVIII): Bell's palsy + ear pain/zoster
Hutchinson's sign: vesicles on tip of nose → may indicate eye involvement
Postherpetic neuralgia: Steroids may prevent; Treatment: TCA, capsaicin, narcotics, gabapentin
Isolate; saline baths; analgesia
Antivirals if: ophthalmic, immunocomp: decr no vesicles, decr time to resolution, decr duration post-herpetic neuralgia; acyclovir 800mg 5x/day 1/52

Chickenpox
Mild in children, severe in adults and immunocompromise
Rash 2 weeks after resp infection - macule - vesicle - rupture - crust
Interstitial pneumonia, encephalitis, transverse myelitis
Give vaccine/Ig to exposed contacts
Highest risk if fetus infected 13-20/40
Antivirals if immunocomp; decr pain and fever, decr risk dissemination, decr time to healing
10mg/kg acyclovir TDS for 7-10/7

Epstein Barr Virus (EBV)
Heterophile ab tests – Monospot; false –ive early
EBV specific ab tests – IgM/G; 97% sens
FBC: incr WBC, incr peri mononuclear cells, atypical lymphocytes
LFTs – incr AST/ALT
Avoid contact sports

Measles – see paeds
aka rubeola.
Fever, cough, coryza, conjunctivitis; Koplik spots
Rash starts on head, then spreads
Can cause diarrhoea, PNA, encephalitis, corneal complications

Mumps
Salivary gland pain/swelling; can spread to CNS (aseptic meningitis), testis, ovary, pancreas

Roseola
Herpesvirus: HHV 6 and 7 (sixth disease)
Age 6mo - 2yrs
Sudden high fever for 2 days → fever resolves → rash
Rash begins on trunk, spreads to head/neck; nonpruritic
Common cause of febrile seizures
No treatment with aspirin due to risk of Reye's syndrome

Rubella
Viral syndrome, rash that starts on face, spreads to trunk and limbs, then fades after 3 days
In pregnant women, causes congenital rubella syndrome

Influenza
Orthomyxovirus; Type A most common and most pathogenic

Avian influenza A - H5N1
Mortality 50%
Minimal human-to-human transfer

Hantavirus
HPS = hantavirus pulmonary syndrome - ARDS-like picture
Tachypnoea, haemoconcentration, thrombocytopenia, leukocytosis
Treatment: supportive

Severe Acute Respiratory Syndrome (SARS)
Coronavirus SARS
Droplet
Incubation 2-7d
1st stage: flu-like prodrome – fever≥38, fatigue, headache, chills, myalgia, malaise, anorexia, diarrhoea.
2nd stage LRT - dry non-productive cough, SOB, progressive hypoxia.
CXR (pulm. infiltrates initially unilateral & peripheral, becoming patchy & bilateral)

Sepsis
SIRS: 2+ of**:** T >38/<35
HR >90, >150 children
RR >20/PaCO2 <32
WBC >12/<4/>10% bands
Sepsis: SIRS +infection
Severe sepsis: sepsis + end-organ dysfunction
Septic shock: severe sepsis + hypotension not reversed by fluid resus

Immediate Management
High flow O2
iv access x2
Fluid bolus 10-20ml/kg + repeat, May require 4-6L fluid during initial resus

Optimise oxygenation
Early intubation and ventilation
ARDS-net ventilation strategy
TV 6-8ml/kg
RR 18-20
PEEP 5cm H2O
Plateau P <30
Goals:
SaO2 88-95%
pH 7.30 - 7.45
PaCO2 45-60 mmHg (permissive hypercapnia)

Optimise circulation
Art line, central line
Target: CVP 8-12 mmHg
MAP 65-90 mmHg
ScVO2 >70%
UO >0.5-1ml/kg/hr (>1mk/kg/hr kids)
Lactate clearance >10%/hr
Consider RBC transfusion (aim Hb 70-90, HCT >0.30)
Early use inotropes to maintain MAP
Noradrenaline 2-10mcg/min
Adrenaline 2-10mcg/min
Dobutamine 2-20mcg/kg/min
Vasopressin 0.03 units/min

Source Control
Start broad spectrum Abs <1hr
Tazocin 4.5g iv adults, cefotaxime 50mg/kg children + amoxyl 50mg/kg if <6/12
Drain abscess/collections
Remove infected lines

Steroids
No mortality benefit
Hydrocort 200mg/day in 4 divided doses if shock unresponsive to fluids and pressors

Blood glucose control
Avoid tight control - incr mortality (NICE-SUGAR)
Insulin infusion if BSL >10

FAST HUG
Feeding/fluids
Analgesia
Sedation
Thromboprophylaxis/temp control
Head up 45 deg
Ulcer prophylaxis
Glycaemic control
Family conference/MDT

EGDT - ARISE, ProCESS
Protocolised EGCT vs standard care
EGDT arm - incr fluid volume and inotropes, incr transfusion
Invasive - ScVO2 monitor for all
Industry sponsored
No difference in outcome

Antibiotic Prophylaxis for Wounds
High risk:
Delayed presentation >8hrs
Puncture wounds
Hands, feet, face
Underlying structures involved (tendon, bone, joint)
Immunocompromise

Management Summary

4/6 Hour Rule

Performance indicator, assumes short time in ED related to quality of care
Patient admitted, referred or discharged within 4/6 hours
NEAT - National Emergency Access Target - by 2015 90% within four hours (6hrs NZ)
Cons - readmission higher, Patient care, Pressure to make fast decisions to avoid breaches, Dealing with long wait rather than ill patients, Premature discharge, Transfer to inappropriate, Unnecessary admissions, Reducted system productivity, stress/morale, Clinical flow rather than quality of care.
Pros - 6hr better than 4hr
Patient perception questionnaire (UK): decr pain, incr admission rate, slight incr overall rating of care

Protocol Development/Purchasing Equipment/Management Plans

Need, Research, Consult
Costing
Guideline draft
External review
Approvals
Pilot, Train, Launch
Audit, Review date

Components of Protocols

Purpose
Patient selection
Consent - Indications, Contraindications, Precautions (compliance, fasting, allergies/meds/co-morbidities)
Preparation - Patient, Staff, Equipment, Drugs, Monitoring
Procedure
- PPE
- Positioning
- Pre-med (sedation/nerve block)
- Prep + drape (sterile tech)
- Perform
- Post-procedure (assess for complications, document, disposition, followup)

Complications + Rescue techniques
Aftercare - Recovery, Disposition, Discharge criteria
Documentation requirements
Review date
Authors

Components of Management Plans

Patient ID
Identify problem: Clinical, Behavioural
Provide strategies:
- Immediate/short term strategies (relevant to each ED visit)
- Medium/long term strategies (relevant to maintenance in community)
- Relevant contacts/referrals and triggers for this

References, Authors, Authorised by and date

Complaints

Individual, System, Process factors
Management
Rectify source of complaint: treat medical issues
Deal with rest of department - appoint senior college to run ED while you deal
Personnel: one specific person
Acknowledge - Prompt, Promise to investigate, Express regret (do not accept liability), Provide contact
Gather info
Plan action - resolve medical issues, resolve complaint, performance management of staff
Notify medicolegal/ED director/involved parties
Respond/feedback - signed by ED director, Thank, Acknowledge impact and opportunity to improve
- Supply info (progression of disease vs new diagnosis), potential consequences, steps being taken

Audit/QA loop - feedback, revise existing protocols, educate, re-audit
Documentation

Management of Adverse Events
Notification (involved parties, legal)
Documentation
Investigation - root cause analysis
Timely response and recommendations
Complaint resolution
Implementation of recommendations and ongoing quality improvement

Did Not Wait/Left Against Medical Advice

Consequences - Patient dissatisfaction; delayed diagnosis; complaints/litigation
LAMA - Patient autonomy vs doctor's beneficience and non-malificence
Duty of Care if: Patient presents for treatment, initially engaged (registration), Treatment can be provided

Management
Acknowledge
Address reasons
Recruit others
Assess: risk of patient, problem severity, reason for DNW/LAMA; assess mental state and competence
Inform: senior medical staff
Increase patient priority
Communicate: risks, benefits, management
Compromise
Stall: last resort
If incompetent - treat under duty of care/implied consent
If competent - encourage to state, simple interventions
Inform potential risks of leaving
Advice, Follow up
Documentation

How to reduce
Shorter wait, Accurate triage, Adequate staff, Comfort, Regular communication, Educate about triage

Clinical Risk Management Strategies

System - adequate resources, protocols, suitable environment, IT systems, support systems, teamwork
Process - direct line to ED admitting officer, 'patient expects' database, senior review, structured handover, timely review post-discharge of results, timely review DNWs, proformas/protocols, reverse triage
Individual - recruitment, selection, orientation, credentialling, training, supervision, CME

EGAIRT (reverse triage)
Education
Guarantee treatment complete
Admission not indicated
Information (documentation) complete
Review arranged
Transport
Telephone triage - aim to provide advice which health service options best for patient, Lacks visual cues
Telephone advice - limited to first aid instruction + advising the caller to seek further assistance
High risk areas - Change of shift, Repeat visits, Private patients, Admitted patients, Chief complaints with higher risk: AAA, AMI, PE etc

Breaking Bad News

PLIIED
Prepare
Location + staff
Introduction - what family already knows
Information - summarise what happened, no euphemisms, check understanding, questions, offer food and drink, telephone, pastoral care referral
Educate - what next
Document

Coroner

Violent or unnatural death
Cause unknown
Suspicious circumstances

Within 24h after an anaesthetic
Mental Health Act
In custody or care
Unknown identity

Domestic Violence

DASCRRR
Detect
Assess
Safety
Confidentiality - duty of confidentiality balanced against duty of care
Referrals
Reporting to Police - Patient consent unless life-threatening
Records

ACEM policy on Elder abuse - admit to hospital/emergency accommodation to allow investigation

ED Design

Access to every area
Triage access to ambulance entry and WR
Central utility/meds/equipment rooms
Consider nights
Security of staff and patients

Total area: 50m2/1000 annual attendances
Acute - half bed areas should have physiological monitoring
Treatment, Clinical, Non-clinical areas

Short Stay Units

1/4000 annual attendances
EM patients, benefit from extended treatment and observation, LOS < 24 hours
10-20% failure rate
Admission process - senior doctor, treatment plan
Admission criteria - Known single diagnosis likely to improve <24hrs, from remote area/MDT/social
Exclusion criteria - complex problems, Multiple problems, Elderly, Paeds, without clear management plan or diagnosis, intensive nursing requirements, Risk to staff patients,>24hrs admission
Pros - Decr LOS, frequent review, Concentration services, Avoid night discharge, Improved flow, Safety net
Cons - Deferral of decisions, Failure to exclude serious diagnosis, Inappropriate optimism

ED Staffing

Rights of patients
Rights of staff
Determine clinical workloads
ACEM and other policies
ED clinical/quality indicators
Clinical and non-clinical time balance

Medicolegal

Duty of care - Legal obligation to deliver a particular standard of care that would be exercised by an ordinary practitioner to protect the patient from risk of harm.
Negligence - Breach of a duty of care
Medical Ethics - Autonomy, Beneficence, Non-maleficence, Justice, Dignity
Mandatory Reporting - Notifiable disease, Coroner cases, NAI, Firearms legislation, Impaired practitioner

Consent

Must be informed, specific, freely given with no undue influence; opportunity to reflect/ask questions
Give info
Discuss - comprehension, recall, paraphrase, what will happen if you don't..., alternatives, consequences
Document
Don't need consent: public health issue (eg. TB), danger to self or public

Implied consent
Patient presents for treatment, willing participant (eg holds out arm for blood test)

Competence

Determination of mental capacity for decision making
Must be able to receive info, process, understand, communicate choice, manipulate info in rational fashion
Gillick Competence: used in medical law to decide whether ≤16yr able to consent to own treatment
Fraser guidelines: doctors can provide contraceptive without parental consent providing:
- understands
- cannot be persuaded to inform parents
- likely to have sex with or without contraceptive treatment
- physical or mental health likely to suffer
- young person's best interests

Not competent to consent - Implied Consent
A reasonable person would give consent in that situation
Condition is an emergency
Mature minor (>14yrs): consent if mature enough to understand, beneficial/non-elective treatment, low risk

Involuntary detention (mental illness)

Appears mentally ill
Requires immediate attention that cannot be given as OP
Patients health / safety or that of others at risk
Refused consent or incapable of giving consent
Cannot receive treatment in a less restrictive manner

Compulsary Assessment and Treatment (Mental Health Act 1992)
Section 8A: request for admission; any adult
Section 8B: qualified docto, must have examined patient, believe there to be mental illness
Section 9: psych assessment and examination by psychiatrist
Admit for assessment for 5/7

ED overcrowding

ED function impeded due to number of patients exceeds physical/staffing capacity of ED
Marker of whole hospital dysfunction; internal disaster
Access block - Inability to access inpatient beds in timely manner for ED patients.
% patients for admission but discharged from ED, transferred, or died in ED whose total ED time > 8 hours.
Contributes to ED overcrowding in 90%; At >10%, impacts on ED level of care
Causes
Access block
Incr patient numbers/complexity/evaluation
Over-processing
Delays in referral or Supporting processes
ED staff, design, size
Unnecessary movement
Underutilisation
Impact of Overcrowding and Access Block
Bio - Adverse events, Decr quality of care, Infectious disease
Psychosocial - Patient dissatisfaction/complaints, Staff stress, Financial stain
Legal/ethical - Record mixing, Privacy, OHS risk
Departmental - Incr waiting time, hospital stay, DNW rate, workload, handovers, risk
Solutions

Reducing Demand
Community: GP funding, community services, hospital outreach
ED: Senior decision making, Short stay units, Accelerated protocols, Access to Ix/consults
Increasing capacity
ED processes: Fast-tracking, Lab times, Senior staff 24/7, Full capacity protocol, Nurse-initiated
ED beds: levels recommended by ACEM
Ward processes: Bed coordination services, Inpatient rounds daily, speed Ix/consults
Ward beds: >3 acute beds per 1000 popn
Improving exit
Ward processes: Morning discharge, weekend discharge, allied health
Community capacity: Incr residential aged care beds, Post-acute care services

Quality Assurance and Improvement

Quality assurance: system used to establish + monitor standards of patient care
Quality improvement: Access, Acceptability, Continuity, Safety, Effectiveness (clinical indicators)

Continuous Quality Improvement (CQI) – ongoing process
Clinical guidelines: reference tools that help guide clinical practice; focus for standardisation, reference point for peer review
Benchmarking: comparing performance with others

Quality Improvement Cycle - plan, do, study, act

Clinical Indicators
Measures of clinical outcomes of care
Must be: measurable, clinically relevant, achievable, acceptable to staff
Access - Waiting times, access block, critical care patients waiting >4hrs in ED
Mental health - waiting times, number DNWs
Paeds - time to Abs in septic infant, salbutamol <30mins in asthma, analgesia <30mins in fractures
Thrombolysis - <30mins in STEMI
Elderly - risk assessment
Pain - scores documented
Efficiency - Waiting time by Australasian triage scale

Prisoners
Higher triage and acuity
Complex illnesses with Medical, psych and addiction comorbidites
Maintenance of confidentiality
Discharge planning
Logistical difficulties managing patients in custody

Drug Seeking Patients
Attempt to develop rapport
Exclude new organic pathology
Determine that genuine pain adequately treated
Set clear limits regarding meds
Consider open discussion regarding behaviours
Consider referral for ongoing care
Develop management plan

VIP
Management based on maintenance of standard clinical procedures
Plan resembling disaster plan to coordinate cares

Triage
A structured process that involves assessing patients and prioritizing them according to urgency of their condition, to determine the type of care required and the urgency of its administration.
- equity and efficiency - greatest good for greatest number

The Australasian Triage Scale (ATS)
ATS 1 - Imminent threats to life requiring immediate aggressive intervention
A, B (↑/↓), C (↓), D (GCS<9, current seizure),Ψ (agitated+risk)
ATS 2 - Serious enough or deteriorating rapidly so as to risk life or organ system failure
ATS 3 - Urgent; ATS 4 - Semi-urgent; ATS 5 - Non urgent

Limitations
Variability: Inter-rater, Institutional, Regional
Minimal time, privacy
Pts vs nurses interpretation of urgency
Lack of evidence for time-goals related with medical outcomes

ATS Category	Max waiting time	ACEM target % seen in time
ATS 1	immediate	100%
ATS 2	10 minutes	80%
ATS 3	30 minutes	75%
ATS 4	60 minutes	70%
ATS 5	120 minutes	70%

Managing Violence in ED
Staff - security, de-escalation and self-defence training, remove stethoscope
Area - Controlled entry, Swipe card, Video, Cubicle setup
Equipment - Duress alarms, Restraint devices, rapid access to sedative agents, Computer systems flag
Policies and Protocols - Zero tolerance policy, Links to police, restraint policy - code black

Violent/psychotic patient

Ensure staff safety
Ensure safety other patients - Clear area, Stop new, Appoint senior to run department, Manage pt yourself
Manage the violent patient - Assemble team (5), drugs drawn up, Pre-assign limbs, Use family if available, verbal de-escalation, po-iv-im, 4 point restraint, exclude organic, Consult, Review need ongoing restraints
Debrief
Document
QA loop/revise protocols

Handover

Transfer of clinical info
Secondary aim education
Potentially dangerous time
Confidentiality
Minimise time away from patient care
Formats: electronic or paper, ward round - Site, Frequency, Attendees
Handover tools - ISBAR (identify yourself, situation, background, agreed plan, read back)

Disaster and Retrieval Summary

Disaster Medicine

Prevention - Preparedness - Response - Recovery
Surge: a sudden increase in patient care demands on health system. 2 surges: 1 in 90 mins, 1 in 2-3hrs (critical patients)
Surge capacity: ability of health system to respond to markedly incr number of patients from usual

Disaster Zones
Hot zone:
- immediately surrounding
- self-contained breathing apparatus/full protective suits only
Warm zone:
- decontamination between hot and cold
Cold zone:
- does not require protective clothing
- medical personnel should only operate in this area

Types of disaster
Red = fire
Blue = cardiac arrest
Purple = bomb threat
Yellow = internal disaster
Black = personal threat/illegal occupancy
Orange = evacuation of ED needed
Brown = external disaster

Disaster plans
Form team - command, operations, planning, logistics, finance
Determine capabilities of hospitals
Define responsibilities: co-operation between different services; hospital-community co-ordination
Determine risk (hazard vulnerability analysis)
Define reason for activation
Prevention and risk reduction: Create public warning systems, disaster plans
QA
Disaster exercises

Disaster triage
Greatest good for the greatest number
Dynamic process, repeated examinations, take into account patient's age/health status etc...
P1 = RED = immediate care needed (RR <10/>30, HR >120, CRT >2sec)
P2 = YELLOW = delayed treatment acceptable ((HR <120, CRT <2sec)
P4 = GREEN = walking wounded
P3 = BLACK = survival unlikely (dead or non-survivable injuries)

Revised trauma score - GCS, SBP, RR
Each item scored 0-4, total out of 12
Low score = more severe injury

Disaster response
Potential to overwhelm resources
May require response from outside agencies
Aim greatest good for greatest number
Walking wounded often arrive before seriously injured

Confirm details: METHANE
Major incident declared
Exact location
Type of incident
Hazards at site
Access
Number of casualties + expected arrival times
Emergency services required and present

Prepare (standby phase, phase A): AEEASH

- Activate major incident plan
- Establish control centre
- ED preparation
  - Divert
  - Decant - ED patients to other clinical areas
  - Discharge
  - Deploy - surge team to commence advance triage process
  - Security presence
  - Triage in ambulance bay - use separate disaster tags and notes
- Areas (red, yellow, green, black, morgue)
- Staff, Equipment and drugs
- Hospital/Region

Activate phase (phase B):

Confirmation - numbers and types of patients
Dispatch site team:
- site medical officer
- site teams
- assess appropriateness of sending team

ED: Staff, Area, Equipment

Patients phase (phase C):

Re-triage on arrival
Decontaminate
Judicious use of labs and XR
Incr nursing staff responsibilities
Discharge/transfer/admit
Incr role USS and DPL
Path limited to Hb, ABG, K, XM
Primary skin closure only

Debrief/audit:

Education
Documentation
Debrief
CQI

On scene management: CSCATT

- Command and control
- Safety – self, scene, patients
- Communication
- Assess scene, patients, hazards
- Triage
- Treat - stabilisation, decontamination
- Transport

The ED is asked to send a team to the scene of a disaster - considerations

PET C CARD P
1. Personnel incl medical commander
2. Equipment
3. Transport
4. Communication
5. Command Structure - Police are in charge of scene
6. Actions at Scene – Sort/Sieve (Triage), Emergency Treatment, Use of Resources
7. Relief
8. Debriefing
9. Post Incident Care of Staff

Respiratory Contagion

Key issues

- Resuscitate patient
- Protect staff and other patients

Patient
- Isolate
- Keep away from other patients
- Apply mask

Staff
- Wear PPE (gloves, gowns, N95 mask, visor
- Hand washing and alcohol gel, Barrier nursing
- No pregnant staff

Area
- Negative pressure room, own facilities, Cohort patients

Equipment
- Avoid aerosoles (nebs, NIV); additional PPE

Notifications
- Hospital admin, ED director, ID
- MOH - should activate chain of events

Policies and Procedures
- Centralised treatment of affected patients eg flu clinic
- Triage-initiated protocol for isolation
- Testing of patients eg PCR of NP swabs

Chemical Weapons

Choking/lung damaging - chlorine, cyanide, phosgene
Blistering - mustard
Nerve gas
Asphyxiants - inert gases asphyxiate by reducing alveolar oxygen tension
- simple (decrease inspired pO2): nitrogen, methane, CO2, argon, helium, NO, hydrogen
- chemical (decrease O2 ultilisation): CO, hydrogen sulphide, hydrogen cyanide

Upper Airway Irritants - **Ammonia**
Mild exposure: inflammation skin/oropharynx/URT, cough, conjunctivitis, headache, burning throat
Moderate exposure: burns/oedema skin/nose/oropharynx, SOB, wheeze, N/V
Severe exposure: laryngospasm, stridor, partial or full thickness skin burns, pulmonary oedema
Lower Airway Irritants - **Chlorine**
Mild exposure: lacrimation, rhinorrhoea, cough, headache
Severe exposure: bronchical epithelial sloughing, ulcers, purulent exudate, pulmonary oedema
Management: rest, supportive care, oxygen, airway support, fluid replacement
Terminal Airway Irritants - **Phosgene**
Alveolar irritant
Initial toxicity: choking, coughing, lacrimation, headache, N/V
Latent period mins to hours
Delayed symptoms: dyspnoea, chest tightness, cyanosis, haemoptysis, pulmonary oedema
Management: supportive, beta agonists, NSAIDs, codeine to reduce cough
Hydrogen sulphide
Similar toxicity to cyanide - pulmonary oedema, collapse, LOC, black discolour coins
Management: prevent secondary contamination, supportive, Na nitrite, consider HBOT
Blistering Agents - **Mustard Gas**
Cutaneous/ophthalmic effects first - Conjunctivitis, corneal damage, viusal loss; erythema, vesicles
Respiratory effects within 24hrs - epistaxis, pharyngitis, laryngitis, cough, dyspnoea, haemorrhagic pulmonary oedema, mucosal sloughing and airway obstruction
Bone marrow suppression days to weeks after exposure
Management: PPE for staff, decontamination of skin, eye irrigation, ophthalmic topical anticholinergics/antibiotics, burn care
Chemical warfare agents - **Sarin Gas (organophosphates)**
rapid onset (5mins) inhaled, slow onset transdermal exposure
Intermediate syndrome: delayed onset (24-96hrs) respiratory paralysis, muscle weakness
Delaying neurotoxicity: 2-3/52 post exposure

Biological Weapons

Anthrax
Cutaneous, Inhalational, GI anthrax
Widened mediasinum, pleural effusion
Immediate notification of public health
Standard barrier isolation; no contact with skin lesions; surface decontamination with bleach and water
Cipro 400mg IV BD + penicillin; treat for 60/7

Plague
Yersinia pestis
Resp isolation; Abx streptomycin/gent
Smallpox
Maculopapular rash - vesicular and pustular in 1-2/7, high fever, malaise, headache, backache, AP, delirium
International health emergency
Tularemia
Highly infective +++
Streptomycin/gent
Botulism
Clostridium botulinum: toxin blocks Ach action
Symm desc flaccid paralysis, CN palsies, constipation, ptosis; normal LOC, no sensory change, arreflexia
Clinical diagnosis; EMG
DDx: GBS, MFS, MG, CNS disease
Supportive care; antitoxin will decr subsequent nerve damage, but doesn't reverse existing paralysis

Medical Retrieval

Principles
Provide best possible care, least possible risk
Level of medical care retained/increased at each transfer
Assess clinical problem in place of referral
Stabilise prior to transport
Transport with physiological support & appropriate monitoring
Deal with foreseeable en route deteriorations
Monitor and review quality of retrieval process

Communication
Transferring/accepting hospital, Transporting team, Relatives and patient
Correct choice of patient - Relative CI to air retrieval:
Bronchopleural fistula
Bowel surgery<10d
Active GI bleeding
Vascular anastomosis<14d
Correct choice of transport
Staff, **Equipment**, **Drugs** - airway, breathing, circulation, monitoring
Patient Preparation
Secure everything, check ABCDE
Sedation/Analgesia/antiemetic
Optimise haemodynamics - fluids, vasopressors
Injuries/condition specific eg ICC for PTX, Heimlich valve, splint, bivalve plasters
Environment - temp
Communication - patient, relatives, sending/receiving hospital teams
Documentation
Anticipate problems
Loading and unloading - removal of lines, thermal insult
Altitude effects -worsen pneumothorax, bowel obstruction, hypoxia, decompression illness
Decr humidity - humidify gases
Decrease temp, darker, space/lighting limitation, noise, vibration, G forces
Vital signs- more difficult to monitor
Staff problems- sickness, sinus/ear pressure
Special considerations - air embolism/eye injury/HI/#/decompression sickness/ACS
Weather conditions
Defib - movement artefact will make it difficult to sync; consult pilot before giving DC shock
Direct handover
Documentation and audit

Helicopter
Pros: flexible landing; less turbulence/faster to mobilise than fixed wing
Cons: limited access, loud noise/vibration, exposure to elements, altitude, poor suction, monitoring difficulties, limited resources, poor lighting, motion sickness, weather dependent, not pressurised
Fixed wing
>200km or road >3hrs
Pros: faster airspeed, more cabin space, less noise/vibration, better temp control
Cons: longer mobilisation time, long landing strip, requires road transport from landing to hospital

Road
Pros: quicker to arrange; good <50km; less dangerous; no complications of altitude; cheap
Cons: slower at longer distances, need road access
Neonatal transfer
Beware: Hypoglycaemia, Hypothermia, Hypoxemia, Hypotension, Infection

Oxygen cylinders

BL	224L	22min at 10L/min
C	490 L	49min
D	1500L	2.5hrs
E	4200 L	7hrs

Prehospital Medicine

Key elements of prehospital trauma care system
First tier: care by first responders
Second tier: basic prehospital trauma care
Third tier: advanced prehospital trauma care

Difficulties of clinical care outside hospital
Unfamiliar environment
Working on the ground
Hazards of incident
Site disorganised
Information unavailable, inconsistent or incorrect
Inadequate staff, equipment
Different hierachial systems

Procedures Pre-Hospital
Stay and Play
Load and Go

Beneficial
Early defib
Needle decompression PTX
Basic airway
Nitrates/GTN/CPAP in LVF
Thrombolytics for MI with long transport time
RSI if long transport time
ALS in SOB
ECG pre-hospital

Mass Gathering Needs/risk assessment

Environment	Outdoors – heat exposure, weather
	Indoors – little heat, confined area, access issues
Activity	Marathon – dehydration, sudden cardiac death, AMI, heat injuries
	Water – hypothermia
Event	Rock concert vs classical music (drugs and ETOH vs comorbidities)
	% children in crowd
	Motorsports – multi trauma
Numbers	25,000 = 2 paramedics/1 doctor
Geography	Further away from hospital, higher level scene support required

Risk Minimisations
Public education re: risks: hydration, sun protection, don't drink and drive
Age limits
No alcohol/drugs to be brought in, No glass bottles, H20 available
No crowd surfing
Defib
Rehydration stops on marathons

Incident Management
Staff
Physician medical oversight
Prepare hospital
Event staff education
Equipment - Basic / advanced; AED
Front-line first aid
On site command post
On site medical/triage area
Treatment facilities
Transport
Communications
Public health - Potable waters, waste mng, food, traffic
Access to care - Signage, high vis clothing
Documentation
Liability - Medical insurance

Neurology/Neurosurgery Summary

Brain Death

Repeat test 4-6hrs; need 2 examinations by at least 2 doctors
Establish cause: must be irreversible
Must be normal: T >35, SBP 100-200, BSL 2-20, Na 115-160, PaO2, PaCO2, K >2
Must be absent**:** drugs; Significant metabolic/endocrine abnormalities

Cranial Nerves

CN I - Olfactory
CN II - Optic VA; visual fields; direct and consensual pupil reflex; pupil sizes; fundoscopy
CN III - Oculomotor SR, MR, IR; IO; ParaS - ptosis, down and out, mydriasis, no light/accom reflex
CN IV - Trochlear SO 4 - can't look down and in, head tilted to opposite side
CN VI - Abducens LR 6 - can't look out, convergent strabismus
CN V - Trigeminal Sensory: corneal reflex, facial sensation; Motor: muscles of mastication, jaw jerk
CN VII - Facial Chorda tympani: taste ant 2/3 tongue; Muscular: facial expression
CN VIII - Vestibulo-cochlear
CN IX - Glosso-pharyngeal taste and sensation to post 1/3 of tongue
CN X - Vagus Uvula deviation away, absent gag, hoarseness, bovine cough
CN XI - Accessory Drooping of shoulder, downward rotation and protraction of scapula, wasting of traps
CN XII - Hypoglossal tongue deviates to side of lesion

Internuclear Ophthalmoplegia
Failure of inward gaze
Causes: young and bilateral = MS; older = stroke

Bell Palsy
= HSV1
Clinical: upper and lower ½ face affected
Paralysis, loss of taste ant ⅔ tongue, pre-auricular pain, dry eyes
"Bell phenomenon" - eye rolling up when trying to close
Management
Eye lubricant 2/24, ointment and patch at night,
Prednisone 60mg 1/52
Ramsay Hunt = VZV - must Rx aciclovir

CVA

TIA: brief episode neuro dysfunction caused by ischaemia with clinical Sx <1hr, without evidence infarction
ABCD2 score: may underestimate risk
Age >60yrs (1)
BP >140/90 (1)
Clinical features: unilateral weakness (2)/speech impairment without weakness (1)
Duration: >60mins (2)/10-60mins(1)
DM (1)
<4 - do CT head and carotid USS within 48-72hrs; OP FU
>4 - admit; do CT/MRI within 24hrs
2-5% 7/7 risk if <5, up to 50% if 6
Prevention: aspirin, clopidogrel/dipyridamole, anticoagulate, BP control, stop smoking, carotid endarterect
Stroke screening tools
FAST: facial movement, arm movement, speech, test

Investigations
CT, MRI, MRA, Carotid USS, ECHO if structural cardiac disease, or suspect emboli (AF, recent MI), Holter

Management
ED stroke and TIA care bundle: rapid initial stroke screen; ABCD2 if TIA; urgent CT/MRI; NBM until swallow assessed; aspirin as soon as ICH excluded; monitor NS, BSL, BP, hydration status
C: Prevent HTN, hypotension
D: Prevent hyperG/hypoG, fever, hypoxia; mannitol
Supportive: hydration, nutrition, seizure control; pressure cares; IDC if unable to void; antiemetic

Thrombolysis
History - onset <4.5hrs, no contraindications
Exam - severity of stroke by NIHSS score consistent with likely to benefit from lysis (>4-25), no clear alternative cause (no stroke mimic)
Dose: 0.9mg/kg tPA (alteplase) (max 90mg), 10% as bolus, 90% over 60mins
Admit stroke unit/HDU bed
Check BP Q15min for 2hrs - Q30mins for 6hrs - Q1hr for 16hrs
CI's: unknown time; improving Sx; minor (NIHSS <4); major (NIHSS >25); SBP >185; DBP >110; high risk CT findings (>1/3 MCA territory, multilobar infarction); seizure; plt <100; PT >15; BSL <2.7 / >22.2; Sx suggestive of SAH; heparin in last 48hrs, incr APTT; unable to consent; >3hrs; >80yrs; demonstrable perfusion

12 trials - 6 showed no benefit, 4 stopped early because of harm
2 methodologically flawed studies promoted as positive (NINDS, ECASS-III)
Even positive trials show 10fold incr ICH
NINDS: better NIHSS stroke scores at 3/12 and 1 year with tPA
    10x ICH rate - 6% ICH in tPA (0.6% in placebo)
ECASS III: slightly higher neurological outcome at 3/12 with tPA
    Incr ICH in tPA (27% vs 17%)
IST-3: large ever stroke trial, 3100 pts
    No difference in death or dependence at 6/12
Problems with these trials: often industry sponsored; imbalances in stroke severity scores

Management of ICH
BP Control
Lower BP if: >200 / >120 or MAP >150
Aim 160/90 or MAP 110
Labetalol 10-20mg IV over 1-2mins - repeat or double dose at 10mins (to max 300mg) or
Coagulopathy
Incr INR - give PTX, FFP
Platelets - if on aspirin and OT planned
Factor VII - decreases ICH size but no change in outcome, so not recommended

Dementia
Syndrome of progressive multiple cognitive deficits and memory loss → behavioural/social issues.
Loss of short term memory and evidence of global impairment
No clouding of consciousness, attention normal
Slow onset, Hallucinations rare, delusions uncommon
Delirium and Coma
Acute organic brain syndrome, Sudden onset
Disordered attention and arousal - reduced ability to focus, sustain or shift attention
Accompanied by disturbances of cognition, psychomotor behaviour and perception
Fluctuating course and lucid intervals

Confusion Assessment Method (CAM) tool
(1) Acute onset, fluctuating course; and
(2) impaired attention, impaired focus of concentration (initiating, maintaining, shifting focus at will)
and either
(3) confusion or any impaired cognition; or
(4) altered consciousness: alertness/activity

Causes of Delirium/COMA
Cerebral (trauma, infection, seizure, stroke)
O2/CO2/acid base
Metabolic (elects, endocrine, environment, encephalopathy)
Alcohol, other drugs
Sepsis

Investigations
Need collateral history
MMSE
Bloods incl gluc, TFTs, vitamins, HIV, cultures if indicated
MSU, ABG and LP if indicated
ECG, CXR, ?CT head

Headache

High risk features/red flags
Sudden onset
First severe or worst ever
Onset during exertion, incl coughing
Focal neurology or papilloedema
Altered mental status
Toxic appearance
Meningism
Immunosuppression
New onset with age>50

Cerebral Sinus Thrombosis

Risk factors: hypercoagulable state, head/neck infections
Sx: severe headache, drowsy, venous findings: bilateral stroke-like symptoms but in non-vascular pattern
CT head without contrast: Delta sign – blood clot in confluence of sinuses
Diagnose with gold standard: MR Venography
Tx: neurosurgical consult, remove clot, dissolve with TPA, craniectomy

Cervical Artery Dissection

Thunderclap headache (like SAH); neck or facial pain
Work-Up: CT head negative/LP negative
Tx: Anticoagulation (neurosurgical consult – angioplasty/stenting in very rare cases)

Temporal Arteritis

Systemic, inflammatory, vascular syndrome that predominantly affects cranial arteries
ESR >50 mm/hr
Temporal artery biopsy gold standard
Prednisone 40-80mg/d PO. IV methylprednisolone if acute visual changes

CT Head

Haemorrhage
Acute = hyperdense/white (+/- dark acute bleeding)
Subacute = isodense (1-3/52)
Chronic = hypodense (4-6/52)

Epidural: biconvex; doesn't cross sutures; usually arterial injury (middle meningeal)
Subdural: concave/crescentic; crosses sutures but not midline; usually venous injury/bridging vessels
SAH: blood in cisterns or cortical sulci
Intraventricular blood
Intraparenchymal blood: esp in basal ganglia

CT Ring enhancing lesions
Mets
Abscess: toxo, TB, cryptococcus, candida, Staph aureus, strep, pseudomonas, anaerobes, bacteroides
Glioma/primary brain tumour
Infarct
Contusion
Demyelination (MS)
Radiation

Atraumatic intracerebal haemorrhage differential
1. hypertensive/aneurysm
2. AVM
3. cerebral amyloid
4. coagulopathy
5. neoplasm haemorrhage
6. drug abuse
7. haemorrhagic transformation CVA 24-48hr

Mass effect
1. Midline shift - measure
2. Lateral ventricle compression
3. Effacement of sulci

4. Basal cisterns effaced
5. Loss of grey-white differentiation

Vasogenic vs cytotoxic oedema
Vasogenic
Causes: tumour, infection, contusion, radiation
CT: fluid (black) accumulates in white matter, Preserves grey-white interface
Cytotoxic:
Causes: infarct, hypoxia, toxins
CT: more subtle, Blurring of grey-white interface - "insular ribbon sign", Local mass effect - effacement of sulci, narrowed sylvian fissure, thrombosed vessel eg MCA
Canadian CT Head Rule
Sensitivity 99%, Specificity 47% for clinically important findings
Inclusion criteria: GCS 13-15, age ≥ 16y, no coagulopathy, no obvious open skull fx

CT indicated if any of following:
High risk features predictive for neurosurgical intervention
1. GCS < 15 at 2 hours
2. Suspected open or depressed skull fracture
3. Signs of basal skull fracture
4. 2 episodes of vomiting
5. Age ≥ 65

Medium risk features for brain injury detection on CT
6. Amnesia before impact of ≥ 30 minutes
7. Dangerous mechanism (ped vs car, ejected, fall ≥ 3 feet or 5 stairs)

NEXUS II
Sensitivity 97%, Specificity 47% for clinically important findings
CT indicated if any of following:
1. Age ≥ 65 years old
2. Evidence of significant skull #
3. Scalp haematoma
4. Neurologic deficit
5. Altered level of alertness
6. Abnormal behavior
7. Coagulopathy
8. Recurrent or forceful vomiting

MRI Brain
T1: CSF dark, bone light - useful for visualizing normal anatomy.
T2: CSF light, fat/white matter dark - useful for visualizing pathology
FLAIR: useful for evaluation of white matter plaques and demyelination near ventricles

LMN Emergencies – Guillain-Barré Syndrome, Cauda Equina
LMN Sx: wasted muscle, hyporeflexia, fasciculations (spontaneous muscle contractions)

Guillain-Barré Syndrome
Acute demyelinating polyneuropathy; immune mediated attack on myelin sheath of peripheral nerves
May cause secondary axonal degeneration with more prolonged recovery
~75% recent history campylobacter jejun, CMV, EBV, HIV, vaccines
Ascending, Progressive, Symmetrical weakness with areflexia, Motor >>sensory, Autonomic dysfunction
Miller-Fisher variant: cranial nerve involvement (bulbar weakness and eye movts)
Life threats:
- Respiratory failure (detect with spirometry, ABGs. Ventilate if FVC <1 or incr CO_2)
- Autonomic instability (avoid sudden postural changes, care with procedures that provoke parasympathetic responses)

CSF - normal cell count with elevated protein
Nerve conduction studies - peripheral demyelination
Serology - antiganglioside antibodies; inciting infections eg CMV, campy
Mechanical ventilation in 1/3, IVIG 2g/kg for 5/7 or plasma exchange/plasmapheresis
Avoid: sux (assoc with sudden death) – completely contraindicated

Cauda Equina Syndrome
Any lesion/central disc herniation into the cauda equina (below L1)
Spinal cord lesion = UMN signs below level of lesion, LMN at level of lesion
Cauda Equina = LMN signs only
Lower back pain + retention, Bowel incontinence/loss of anal tone, decreased reflexes, Saddle anaesthesia

UMN Emergencies – MS, ALS, MG, Periodic Paralysis

UMN Sx: hyperreflexia, positive Babinksi, increased tone

Multiple Sclerosis
Clinical evidence of lesions separated in time and space without alternative explanation.
Electrophysiology, MRI, Lumbar puncture/CSF: ↑protein with ↑Ig with oligoclonal bands

Myasthenia Gravis
Acquired autoimmune disease with antibodies against nicotinic ACh receptor at NMJ
→ muscular weakness with easy fatiguability
CN 3 palsy, ptosis, impairment extra-ocular movement, Cardiac arrhythmias and AV blocks
Edrophonium (Tensilon) test
Airway is First Priority – follow vital capacity and intubate if necessary

Eaton-Lambert syndrome
Associated small cell lung cancer
MG - fatigue with repetitive movement
Eaton-Lambert - increase in strength with repetitive movement

Meningitis

Strep pneumoniae - G+ive diplococci
N meningitidis - G-ive aerobic diplococci
Grp B strep, E coli: if <3/12
Hib: if non-vaccinated
Listeria: if neonate and immunocomp
Staph: if CNS shunt, open wound, neurosurg
Viral: mumps, coxsackie, enterovirus, herpes, EBV, echovirus, HIV, CMV
Other bacterial: TB, mycoplasma, borrelia, treponema pallidum, brucella
Fungi and parasites: cryptococcus, toxoplasma
Other: sarcoid, SLE, Wegener's

Blood - cultures, PCR - N.meningitidis
CSF - cell count + diff, gram stain, cultures, PCR - N.meningitidis, HSV, enterovirus; india ink stain (crypto)
Urine - strep antigen

Management
If shocked give IVF; SIADH in children - use 50% maintenance after resus
Supportive: seizure control, analgesia, fever control, BSL
Steroids: IV dex 0.2mg/kg Q6h 15-30mins before Abx
Antibiotics: **<3/12:** amox 50mg/kg QID + cefotaxime 50mg/kg QID
>3/12: cefotaxime 100mg/kg loading dose - 50mg/kg QID (max 2g)
In adults: MCQ says ceftriaxone 2g + benpen 1.8g
Aseptic Meningitis/encephalitis: IV Acyclovir 10mg/kg TDS IV
Contact prophylaxis*:* meningococcus/Hib – rifampicin 10mg/kg BD x4

Lumbar Puncture

Indications
Suspected CNS infection
?SAH after normal CT scan > 6hrs
Demyelinating conditions: Guillain Barre, MS
Benign intracranial hypertension (therapeutic)
Contraindications
Skin infection overlying puncture area
? ↑ICP or mass lesion (↓LOC, IIIn palsy, focal neuro deficit, papilloedema, seizures)
Coagulopathy
Immunocompromise
Complications
Uncal or tentorial herniation if elevated ICP

Low pressure headache - reduced by smaller needle, rounded, align bevel with dural fibres, re-insert stylet
Spinal epidural haematoma
Rarely: infection, laceration of intervertebral disc, nerve root injury

Technique
go L3-4; use USS if can't feel IV spaces
22-25G adult (12cm), 22-25G child (6cm), 2cm neonate
20-30deg cephalad; replace stylet before removing; no evidence for immobilisation after

	Normal	Bacterial	Viral	Fungal/TB
Pressure (cmH20)	5-20	> 30	Normal or mildly increased	
Appearance	Normal	Turbid	Clear	Fibrin web
Protein (g/L)	0.18-0.45	> 1	< 1	0.1-0.5
Glucose (mmol/L)	2.5-3.5	<2.2	Normal	1.6-2.5
Gram stain	Normal	60-90% Positive	Normal	
Glucose - CSF:Serum Ratio	0.6	< 0.4	> 0.6	< 0.4
WCC	< 3	> 500	< 1000	100-500
Other		90% PMN	Monocytes 10% have >90% PMN 30% have >50% PMN	Monocytes

Acute Dystonic Reactions
Disturbed balance between excitatory cholinergic and inhibitory dopaminergic
Recent use of antipsychotic or antiemetic. H2 antagonist, erythromycin, antihistamine, SSRI, antimalarial
Oculogyric crisis, Torticollis, Macroglossia, Buccolingual crisis, Laryngospasm
Benztropine (Cogentin) 1-2mg (0.02mg/kg) IM/IV
Diazepam

Raised Intracranial Pressure
ICP = MAP-CPP. Normal ~10mmHg
Cushing reflex: (↑BP, widened pulse pressure and ↓HR).
Indications for pre-hospital hypertonic saline:
Temporising therapy - evidence of critically elevated ICP, rapidly falling GCS, unilateral dilated pupil
Normal pressure hydrocephalus - triad of wet, wacky, wobbly (incontinence of urine, altered, ataxia)
Idiopathic Intracranial Hypertension - Chronic headaches, Young obese women, papilloedema
CT normal, lumbar puncture diagnostic and therapeutic

Head Trauma
Head up 30 deg
Remove C collar when spine cleared
Maintain oxygenation (02 via NP to sats >94%)
Maintain normotension (MAP 70)
Maintain normoglycaemia
Close monitoring for fall in GCS (q15min)
Referral to neurosurgery for urgent OT
If falling GCS:
- mannitol 2g or hypertonic saline 3% 3ml/kg
- intubate and ventilate to low normal pCO2 (35-40)
  - fentanyl 2-5mcg/kg to minimise rise ICP with intubation
  - sux 1.5mg/kg (good intubation conditions rapid onset, less risk hypoxia during intubation)
  - ketamine 2mg/kg (CVS stable, no evidence ICP rise) or propofol
- immediate OT

Treat seizures with benzos
Discontinue offending drug

Subarachnoid Haemorrhage
Risk factors
F:M 2:1; prev SAH; FH; smoking; HTN; CT disorders (Marfan's, Ehler-Danlos) polycystic kidney disease)

Grading system

Hunt and Hess: I: minimal symptoms - 70% survival
II: mod-severe headache; nuchal rigidity; maybe CN palsy - 60% survival
III: drowsy, confused, mild FND - 50% survival
IV: stupor, hemiparesis - 40% survival
V: coma, decerebrate, moribund - 10% survival

Investigation

CT head 97.5% <12hrs, 50% >1/52
Negative CT + LP >99% sensitive
Most sensitive at 12hrs
At 24hrs WCC:RCC ratio 1:1000
WCC might start to rise later due to chemical meningitis
Xanthochromia still present at 2/52, in 70% at 3/52
ECG**:** ST changes in inf leads, wide QRS, prolonged QT, peaked/inverted T waves

Complications

Rebleed
Vasospasm
Hydrocephalus
Other: cerebral oedema; seizures, SIADH

Management

As per 'Head Trauma' +
Treat if MAP >130 or evidence of end-organ dysfunction
Nimodipine: decr vasospasm- 60mg PO Q4h for 1/52
D: analgesia; mannitol
Supportive care: antiemetics; quiet dark room; anticonvulsants; correct electrolytes
Disposition: urgent neurosurg; OT decr risk of re-bleed

CSF Shunt Complications

Disconnection
Migration
Calcification
Blockage
Infection - Staph epidermidis, S.aureus
Peritonitis

Seizures

Status Epilepticus

2+ seizures without full recovery between/5mins continuous convulsive seizures
FBC: incr WBC common
Biochem: AGMA, incr prolactin
In status: Glu, U+E, Ca, Mg, drug screen, anticonvulsant levels, CK, ABG
ECG: long QTc
CT head: ?SOL, ongoing altered LOC, fever, recent HI, PMH Ca, anticoag, ?HIV, >40yrs, partial seizure, focal
LP, EEG, Drug screen

Management

O2, suctioning, coma position, trolley sides up, padded; treat cause
1. Benzo's:
Midazolam 5mg (0.15mg/kg) iv to max 10mg
Diazepam 5-10mg (0.2mg/kg) iv to max 20mg
2. Repeat benzos after 5mins
3. Phenytoin/valproate/Levetiracetam 20mg/kg IV over 30mins
5. RSI with Sux 1.5mg/kg IV + Thiopentone 2-5mg/kg IV or Propofol 1-2mg/kg - 5-10mg/kg/hr
Consider dextrose (5ml/kg 10% dex), pyridoxine

Spinal Epidural Abscess

Direct extension from vertebral osteomyelitis, epidural injections or Haematogenous spread
Risk factors: IVDU, DM, alcoholism, immunosuppression
S. aureus, Pseudomonas, E coli, TB
IV Abx: flucloxacillin 2g (50mg/kg) IV q6h + gentamicin 7mg/kg IV od
Emergency surgical decompression and drainage of abscess

Diphtheria

Acute upper respiratory tract infection
Gram-positive aerobic rod
Pseudomembranous pharyngitis, fever, enlarged anterior cervical lymph nodes - "bull neck" appearance

Effects of toxin

Cardiomyopathy and myocarditis, arrhythmias
Neuritis affects motor nerves - paralysis of soft palate, causing dysphagia and nasal regurgitation, then ocular nerves, peripheral nerves and diaphragm with resulting infection and respiratory failure.
Nephritis and proteinuria
Thrombocytopenia

Management

Antitoxin should be given within 48 hours of onset (horse serum, reactions common)
Barrier nursing
Benzylpenicillin IV is followed by oral penicillin V for 10 to 14 days.
Urgent tracheostomy may be required for respiratory obstruction.
Contact testing: Swab close contacts, treat with a single dose IM benzylpenicillin

Tetanus

Clostridium tetani – anaerobic G+ive rod
Complications: Rhabdo, long bone #, complications of prolonged hospitalisation, aspiration pneumonia
Ix: Wound swab, incr CK
Rx: Supportive; sedation, paralysis, ventilation, benzos, minimal stimulation
Debride tissue; metronidazole
Tetanus Ig: neutralises toxin not yet entered CNS; decreases mortality; give before wound debridement

Immunisation

Tetanus toxoid: 2/4/6/18 months, 5/15yrs, every 10yrs
Tetanus Ig: passive immunisation; 250iu
Immune: at least 3 doses and UTD

Botulism

Clostridium botulinum
Food-borne, Intestinal, Wound botulism
Acute symmetrical, descending, flaccid paralysis
Difficulty swallowing and speaking, D & V or constipation & retention
Patient remains alert
Acute onset of bilateral cranial nerve involvement
Failure of accommodation, pupils fixed in mid position or dilated, blurred vision, ptosis

Management

Respiratory support: Recovery time typically ranges 30-100 days. Tracheostomy may be req
Activated charcoal, Antitoxin

O & G Summary

Ovarian Hyperstimulation Syndrome (OHSS)

Follows superovulation stimulated by hCG and human menopausal gonadotrophin.
Many inflammatory mediators are released and increase capillary permeability and fluid retention.
Abdo pain, N+V, ascites, pleural effusion, renal failure, VTE, ARDS
Investigations: FBC (↑Hct), U&Es, coags, LFT. CXR, pelvic/abdo USS
Management
Prevention: monitoring of oestrogen level & USS and withholding hCG if high risk OHSS.
Mild OHSS: analgesia & ↑oral fluids for hypovolaemia. Settles <7d unless pregnancy occurs.
Mod-Sev OHSS: Strict fluid balance: IV Fluids & correct electrolyte abnormalities, Albumin.
DVT prophylaxis, Analgesia, Antiemetics. Paracentesis. Diuretics. HDU or ICU
Complications: Thromboembolism, ARF, hyperK+, ARDS, ovarian torsion, infection, occasionally fatal.

PID

Hx: dyspareunia, purulent PV discharge, previous PID or STD, hx UPSI, recent instrumentation of uterus
Non-STD:
- Mild: po augmentin + doxycycline 100mg BD 14/7
- Severe: iv ampicillin 2g q6h + gentamicin 4-6mg/kg OD + metronidazole 500mg bd

STD:
- Mild: po azithromycin 500mg stat + po doxycycline 100mg BD + metronidazole 400mg BD 14/7 (if gonorrhoea suspected add ceftriaxone 250mg iv/im stat)
- Severe: po doxycycline 100mg BD + iv metronidazole 500mg BD + ceftriaxone 1g OD

Remove RPOC or IUD
Contact tracing and treat sexual partners
Education re safe sexual practices and contraception
USS: if abscess suspected
Admit if: toxic; severe pain; unable to tolerate PO meds; pregnancy; pre-pubertal; HIV; poor compliance; IUD

Emergency (Post-coital) Contraception

Prevents ovulation/implantation.
Progestogen-only Emergency Contraception (POEC)
Dose: Levonorgestrel 0.75mg PO q12h x 2 OR 1.5mg stat within 120h of SI (ideally<72h)
Failure rate 1.1% if given <72h

Sexual Assault

Triage with high priority, provide immediate privacy
Traumatic physical injuries - ABCs, surgical abdomen, excessive bleeding, other injuries
Advice patient not to eat, drink, change clothes or wash
Analgesia
Contact Doctors for Sexual Abuse Care via Police Control Centre
Warn pt may have to talk to male detective before further medical assessment

Hx: Gynaecological history, Current method of contraception, LMP
Ix: HIV, Hep B (HbsAg, anti-Hbc, anti-Hbs), Hep C, RPR +TPHA, PV swabs, pregnancy test
Colposcopy for photographic recording of injuries
Post-coital contraception
- Morning after pill - Levonorgestrel: 0.75mg stat - 0.75mg at 12hrs; or 1.5mg stat, 85% effective
- Follow-up bHCG

Post-coital disease transmission / STD prophylaxis
- All patients: azithromycin 1 g orally + Hep B vaccine
- High risk: ceftriaxone 250 mg IM single dose + Hep B Ig 400iu
- HIV prophylaxis - risk relates to local prevalence of disease. D/W ID
- ADT

Psychological injuries incl risk of suicide
- Psychological support

Evidence collection - within 72hrs by experienced forensic medical officer

Safe place to go on discharge - involve SW, family, rape crisis group
Counselling, GP
STD - FU in 2/52 for initial test results, in 3/12 for further HIV/Hep B/syphilis tests, 6/12 for Hep C

Anti-D Guidelines

100IU =1.0ml fetal RBC =2.0ml fetal blood
NB: Ideally should quantify volume of FMH in all sensitising events, to ensure enough Anti-D given
= Kleihauer-Betke test

Sensitising Events

Miscarriage, TOP, CVS/amnio, abdominal trauma, antepartum haemorrhage, ectopic pregnancy, delivery

Doses

1st trimester: singleton 250 IU; multi 625IU im
2nd/3rd trimester: 625 IU im
(Routine) 28 + 34 wks: 625 IU, given regardless of doses given for sensitising events
Post-partum: 625 IU (routine)
Should be given </= 72 hrs after sensitising event, But can give up to 10 days after

Assessment of Pregnancy

Assessment of Fetal Wellbeing

Monitor fetal movements (chart)
Fetal HR Doppler
CTG monitoring 4-24hrs
USS to assess for abruption
Kleihauer-Betke test – for evidence of feto-maternal transfusion

Calculation of date of delivery

Naegele's rule - from the first day of the last menstrual period - add 7 days to the date, add nine months

Home pregnancy tests

Detect HCG levels > 500 mIU/mL
Positive by 4 weeks of gestation

Physiological changes in pregnancy:

CVS:

Incr blood volume (40%), incr CO (40%), incr HR – mild tachycardia normal
Decr SBP (10mmHg), decr DBP (15mmHg), decr SVR – mild hypotension normal
Haemodynamics difficult to assess – delayed detection of shock; IVC compression when supine

Resp:

Incr tidal volume (40%), incr minute ventilation – compensated resp alkalosis - decr ability to buffer acidosis
Decr FRC due to elevated diaphragm, rapid desat during intubation
Airway and laryngeal oedema – intubation more difficult
Incr O2 consumption – incr sensitivity to hypoxia
Difficult intubation (adipose, oedema, large breasts, reflux)
Chest drains 1-2 IC spaces higher

GI:

Incr aspiration risk, incr ALP, abdo organs displaced by uterus
Decr GI motility, decr LOS tone

Renal:

Incr kidney size, incr GFR, mild hydronephrosis
Bladder displaced caudally by gravid uterus – more exposed to traumatic injury
Cr >90 indicates renal failure

Haem:

Incr plasma volume/number RBCs/retics/WCC/clotting factors/ESR
Decr Hb concentration, decr plt count
Incr risk VTE

Endo:

Incr insulin – fasting hypoglycaemia; incr metabolic rate

Gynae:

Incr breast size, massive increase in uterine blood flow – risk hypovolaemic shock from placental abruption
Fetal compromise may occur without signs of maternal compromise

Fetal:

Curve shifted L (higher affinity O2) - fetal pO2 doesn't decr until maternal pO2<60, then steep portion curve

Miscarriage

First trimester bleeding ddx

Ectopic pregnancy
Miscarriage (threatened, complete, incomplete, inevitable, septic)
Cervical bleeding (polyp, ectropion, Ca)

Trauma
Endocrine (eg thyroid)
Dysfunctional bleeding

Management

If unstable: ?cervical shock - resus, IVF, atropine 600mcg IV if bradycardic (to max 3mg), speculum ASAP; can consider uterine compression, vaginal packs, compression of abdominal aorta, urinary catheter, ergometrine/oxytocin

Rh prophylaxis

Incomplete / inevitable: women's preference

1. ERPOC – incr infection risk, cervical trauma, uterine perf, intrauterine adhesions
2. Medical – misoprostol 600mcg PO
3. Watch and wait – longer duration of PVB and pain, incr need for blood transfusion

D/C with EPAC referral if: bleeding not severe, easy hospital access, good D/C advice (come back if deterioration, avoid sex and tampons if threatened), cervical os closed, >6/40 with IUP on scan USS before discharge if: can't get to EPAC <72hrs, high maternal anxiety and in-hours, >6/40 with no IUP on USS

Refer gynae if: ?ectopic (unilateral pain, severe, pain, PMH ectopic / tubal surgery / PID), ?actively miscarrying (heavy bleeding / products / USS evidence of miscarriage), unwell, non-viable fetus on USS

Hyperemesis Gravidarum

Persistent severe N+V, onset <20/40 - dehydration, electrolyte imbalance, ketosis, weight loss > 5%
Exclude other causes; weight loss, dehydration; there should be no AP

Investigation

FBC, U+E (incr HCO3 due to vomiting, decr HCO3 due to ketosis), urine (exclude UTI, incr ketones), TSH (exclude hyperthyroidism)

Management

IVF: containing 5% dex
Antiemetics
Thiamine
Admit if: severe dehydration, intolerance of PO intake, ketosis, infection

Complications

Wernicke's encephalopathy
Mallory-Weiss tears, oesophageal rupture
Hyponatraemia
Depression

Ddx

UTI, appendicitis, gastro, DKA, hyperthyroidism

Ectopic Pregnancy

Heterotropic pregnancy: IUP + ectopic; incidence 1:30000 pregnancies; IVF 1:100
Risk factors: Previous tubal STD/surgery, old mum, endometriosis/atropic endometrium, abnormal anatomy, IUD/assisted reproduction, smoking, OCP (esp progestrogen only eg. Norethisterone). Not FH.

Beta-hCG: should incr 2x in 48hrs; beta-hCG + <50% 2/7 suggests ectopic
Bedside: glucose, VBG (rapid Hb check, evidence of shock – lactate), urine (infection), bedside USS – FF, pregnancy assessment
Lab: G+H, Rh status, FBC, coags, U+E, cervical swabs for MC+S, first void urine for gonorrhoea/chlamydia

USS

TVUS: discriminatory zone >1500 (ie. >4.5/40)
TAUS: discriminatory zone >6500 = TAUS (lag behind TVUS by 1/52)

TAUS: Non-cystic adnexal mass + FF = 95% PPV ectopic

Possible diagnoses

Ectopic pregnancy diagnosed if:
- bHCG above threshold + no gestational sac seen on USS
- bHCG positive + adnexal mass visualised

Pregnancy of unknown location diagnosed if:
- bHCG below discriminatory threshold + non-diagnostic USS

Intra-uterine pregnancy diagnosed if:
- Gestational seen within uterus on USS
- Viable if >7 weeks and normal cardiac activity (rate ~160 bpm)
- Miscarriage if > 7 weeks and no cardiac activity seen

Management

1. Determine stability – shocked vs not shocked
   - Shocked = rupture ectopic - Immediate transfer to OT for laparotomy
2. Resus
   - A+B support airway, maintain oxygenation
   - C treat hypovolaemic and cervical shock
     - 2 x large IV. Xmatch. FBC, coags, blood type/Rhesus status
     - Fluid bolus 20ml/kg N saline
     - Major haemorrhage pack if bleeding (4 U O neg , 2 U AB FFP)
     - Speculum + removed products of conception from cervical os
3. Supportive care
   - Analgesia + antiemetic
   - Explanation/reassurance; Involve partner/family
   - Any concerns re sexual assault/child abuse?
     - Offer support/counselling, notify relevant authorities
4. Specific treatment
   - Rhesus D immunoglobulin/anti-D
     - 250 IU in first trimester
     - 625 IU in 2^{nd}-3^{rd} trimesters
   - Rupture/unstable – laparotomy
   - Stable – consider surgical vs methotrexate
   - Pregnancy of unknown location – O&G followup in 48hrs for repeat bHCG and USS
     - Safety netting

Indications for conservative trt (observation): beta-hCG <1000 and falling
Indications for OT: CV instability, cervical pregnancy, ectopic FH activity, >100ml FF in pouch of Dougla

Pre-Eclampsia

1. >20/40
2. BP >140/90
3. Baseline normal BP
4. End-organ damage
   - Proteinuria >300mg/day
   - Prot:Cr ratio >30mg/mmol
   - Derange ALT/AST
   - Raised uric acid levels

Severe Preeclampsia

HTN	BP >170/110
Renal	Proteinuria >1000mg/day
	Spot prot:Cr ratio >100
	Cr >90
Hepatic	RUQ pain (subcapsular liver haematoma)
	Raised bili/ALT/AST
CNS	Severe headaches
	Visual scotoma = occipital cortical ischaemia
	Hyperreflexia + clonus – imminent seizures
	Eclampsia – indication for MgSO4
Haem	Thrombocytopenia, DIC, haemolysis, HELLP
	Schistocytes on blood film
Cardiac	APO

ICH is most common cause of maternal mortality

Risk Factors

Primigravida, PMH/FH, more babies, hydatiform mole, multigravida with new partner, obesity, renal disease, HTN, DM, autoimmune disease, thrombophilia, <20yrs

Assessment

Symptoms: headache, visual disturbance, hyperreflexia, V, epiG pain, weight gain (>2kg/wk), generalised oedema (esp feet, hands, face), pregnant woman with RUQ pain has pre-eclampsia until proven otherwise; should resolve with lowering of BP
Examination: BP, oedema, vol status (depletion), clonus, hyperreflexia, RUQ pain / tenderness (liver haematoma, capsule rupture)
Investigation

Bedside	Glucose, ECG, CTG
FBC	Thrombocytopenia, rising Hb (volume contraction)

U+E	Cr >90 abnormal
LFTs	Raised bilirubin (haemolysis), AST (HELLP)
Uric acid	Raised in PET
Coags	DIC
Urine	Protein 1+ suggests significant proteinuria
	Spot Pr:Cr ratio >30mg/mmol
	24 hr urine collection >300mg/day
Imaging	CXR (ARDS), USS (RUQ pain)
	CT if: prolonged coma, persistent neuro changes, seizure/altered LOC, refractory seizures
CTG	
ECG	evidence of myocardial dysfunction

Management
Delivery is only cure
Call for help – obstetrics, paeds, midwife, ICU, whilst moving to resus bay with monitoring
A/B – 100% O2 via NRB
C – iv access; cautious fluids (APO, cerebral oedema). Treat BP if >179/110
Position – left lateral
Attach CTG/perform US fetal wellbeing

Drugs
Hydralazine – 5mg increments iv q15mins, up to 15mg, infusion 5-10mg/hr, aim 140/80
Labetolol – titrated – issues if asthmatic. 100mg po BD, 10-20mg iv and double to 40 then 80mg iv Q10min to max 220mg – 1-2mg/hr infusion
Nifedipine – may drop BP suddenly, d/w O&G. 10mg po – rpt Q30min then po Q4H
Do not combine with MgSO4 – risk precipitous hypotension
Methyldopa: 250mg PO Q6hrly - titrate up to control BP to max 3g/day
End points: Slow achievement of BP 140/90-160/100
Aim to decr BP by 20% slowly
Improvement in headache
IV MgSO4 4g over 10mins then 1g/hr infusion
Indications: eclampsia/"premonitory signs eclampsia": hyper-reflexia, clonus, headache, visual sx
Endpoints: resolution of seizures
Monitoring: UO/renal function, reflexes, resp rate. Mg level q6h (stop if >3.5 mmol/L)
Side effects: ECG changes (long P-Q/wide QRS/blocks), decr BP, GI upset, resp paralysis
Rx of Mg toxicity: Ca gluc 10ml 10%

Steroids for fetal lung maturation if <34/40 and delivery likely (betamethasone 11.4mg im Q24hr x2)
Treat seizures iv midazolam 5mg
Consider glucose or other causes of seizure
Pulmonary oedema – mannitol 50ml of 20% iv bolus then infusion

Immediate delivery if:
- eclampsia or pre-eclampsia >37/40
- unable to control BP
- abnormal CTG
- placental abruption
- deteriorating renal/liver function
- progressive thrombocytopenia

Supportive Care
Cautious fluid eg 500ml bolus saline for hypotension (risk APO, cerebral oedema)
Correct coagulopathy eg FFP
Continuous CTG monitoring

Disposition
ICU for severe PET/eclampsia

DDx
CVA/ICH, HT encephalopathy, SOL: tumour, abscess; metabolic: hypoglycaemia, uraemia, SIADH/H2O intox; infection; TTP; illicit drug use

HELLP Syndrome

Severe variant pre-eclampsia with Haemolysis, Elevated Liver enzymes and Low Platelets
Symptoms: N&V, epigastric pain prominent, symptoms of pre-eclampsia/eclampsia
Signs: Jaundice, RUQ tenderness, hepatomegaly, easy bruising/purpura
Ddx: Acute fatty liver of pregnancy, TTP, HUS, exacerbation of SLE
Management: As per pre-eclampsia. Dexamethasone; Deliver baby; Plasma exchange if organ failure

Feature	HELLP	TTP/HUS	AFLP
Hypertension	Almost always	Sometimes	Sometimes
Proteinuria	++	+/-	+/-
Glucose	Normal	Normal	Low
Low plts	+++	+++	+++
LDH elevation	++	++++	++
LFTs	++	Normal	++
Fibrinogen	Normal to low	Normal	Normal to low
Schistocytes	Present	Present	Absent
Ammonia	Normal	Normal	Elevated

Antepartum Haemorrhage

Bleeding from genital tract after 20/40 gestation and prior to onset of labour
40% idiopathic, 30% praevia, 30% abruption
Main causes:

Placental Abruption (30% APH)
Bad 4 mum and baby
Painful
Large, dark red PV bleed (but may be concealed)
Tender, firm uterus
Causes: HTN, trauma, smoking, coagulopathy
Ix: CTG, USS, tests for DIC, Xmatch
Complications: DIC, fetal death, maternal shock and death

Placenta Praevia (30% APH)
Bad 4 mum
Painless
Bright red PV blood
Soft, non tender uterus , maternal shock, no fetal distress
Causes: PMH same, prev CS, multiparity, incr maternal age, more babies, prev TOP, smoking
Ix: urgent USS, bloods, Kleihauer
Mx: XM, urgent help, emergeny CS if severe haemorrhage, consider steroids, antiD
Complications: maternal shock, premature delivery

Vasa Praevia
Bad 4 baby
Painless
Small PV bleed
Fetal distress without maternal distress
Risk factors: PP, IVF
Ix: CTG, USS, Apt test (detects HbF in PV blood)
Complications: 75% fetal death
Mx: emergent CS

Uterine Rupture
Rare, high fetal and maternal mortality/morbidity
Causes: obstructed labour, malposition, large baby, prev uterine scar (10x incr risk), grand multiparity, IOL, CT disorders, bicornate uterus
Mng: resus, delivery

Other APH (30%)
Cervical (ectropion, cervical incompetence), polyps, vulval varices, trauma, infection, malignancy, physiological (ie PROM), incidental (lower genital tract)

Management

PV exam contraindicated until praevia excluded by USS - only done if active treatment for bleeding available (ie in OT, under GA, cross matched blood ready, ready for emergency C section)
If shocked/profuse bleeding: 2 large iv cannulae, Xmatch, coag. Transfuse. Refer O&G, theatre on stand
If not shocked/profuse bleeding: U/S

Labour and Delivery

Stages

First Onset of regular contraction - full cervical dilatation: 14hrs primip, 6-8hrs multip
Second Full dilation - delivery: 20-60mins primip, 10-30mins multip, >2hrs prolonged
Third Delivery of baby - delivery of placenta

Too late to transfer if: dilated >6cm in multip, 7-8cm in primip; presenting part on view

Delivery in ED

Call for help early
Hx: Gestational age, antenatal care, progression of pregnancy, past obstetric and medical history
Exam: Vital signs, Gestational age
Progression of labour: Frequency, regularity, duration and intensity of contractions; Sterile PV
Number of babies and foetal well-being
Presence or absence of complications

1. Staff: Prepare 2 teams for delivery (one for mother, one for baby), allocate roles
2. Equipment: neonatal resuscitaire, neonatal resus equipment, suction, BVM, delivery pacl
3. Drugs: syntocinon 10U. Analgesia
4. Call to notify nearest O&G team of patient and risk of imminent delivery in your department

Position - mum in dorsal lithotomy or lateral sims position; wash perineum

Management of 3rd stage of labour

1. Immediate uterine assessment (fundal height/tone, check no twin) and gentle massage
2. Syntocinon 10 U IM
3. Controlled cord traction, delivery of placenta, inspect for complete placenta delivery
4. Assess for bleeding from lower uterine tract and perineum, and repair if required
5. Encourage early suckling of infant to promote uterine contraction
6. Observe for further PV loss over next 1hr

Premature Labour

Labour <37 weeks

Tocolysis

Can only delay delivery by 2-7 days
Purpose:
- allow times for steroids (lung maturity) to work
- allow time for transfer of mother to tertiary hospital

Contraindications: >34/40, pre-eclampsia, abruption, intra-uterine infection, advanced labour, fetal distress

Options

1st line: Calcium channel blockers - oral nifedipine (20mg stat, then 20mg every 30mins, then 20mg 8hrly)
- CIs: heart disease, decr BP, concurrent MgSO4 or salbutamol, anti HTN meds, GTN
2nd line: iv salbutamol infusion
- CIs: arrhythmia, poorly controlled DM or thyroid
Betamethasone 11.4mg im, 2 doses, 24hrs apart
GBS prophylaxis: benpen 1.2h iv then 600mg q4H until delivery
Treat UTI (augmentin)
If foetal distress: Oxygen, Left lateral, IV fluids, Seek advice

Complications of prematurity

Lung disease – lack of surfactant
Feeding difficulties – immature sucking + swallowing reflex
Temp dysregulation
Apnoea – immature resp centre
Jaundice
Neurological disabilities

Shoulder dystocia

Delivery within 5 minutes is essential to prevent asphyxia
IDC
McRoberts manoeuvre – exaggerated flexion of maternal legs resulting in widening of pelvic diameter
Suprapubic pressure – shoulders rotated to a transverse position freeing the obstruction
Wood's corkscrew manoeuvre
Delivery posterior shoulder
Deliberate fracture of clavicle
Zavanelli's procedure – replacing head in uterus and performing a CS

Prolapsed Umbilical Cord

Elevate patient's hips, place oxygen, and wrap the cord in a moist sterile towel. Facilitate stat C-section.

Obstetric Shock

APH
Uterine rupture, Uterine inversion
Amniotic fluid embolism
PE
Adrenal haemorrhage
Septicaemia

Amniotic Fluid Embolism

Sudden SOB, hypotension. 20% seize
May be complicated by ARDS and DIC
O2 +/- CPAP or tube; Deliver baby ASAP; If shocked give fluid. May need Inotropes

Post Partum Haemorrhage

>500ml first 24hrs after NVD or >1000ml after C-section

Causes

Primary:

Tone - uterine atony (70%)
Trauma - genital tract trauma, uterine rupture/inversion
Tissue - retained placenta
Thrombin - coagulopathy
An **EMPTY, CONTRACTED, INTACT** uterus will not bleed in the absence of **COAGULOPATHY.**

Secondary: RPOC, infection

Management

Get help early. All ED treatment = temporising until surgical intervention

1. IV access x2 large bore, cross match. Saline bolus if shocked, Massive transfusion protocol
2. Syntocinon (40IU in 1L saline) and deliver at rate of 10 U/hr
3. Examine and repair perineal tear
4. Rub uterine fundus; Bimanual uterine compression; manually remove placenta
5. Notify theatre, anaesthetics, O&G consultant to attend
6. Consider vaginal packing
7. Correct coagulopathy

Secondary: ABC, fluids, analgesia, ergometrine 0.5mg IV/IM, ampicillin, gentamicin & metronidazole, D&C

Trauma in Pregnancy

Specific Injuries

Fetal distress
Placental abruption (50% major trauma)
Amniotic fluid embolism
Uterine rupture
PROM/premature labour
Feto-maternal haemorrhage
Direct fetal injury

Management

2 patients. 1st priority: mother

Get O+G help (should be part of trauma team)
2 large IV lines. G+H/Rh, FBC, VBG, Kleihauer-Betke (to work out dose of Anti-D if needed), coags
Left lateral tilt
O2 (decr resp capacity), intubate early (decr LOS tone/incr intra-abdo pressure)
Abdo exam: gestational age, contractions, tenderness (?abruption, ruptured uterus)
PV by O+G to look for blood, amniotic fluid (pH 7-7.5), cervical dilation, fetal presentation
XR: no incr risk to fetus if radiation <0.1Gy and >20/40 (ie. Pelvis, chest, C spine OK); CT 0.05-0.1Gy
CTG: 4 hours minimum
Fetal distress- late decelerations, fetal tachycardia, loss of beat-beat variability
USS: FF – uterine rupture, gestational age, fetal wellbeing
DPL: high sens, low spec; misses retroperitoneal injs; safe/accurate in pregnancy via open technique
Rh: anti-D if Rh – mother
Prem labour: give tocolytics (eg. IV salbutamol, MgSO4)
Consider immediate (within 4 minutes) caesarian if mother dies.
Consider domestic violence

Uterus
At 24wks: navel
32wks: ½ way between navel - xiphisternum
36wks: at costal margin
40wks: 1-2 fingers below costal margin (drops as head engaged)

Uterus larger than dates = abruption
Uterus smaller than dates = uterine rupture

Uterine tone: tense = abruption; contractions = premature labour; palpable fetal parts = uterine rupture

Perimortem C section
Complex
Best outcomes if <5 mins from arrest
Survival unlikely if >20mins after arrest
Gestation >23 weeks
Method: vertical incision in abdomen, vertical incision in uterus
MUST continue full maternal CPR
(delivery may improve haemodynamics)

Orthopaedics Summary

General management

Haemorrhage control (1.2-1.5L in femur; 0.5-1L in tibia; 500ml in humerus)
Decontamination: if open; irrigation - early surgical debridement
Analgesia, **ADT**
Antibiotics: fluclox 2g QID; significant soiling/>10cm wound/loss of bone coverage: gent + augmentin
Elevation
Reduction + **Immobilisation**
Urgent OT if: amputation for life saving; uncontrollable haemorrhage; open #; contaminated wound; ischaemia >6-8hrs

Increased risk # infection

Contaminated; STI; debridement delay 8hrs; Abx delay 3hrs
Staph aureus, strep pyogenes; C perfringens

Fracture Complications

Acute
Soft tissue: compartment syndrome, skin necrosis, rhabdo
Nerve: neuropraxia or transection
Vascular: contusion or traction, distal ischaemia, haemorrhage
Bone infection, other bone injuries
Visceral complications
Fat Embolism
Iatrogenic: Complications of anaesthesia, manipulation, hospitalisation, medications

Delayed
Union: Non, Slow, Delayed, Malunion
Traumatic epiphyseal arrest
Joint Stiffness, early OA
AVN
Volkmann's ischaemic contracture
CRPS
Myositis ossificans
Osteomyelitis
Social - Loss of function, mobility, work

Complex Regional Pain Syndrome

Group 1: "Sudeck's atrophy, reflex sympathetic dystrophy"
Group 2: Injury to major peripheral nerve eg gunshot wound/amputation affecting sciatic n.

Ottawa Ankle Rules

Pain in malleolar area +
1: tender posterior edge or tip lateral malleolus
2: tender posterior edge or tip medial malleolus
3: unable to WB 4 steps immediately and in ED

Ankle # Classification

Potts: Uni/bi/trimalleolar; bi and tri and unstable
Weber: Level of fibular fracture relative to tibiotalar joint
Maisonneuve #: Proximal fibula + medial malleolus (or deltoid ligament rupture); unstable; needs OT

Back Pain Ddx

<30yrs: ank spond, RA, OM, discitis, extradural abscess
>30yrs: bony mets, myeloma, lymphoma, renal/pancreatic disease, aortic aneurysm
>60yrs: OP, Paget's, OA, spinal stenosis
Red flags
Recent significant trauma; recent mild trauma >60yrs; prolonged steroid use; OP; >70yrs; PMH Ca; recent infection; fever; IVDU; low back pain worse at rest; unexplained weight loss; nocturnal pain, features of SC compression; ?Ca; ?infection; immunosuppression; >6/52 duration

Cauda Equina

Urinary incontinence/retention (most common symptom; 90% sens, 95% spec) residual >200ml

C5 biceps jerk
C6 wrist extension
C7 triceps, pronator teres
C7-8 triceps jerk
L1-2 hip flexion
L3-4 knee extension, knee jerk
L5 great toe and ankle dorsiflexion, heel walking
L5-S1 SLR test, ankle jerk
S1 ankle and toe plantar flexion, ankle eversion, toe walking
S3 hip extension

Clavicle

Neer classification

I. Middle 1/3 ~ 80% II. Distal 1/3 ~ 15% III. Proximal 1/3 ~ 5%

Indications for OT

Open # or Integrity of skin threatened
Severe angulation or complete displacement of mid-shaft
Floating shoulder with displaced clavicular fracture and unstable scapular fracture
Displaced Neer Type II fracture
NV injury
Unable to tolerate closed management - rare- e.g. Parkinson's, seizures; Unacceptable cosmesis

SCJ dislocation

Posterior dislocation – brachiocephalic/subclavian venous obstruction, tracheal compression, subclavian/brachiocephalic/carotid artery compression

ACJ dislocation

I AC ligament sprain
II AC ligament torn; CC lig sprain; subluxation <1cm; normal CC joint space
III AC and CC ligs torn; >1cm subluxation/>50% widening CC joint
IV As III, but posterior displacement of clavicle
V 200-300% superior displacement
VI Inferior displacement

IV, V & VI = surgery

Scapula

Associated injuries common - high energy
Skeletal – shoulder disloc, clavicle #, rib #s
Pulmonary – PTX or contusion
Brachial plexus or axillary artery injury
Head/neck injuries

Shoulder Anterior dislocation (95%)

Complications

Rotator cuff inj (esp subscapularis; in 86% if >40yrs)
Greater tuberosity or humeral neck
Axillary artery and nerve, brachial plexus
Bankart lesion - avulsion ant glenoid labrum, tear anterior capsule, assoc with recurrent dislocations
Hill-Sachs deformity - compression # post-lat humeral head due to abrasion by glenoid
Reverse Hill-Sachs lesion - compression # anteromed humeral head, posterior shoulder dislocation
Recurrent dislocation

Shoulder Relocation

Kochers - pt seated, flex elbow, traction, ext rot
Milch - supine, extend elbow, traction, abduction + ext rot
Stimson - prone, 5-10kg weight on wrist
Scapular rotation - prone or seated, scapular tip medially
Hippocratic - Traction-countertraction - supine, abduct, sheet axilla, traction on abducted arm
Cunningham - seated, arm adducted/downwards, flex elbow, arm on doc's shoulder, doc's wrist over patient's forearm, massage trapezius/deltoid/biceps, patient to hold 'shoulder blades' together/sit up
Spaso technique - supine, arm lifted vertically, slight external rotation

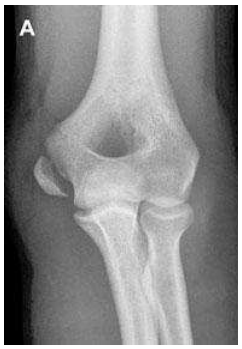
Posterior dislocation
Often associated with posterior glenoid and reverse Hill-Sachs deformity
Reduction
Traction with arm at 90 deg abduction and external rotation; or traction to adducted arm and assistant pushes humeral head anteriorly

Luxatio erecta - **Inferior dislocation**
Complications: significant risk NVI (60% neuro injury, usually axillary)
80% have rotator cuff injury or # proximal humerus

Proximal humerus #
Neer Classification
Displacement = >1cm, Angulation = >45 deg
1 part (no displacement/angulation)
2 part (most common; displacement of 1 element eg fracture of surgical neck or GT or LT)
3 part (displacement of 2 elements; humeral head in contact with glenoid)
4 part (displacement of 3+ elements; dislocations of GH joint)
Complications
Most often axillary nerve related to surgical neck. Also radial or musculocutaneous nn.
Vascular – axillary artery

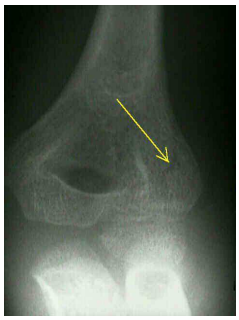
Humeral shaft #
Complications
Brachial artery injury
Radial nerve injury, Also ulnar and median nerves
Displacement (common due to many muscle attachments)

Supracondylar/transcondylar fractures
Gartland Classification
I - non-displaced
II - displaced but posterior cortex intact
III - completely displaced
Complications
Median, radial & ulnar nerve
Brachial artery
Compartment syndrome
Volkmann's ischaemic contracture: neurovasc compromise 2o missed compartment syndrome
Stiffness: early range of motion may prevent or reduce its severity
Cubitus varus – mainly cosmetic
Post-traumatic arthritis: can result from the initial articular impact
Heterotopic ossification



Medial humeral epicondyle # (appears at 5-6yrs)
3rd most common paeds elbow #
50% assoc with elbow dislocation
Needs OT if >1cm of articular surface, or ulnar nerve involvement

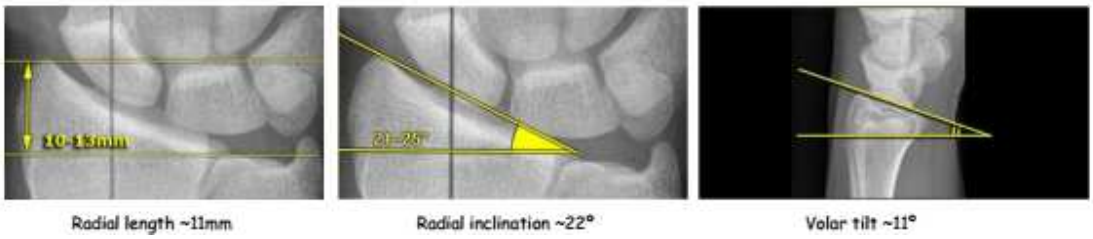
Lateral humeral condyle (appears at 11-12yrs)
Unstable, often also involves all of capitellum and ½ of trochlea
Milch I = Salter Harris IV
Milch II = Salter Harris II (into jt/lat part of trochlea), most common
OT if displaced or ulnar nerve involvement



Elbow dislocation
90% postero-lateral
Complications
1/3 # (coronoid process, radial head)
15% medial epicondyle #
Brachial artery, ulnar nerve
"Terrible triad" = dislocation + radial head and coronoid #
Management - traction, correct med/lat displacement, downward pressure on forearm, flexion with thumbs pushing on olecranon

Epicondylitis (Tendonitis)

Tennis Elbow: Lateral epicondylitis where ext. carpi radialis brevis inserts
Golfer's Elbow: Medial epicondylitis of CFO. Worse on resisted wrist flexion.



Colles

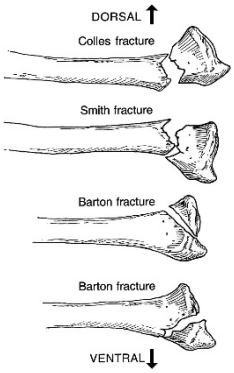
Associated ulnar styloid # in 60% - suggests serious disruption of inferior radio-ulnar joint

Complications

Median nerve compression
CRPS (1-4%)
EPL rupture (3%; due interrupted vascular supply; occurs 4-8/52 later)
Compartment syndrome
Triangular fibrocartilage complex inj; radioulnar and radiocarpal instability

Smith's

distal radius, volar displacement and angulation



Barton's

Dorsal/volar rim # of distal radius extending intra-articularly
unstable as ligamentous injury assoc; ORIF needed

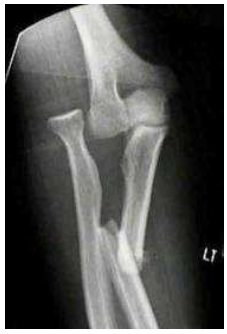
Henderson (Chauffeur's)

Radial styloid #
May be assoc with lunate dislocation, scapholunate dissociation, trans-styloid perilunate dislocation, dorsal Barton's #

Radial head

Classification

I Displaced <2mm; no mechanical block
II Displaced <2mm; >30% radial head involvement; maybe mechanical block
III Comminuted
IV + dislocation



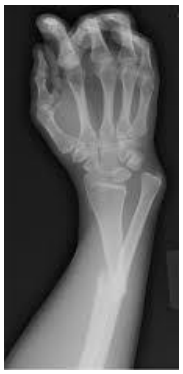
Olecranon

Classification:

I Displaced <2mm; trt conservatively
II Displaced but ulnohumeral joint stable; needs OT
III Displaced and unstable

Nightstick

Midshaft ulna due to direct blow;

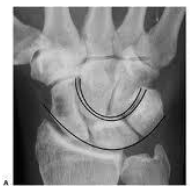


Monteggia

Fracture prox ⅓ ulna with dislocated radial head (anteriorly in 60%)
Complications: interosseous/radial nerve injury; malunion and nonunion; unstable radial head

Galeazzi

Reverse Monteggia
midshaft or distal ⅓ radius with dislocated distal radioulnar joint
Complications: instability DRUJ; ulnar nerve and ant interosseous branch of median nerve



Hume

Fractured olecranon with radial head dislocated anteriorly

Essex-Lopresti

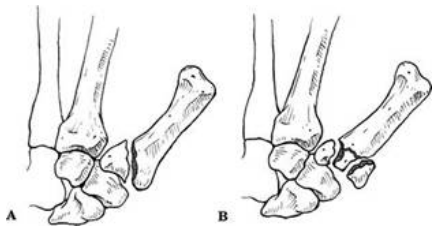
Fractured radial head and dislocation of DRUJ

Radiocarpal joint dislocation

Disruption of Gilula's lines; incr carpal joint spaces >2mm
Lunate dislocation - middle 'c' displaced volar - spilled tea cup
Perilunate dislocation - dislocation of carpus dorsally (Lunate still attached to radius) - lateral view capitate dorsal to lunate
Trans-scaphoid perilunate dislocation: distal scaphoid fragment displaces posteriorly with rest of carpals
Scaphoid dislocations: prox pole goes dorsal, distal goes volar

Scaphoid # - 30% prox pole #'s get AVN, nonunion, CRPS
Triquetrum # - 2nd most common carpal #; avulsion or through body; tender dorsum of wrist
Hamate # - Ulnar nerve inj

Bennett's #



Intra-articular # - dislocation carpo-metacarpal joint of thumb
Management: traction, abduction and pressure over base of thumb
Usually needs K wire fixation

Rolando's #
3 part # base of thumb (T or Y), intra-articular, uncommon, worse prognosis than Bennett's, always need ORIF (= comminuted Bennett's)

Paronychia - Infection between cuticle/lateral nailfold and nail plate - give fluclox; I&D if collection visible
Felon - Infection of distal finger pulp, very painful; I&D if abscess; fluclox

Hand hx: DM, immunosuppression, drugs/allergies, systemic sx, ADT, FB, occupation, handed, Hep B if bite

Radial Nerve
Sensory - dorsal aspect radial two-thirds of hand and thumb
Motor - extension of wrist, thumb, and all finger MCP joints
Ulnar Nerve
Sensory - dorsal and volar sides of medial half of ring finger and entire little finger
Motor - intrinsic muscles of hand: flexion MCPJs, extension IPJs, adduction thumb, wrist flexors
Median Nerve
Sensory - volar aspect of hand and fingers from thumb to radial half of ring finger; dorsal aspect of index, middle, and radial half of ring finger from PIP joint to tip of finger
Motor - thumb opposition

Pelvic Trauma
Complications
Vascular:
Internal iliac arteries intrapelvic - if post ring involvement can lose up to 4-6L blood
Most bleeding is low pressure venous bleeding and bleeding from bone edges
10-15% arterial (from internal iliac)
Shock and death usually due to arterial; if bleeding refractory to resus, likely arterial - angiography
Neural:
Lumbar and sacral plexus
S1-2 nerve roots commonly involved in post element #'s
Impotence in 1/6th sacral #'s
GU:
Bladder or urethral in 16% - If suspect, do retrograde urethrography before placing IDC
High fetal death rate
GI: Rectal injury uncommon
Other: Ruptured diaphragm

Avulsion #
ASIS - sartorius; pain on flexion + abduction
Ischial tuberosity - hamstrings; non-union common; OT needed
AIIS - rectus femoris; can't flex hip
Post spine - erector spinae
Iliac crest - direct violence

Acetabular #
Assoc with sciatic and femoral nerve inj, femoral #, knee inj

Pelvic # Investigations

Pelvic inlet view for ant SIJ inj
Pelvic outlet view for sacrum
Judet view for acetabular #
Retrograde urethrogram

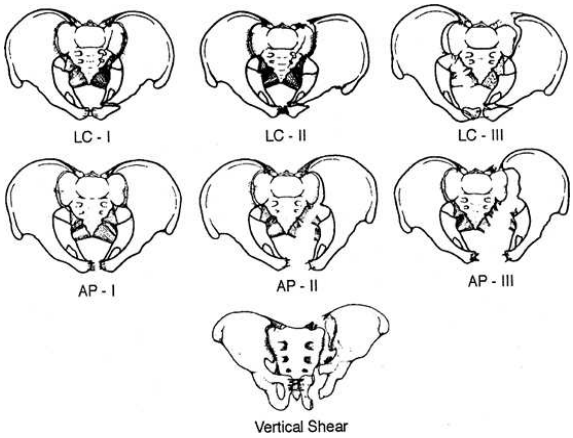
Angiography and embolisation

If continuing blood loss and other sources excluded even if haemodynamically unstable
Only CI'ed if needs laparotomy

Pelvic # Classification

Single break = stable inj; 2 breaks = unstable with risk of displacement

Young- Burgess Classification



LC (Lat compression)

Type I 50% - Most common
Stable (4% bladder rupture)
sacrum on side of impact + pubic rami

Type II Unstable to int rotation
36% severe haem, 7% bladder rupture
iliac wing near SIJ + pubic rami

Type III Unstable (60% severe haem, 20% bladder rupture, 20% urethral inj)
Contralat AP compression inj (open book #), ipsilat lat compression inj (ie. LC I/II)

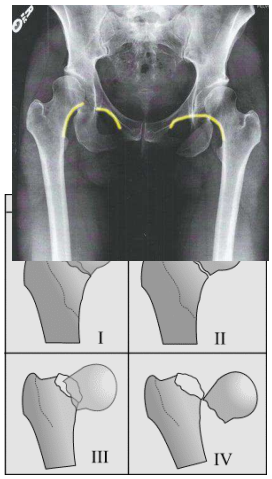
APC (antpost compression)

Type I Symphysis diastasis
Type II Disruption sacrotuberous/sacrospinous/ant SI ligs, intact post SI ligs; wide SIJ; open book
Type III Complete disruption hemipelvis, posterior involvement

VS (vertical shear)

Significant blood loss (75% severe haem, 15% bladder rupture, 25% urethral rupture)

NOF

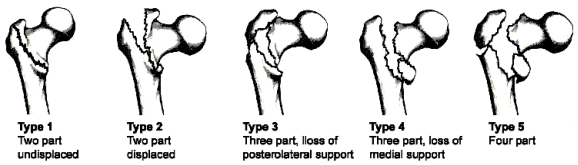


F >M if >60y, otherw
Leg shortened, adducted, externally rotated if extracapsular #
Asymmetry of Shenton's line (sup border of obturator foramen and medial aspect of femoral metaphysis)
Angle to neck of shaft normally 135deg

Classification

Garden 1 - Superior cortex buckled/fractured, Inferior cortex intact
Trabeculae angulated, Non-displaced, stable
Garden 2 - Complete fracture, Trabeculae interrupted but *not angulated*, Non-displaced, unstable
Garden 3 - Complete fracture, Abduction & Rotation of head, Displaced
Garden 4 - Complete fracture, Fully displaced

1-2 have up to 20% AVN
3-4 have worse prognosis than this; 15-35% risk of AVN overall
Garden I-II/all grades in younger patients/extracapsular = internal fixation with dynamic hip screw
Garden III-IV = hemiarthroplasty
Consider THJR in younger patient



Extracapsular

Less risk of AVN; 4x more common; non-union rare; OT easier

Extracapsular - Evans

I - Single #; Minimal displacement
II - Lesser trochanter #
III - Greater + lesser trochanter # + femoral neck separate
IV - # spirals into femoral shaft

Greater trochanter

Direct trauma (older), or avulsion from contraction of gluteus medius (7-17yrs). If displaced >1cm needs OT

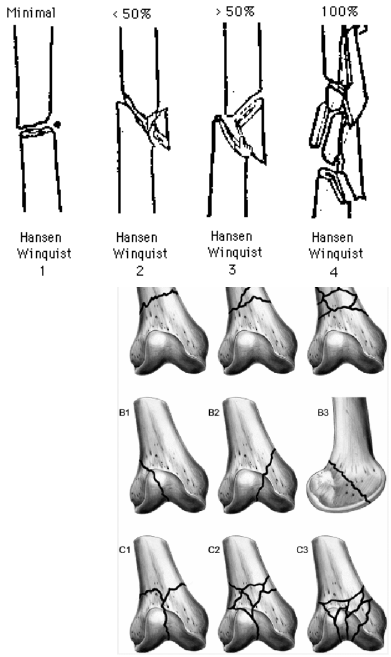
Lesser trochanter

Iliopsoas avulsion. Pain on flexion and int rotation; Ludloff sign (can't raise foot off ground when seated)

Hip Dislocation

Complications

10% AVN
50% acetabular/femoral #
Sciatic nerve injury, femoral head #



Femoral shaft

Winquist classification:

I - minimal/no comminution
II - comminution of <50% circumference of major # fragments
III - comminution of >50% circumference of major # fragments
IV - all cortical contact lost/circumferential comminution segment of bone

Supracondylar

Classification (Muller AO)

A - extra-articular, transverse
B - intra-articular, unicondylar
C - intra-articular, bicondylar - displacement, post angulation, rotation

Femoral condylar

Intercondylar/condylar
Complications - Popliteal artery/deep peroneal nerve (1st web space), DVT, fat emboli

Ottawa knee rules

Pain in knee + >55yrs
tender head of fibula / patella
active knee flexion <90deg
inability to WB 4 steps immediately and at time of assessment

Pittsburgh Knee Rules

Xray if: Blunt trauma or fall plus one of:

1. age <12 or >50
2. unable to walk 4 steps in ED

Adults & children; as sensitive & MORE SPECIFIC than Ottawa; Specificity relatively low

Knee dislocation

40% anterior, 33% posterior, 18% lateral
Spontaneous reduction 50% - high index suspicion esp if ant/post drawer positive

Complications

Nerve - common peroneal (foot drop, lateral foot sensation), tibial
Vascular - popliteal artery
Tendons/ligaments
Compartment syndrome
Joint stiffness, instability

ACL injury

Accounts for 70% haemarthroses
Segond #

Tests:

Lachman (85-95% sens, 100% spec; >5mm positive)
Ant drawer (60% sens, 65% spec; >6mm positive)

PCL injury - Tests: Post drawer (55-85% sens)
LCL injury - Complication: peroneal nerve injury

Meniscal injury

Medial meniscus 2x more common

Tests:

McMurray's test (50% sens)
Apley compression/Grind test (50% sens)

Tibial plateau

Lateral tibial condyle most common (due to valgus stress; assoc with ACL and MCL inj)
Medial plateau inj assoc with PCL and LCL inj

Classification

I Wedge # of lateral plateau
Depression/displacement <4mm
Usually young patients

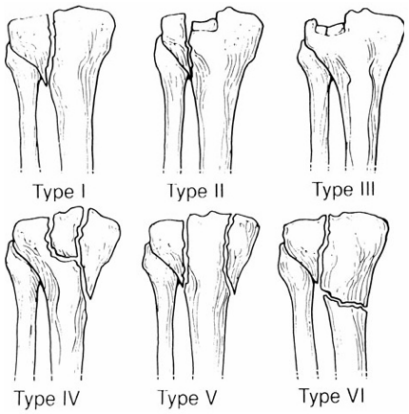
II Split fragment from articular surface with depressed areas
Associated with fibular #; ligament inj in 20%
Usually older patients

III Depression without associated wedge #
Usually older patient with OP

IV Wedge # of medial plateau
Associated with medial meniscus injury
Usually older patients (younger if high energy injury)

V Wedge # medial and lateral plateau

VI Bicondylar # and distal oblique shaft #



Management

I and III - usually conservative
II - conservative if <6mm depression and displaced fragment reduced with traction
IV - reduction and internal fixation

Complications

Peroneal nerve inj; popliteal artery inj; ACL, PCL, MCL, LCL inj, DVT, OA

Tibial shaft

Gustillo classification (open tibial fractures)

I minimal STI, skin lac <1cm

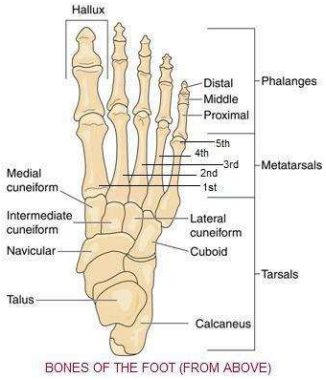
II mod STI; wound 1-5cm; mod contamination

III segmental #, vascular, wound >10cm, highly contaminated

IV total/subtotal amputation

Tibial plafond (Pilon) #

As talus is driven into bottom of tibia; high energy mechanism; often comminuted; often assoc with L1 # and compartment syndrome



BONES OF THE FOOT (FROM ABOVE)

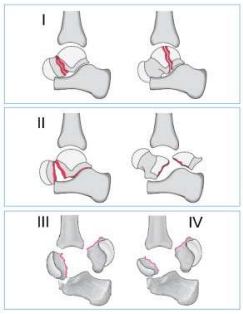
Ottawa Foot Rules

Pain in midfoot zone plus:
1: tender base 5th metatarsal
2: tender navicular (medial)

Ottawa Rules:

Pros: 100% sens, can be used by RNs, decr XR 30%
Cons: not applicable to children or non-cooperative, distracting inj, potential litigation for missed fracture

Talar



Hawkin's classification

I - non-displaced; 10% AVN
II - displaced; ankle joint OK; 30% AVN
III - displaced; dislocation talus from ankle/subtalar joint; 90% AVN; reduce ASAP

Calcaneal

Complications: other #s - other foot/acetabulum, 10% vertebral, 50% chronic pain, subtalar joint instability, early OA, compartment syndrome
Bohler's angle: post tuberosity to highest midpoint/ant tuberosity to midpoint; normal 20-40deg

Lisfranc #/dislocation

Tarso-metatarsal joint. Lisfranc ligament runs lateral base medial cuneiform to medial base 2nd MT

AP: Medial border 2nd MT lines with medial border middle cuneiform

Oblique: Med + lat border 3rd MT lines with med + lat border lat cuneiform
Med border 4th MT lines with med border of cuboid

Complications: dorsalis pedis compression/laceration, RSD, compartment syndrome

Base 5th Metatarsal

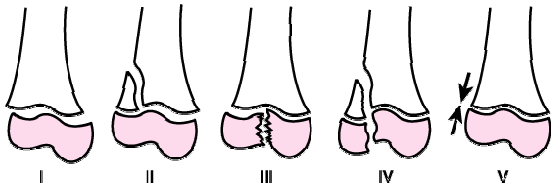
Jones # - intra-articular transverse # base 5th MT, 35-50% non-union
OT if >30% articular surface or >2mm displacement

Pulled elbow

Subluxation of radial head.

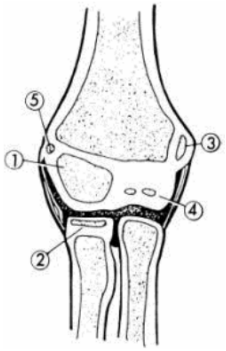
Supination/flexion technique: hold arm with thumb on radial head - supinate and flex arm
Hyperpronation method: hold elbow - hyperpronate forearm with other hand; 95% success rate

Salter Harris injuries



I: **Separate**: through epiphysis; diagnosis clinical
II: **Above**: through epiphysis and metaphysis; most common
III: **Low:** intra-articular # into epiphysis.
IV: **Thru:** intra-articular # into epiphysis and metaphysis
V: **Rammed:** crush/axial loading to epiphysis - prognosis poor

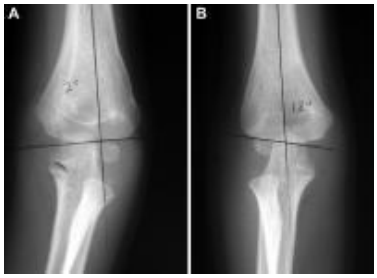
Paediatric elbow



	Appears	Closes
Capitellum	1-3 years	14 years
Radial head	3-4 years	16 years
Int epicondyle	5-6 years	15 years
Trochlea	7-9 years	14 years
Olecranon	9-10 years	14 years
Lat epicondyle	11-12 years	16 years

Paediatric elbow XR interpretation

1. **Ant humeral line** bisects capitellum in middle ⅓ on lateral;
2. Angle between line through centre of capitellum and ant humeral line should be 30-45 deg
3. **Radio-capitellar line**: abnormal in lat condyle, radial neck, Monteggia, elbow dislocation
4. **Baumann angle**: angle between physeal line of lat condyle of humerus and line perpendicular to long axis of humeral shaft = 8-28 deg; supracondylar #
5. **Bowing of anterior fat pad**
6. **Any posterior fat pad**



Supracondylar fracture humerus

Significantly displaced # surgical emergency (brachial artery, median/radial/ulnar nerve; Volkmann's contracture); compartment syndrome

Elbow dislocation: neuro inj in 10%; post most common; ulnar/median nerve inj

?NAI

Clavicular # <2yrs
Mid-humerus # in small children
Femoral shaft # if not yet walking
Metaphyseal # (bucket handle/corner #)
Rib #, esp posterior ribs
Non-parietal skull #
Scapular #
Sternal #

Osteomyelitis

More common in neonates, SCD, open #, chronic ulcers
Usually long bones in young; axial skeleton in adults
Direct spread in children, haematogenous in adults
Staph aureus most common cause (80%)
Neonate (<4/12): staph aureus, enterobacter, grp A+B strep
Children and adults: staph aureus, grp A strep, Hib, enterobacter
Adults: also gonorrhoea (usual cause in healthy adult), E coli
Bloods: incr ESR/CRT in 90%; blood cultures +ve in 50%; WCC not sens
<5yrs: fluclox 25-50mg/kg QID + cefotaxime 25-50mg/kg TDS or ceftriaxone 50mg/kg OD
>5yrs: fluclox 25-50mg/kg QID
Adults: fluclox 2g IV QID for 2-4/52 (6/52 if chronic) (+ cefotaxime 2g TDS if ?G-ves). If MRSA: vanc

Paget's Disease of the Bone

Increased bone turnover in focal areas, 2 phases: lytic, sclerotic
Commonest in pelvis, lumbar spine, long bones, skull
Commonly asymptomatic & discovered by elevated serum ALP or XR

Paediatrics Summary

Weight
1-10yrs: (age + 4) x 2
>10yrs: age x 3
ETT
Mm: (age/4) + 4 (uncuffed) + 3.5 (cuffed)
Length: (age/2) + 12
Observations
BP = (age x 2) + 80
UO = 2ml/kg/hr in infant, 1ml/kg/hr in child

Age	Weight	HR	RR	SBP
Term	3.5kg	110-170	40-60	50-90
1yrs	10kg	100-169	30-40	65-90
6yrs	20kg	70-115	20-25	75-110
10yrs	30kg	60-100	15-20	85-120

Choking
Suspect if sudden onset, cough, gag, stridor
Call for help
Effective cough: encourage coughing
Ineffective cough:
Unconscious - BLS: CPR, direct laryngoscopy
Conscious - 5x back blows - 5x chest thrusts - look in mouth/recheck breathing - repeat
Finger sweep if visible material

Bronchiolitis
RSV (40-70%)
Mod: SOB on feeding, feeding >50%, mod WOB, SaO2 <94%, lethargic, dry, wheeze
Severe: <50% feeds, marked WOB, high O2 requirement, apnoeic episodes, fatigue, insp and exp wheeze
Investigations
Septic screen if <1/12; NPA
CXR: if severe/atypical/complication
Apnoea monitor if <1/12
Management
O2 to SaO2 >92% , NP CPAP
Fluids at 2/3 maintenance
ABx (if secondary infection)
Admit if: <3/12, prem, SaO2 <92%, apnoeic episodes, dehydration, severe WOB, comorbidities, social

Congenital Heart Disease
Non-innocent murmurs: Loud, pan-systolic/diastolic; assoc with symptoms; radiate; not brief
Cyanotic Heart Disease - RIGHT TO LEFT (5T's, 2E's)
Tetralogy of Fallot
Truncus arteriosus
Tricuspid atresia
Transposition of great arteries
Total anomalous pulmonary venous drainage
Eisenmengers
Ebstein's (+ASD + R-L shunt)
Sx: incr RR, polycythaemia; presents in neonatal period; cyanotic spells
Ix: *hyperoxia test:* measure PaO2 - 15min high flow O2 - PaO2 should rise by 20mmHg, if not = cyanotic

Tetralogy of Fallot
1. Large VSD - R-L shunt
2. Pulmonary stenosis - RV outflow obstruction
3. Over-riding aorta
4. RVH

Sx: onset of cyanosis in 1st few wks/mths of life; cyanosed after feeding
Tet spells: caused by RV outflow tract obstruction - R-L shunting through VSD - hypoxic episodes
Rx: 1. O2 100%
2. knees bent posture; rest; abdo compression; calm child
3. morphine
4. IVF 10-20ml/kg

Transposition of great vessels
Only compatible with life if mixing of R and L circulations (VSD, ASD, PDA)
Sx: onset severe cyanosis within hours, unresponsive to O2

Eisenmenger syndrome
L-R shunt - incr pul blood flow - pul HTN - becomes R-L shunt through VSD
Examination: clubbing, cyanosis
No surgical trt available; maintain intravascular vol; avoid hypoxia and vasoD

Duct dependent lesions
Shocked neonate in first few weeks of life, acidosis, hypoxia - doesn't improve with O2
O2 can worsen systemic perfusion. Only give O2 if inadequate tissue perfusion
PGE1 0.1mcg/kg/min
IVF 10ml/kg bolus, NaHCO3, pressors
Give empiric Abx as cannot exclude sepsis

Acyanotic - LEFT TO RIGHT
L-R Shunt: ASD, VSD, PDA
No Shunt: bicuspid AV/congenital AS, coarctation, dextrocardia, PS/TS, Ebstein's anomaly
75% of all congenital heart disease; presents after 1-3/12

Croup
Laryngotracheobronchitis
Parainfluenza, influenza A, adenovirus, RSV
Ix: SaO2, AP CXR - Steeple sign (subglottic narrowing)
Rx: Nurse upright, reassure, O2 if low sats
Dexamethasone 0.15mg/kg PO (max 12mg), adr neb
Westley croup scoring system. 1 good, 4 bad.

Westley croup scoring system
(scoring systems not extensively evaluated)

Stridor	
• None	0
• Only with agitation/excitement	1
• At rest with stethoscope	2
• At rest without stethoscope	3
Retraction	
• None	0
• Mild	1
• Moderate	2
• Severe	3
Air entry	
• Normal	0
• Decreased	1
• Severely decreased	2
Cyanosis	
• None	0
• With agitation	4
• At rest	5
Level of consciousness	
• Normal	0
• Altered mental status	5

Mild (0-2), Moderate (3-6), Severe (>6)

Differential Diagnosis of Stridor
Epiglottitis
Mx: calm, resus room, O2, minimal interaction, ceftriaxone 50mg/kg
Bacterial Tracheitis
Staph aureus, H. influenzae, Moraxella
"toxic croup" - high fever, croupy cough, resp distress, drooling, purulent secretions, pseudomembranes
Anti-staph Abs; >50% intubated
FB, Retropharyngeal abscess, **Diphtheria**

Dehydration and IV Fluids
Assessment of dehydration % body weight lost is gold standard
Mild (<5%): thirst, dry MM, decr UO
Mod (5-10%): as above ++; and lethargy, sunken eyes, decr skin turgor, incr HR, poor perfusion
Severe (>10%): as above +++; and incr RR, decr BP, anuric, SHOCK

Fluid
1. Resuscitation 20ml/kg iv N saline
2. Deficit
   Deficit = %dehydration x weight x 10 ie. 10% dehydration = 100ml/kg deficit
   Na deficit = (135 – Na) x 0.6 x kg
3. Maintenance (4,2,1)
   First 10 kg 4ml/kg per hour
   Second 10 kg + 2ml/kg/hr every kg >10 kg
   Over 20 kg + 1ml/kg/hr every kg >20 kg

   Neonate: 0.45% NaCl + 10% glucose +/- 20mmol KCl/L
   Infant/child: 0.45% NaCl + 5% glucose +/- 20mmol KCl/L
4. Ongoing losses (vomiting, diarrhoea, drains)
   10ml/kg/stool, 2ml/kg/vomit
   Replace previous hour's losses over the next hour

IV rehydration indications
Shock, haemodynamic compromise, altered mental status, ileus, Na >160, osm >350, failure PO/NG
Mild-Moderate
ORT, aim full rehydration within 4hrs; 20ml/kg over 1hr
Consider ondansetron 0.15mg/kg

ECGs Paediatrics

Become more adult-like age 8
RV dominance up to 1-2mths
Rate: relate to question… relative tachycardia normal, rate 140-160 in infant
Rhythm: sinus tachycardia
Axis: RAD
R: poor R wave progression
QRS: right sided dominant, Prominent R in V1, Incr voltages right side
Juvenile TWI V1-V3/4
QTc: shortens with age

SVT

Commonest arrhythmia in kids - Fussy/irritable, poor feeding, pallor, lethargy
ABC/IV/02
VAGAL: ice in plastic bag on face, Ice water in bucket
Adenosine: 0.1mg/kg (incr 0.1mg per dose) to 0.5mg/kg
DCC synch

	Sinus tachy	**SVT**
Rate	< 200	> 200
Variability	Varies	Fixed
P-axis	0-90 degrees	Upright
Return to SR	Gradual	Abrupt
Associated	Fever, pain etc	Poor perfusion

Myocarditis

Lethargy, poor feeding, sweaty, tachypnoea, tachycardia
Hepatomegaly = best sign for CCF in kids. ECG: sinus tachy, frequent VE's, Low QRS voltages, flat/inv T's

Foreign Body Ingestion

Sites of narrowing

Cricopharyngeus C6 (most common site in children)
Oesophagus: thoracic inlet T1 (between clavicles CXR), aortic arch T4, lower oesophageal sphincter T10

Xray

Coins in oesophagus circular (coronal plane), in trachea longitudinal (sagittal plane)
Lodged in oesophagus - endoscopic removal <6hrs (risk corrosion/mediastinitis)
In stomach - review in 48hrs - if still in stomach, endoscopic removal
Do rpt XR if: FB in oesophagus (give food and drink, observe, rpt @24hrs – unless button battery)
High risk object (daily until past duodenum)
Passage times: 25% in 24hrs, 90% in 96hrs

Indications for Endoscopy

Lodged in oesophagus with obstruction, stomach >48hrs, significant symptoms, button battery in oesophagus, airway compromise, gastric battery with no mvmt 2-7/7, gastric coins with no mvmt at 2-3/52
If button battery below diaphragm, can observe at home with FU XR at 4/7

Febrile Child

SIRS: T >38/<36
+ HR >150
+ RR >50
+ WCC >12/>10% bands
Severe sepsis: above + hypotension (<65 infants, <75 children, <90 adolescent)

Most common bacterial causes of sepsis

Neonate: Grp B Strep, E coli, Listeria, C trachomatis; Other G-ive 15-20% (Klebsiella)
<3/12: N meningitidis > Hib > Strep pneum > Grp B strep > E coli > Listeria
>3/12: N meningitidis > strep pneum > Hib

Assessment

Rochester Criteria: <60d/well, no peri-partum/prior illness, normal FBC/urine/CXR - SBI excluded; will miss 1% SBI; least sensitive
Philadelphia Protocol: 29-56d/well, no immunodef, normal FBC/urine/CXR/CSF; sens 98%, spec 44%
Boston Criteria: 28-89d/well, no recent immunisation/Abx, WBC <20, normal MSU/CXR/CSF; 99% sens

Investigation

<6/52, appears well: FBC, blood culture, urine, CSF, CXR; stool if diarrhoea; admit, empiric Abx
<3/12, ?bronchiolitis: urine
<3/12, ?viral: urine and bloods
>3/12, appears well: urine

Management

Fever reduction: decr metabolic demands; improved neuro assessment; symptomatic relief
Sepsis: 10-20ml/kg IV saline bolus; +/- inotrope; hydrocortisone if resistant to inotropes
<3/12: amoxyl 50mg/kg QID (Listeria + Gp B strep)+ cefotaxime 100mg/kg (or Gent 7mg/kg OD)
>3/12: cefotaxime 100mg/kg loading dose

Discharge criteria
Term baby; no co-morbidities; no Abx during illness; WCC 5-15; other Ix normal; responsible carer; high probability of follow up

Febrile Convulsions

Simple febrile convulsion
Generalised TC seizure lasting <15mins with T >38
Aged 6/12 - 6yrs
1/24hr; 1 seizure/fever
No other cause

Management
Seek cause of fever; seek concurrent Abx; investigate as per usual fever; consider Ca/glucose/pyridoxine

1. Diazepam 0.25mg/kg IV / 0.5mg/kg PR or Midazolam 0.15mg/kg IV / IM
2. Repeat after 5mins
3. Phenytoin 20mg/kg over 30mins or Phenobarbitone 20mg/kg over 30mins
4. Thiopental 5mg/kg IV + RSI

If no IV access: paraldehyde 0.3mg/kg PR

Discharge
If simple seizure, now neurologically normal, source of fever OK, sensible parents; close FU if complex

The Limping Child

1-3yrs: transient synovitis; toddler's #; NAI; haemophilia/HSP
4-10yrs: transient synovitis; Perthes; juvenile arthritis; RhF, haemophilia/HSP
11-16yrs: SUFE, overuse
Transient synovitis: 3-8yrs; recent URTI; acute onset, mild-mod Sx; esp internal rotation, otherwise well
Effusion on USS, Lat displacement HTDD hip to teardrop distance
Rx: rest, analgesia
Perthe's disease: M>F; 3-10yrs; AVN of femoral head; 20% bilateral
Gradual onset pain, limp, restricted movement
Risk factors: malnourished, low weight, passive smoking, delayed diagnosis
Rx: physio, surgery if >6 years
SUFE: early adolescence; often overweight; external rotation and shortening
Septic arthritis:
Neonates - GBS, Staph, Gram negative rods (pseudomonas, enterobacter)
Children - Staph, GAS
Young adults - N. gonorrhoea, Staph
Clinical findings: Non-weightbearing, T >38.5, WCC >12, ESR >40
Probability of septic arthritis: 0 findings = 0.2%, 4 findings = 99%

Haemolytic Uraemic Syndrome

Commonest cause ARF <5yrs
90% diarrhoea-related - E coli 0157:H7 (Shiga toxin), salmonella, campylobacter
ARF + microangiopathic haemolytic anaemia + thrombocytopenia
2 weeks after gastro illness - vomiting, bloody diarrhoea, crampy abdo pain, haematuria, oliguria, lethargy
Ix: Incr WBC, anaemia, plt <150, incr Cr/U; stool for Shiga toxin/E coli O157:H7; haematuria/proteinuria/casts
Complications: Anaemia, HTN, encephalopathy, seizures, hepatosplenomegaly, ileus, CCF, intussusception, DM, colitis, electrolyte abnormalities
Ddx: DIC with sepsis, ITP, leukaemia, toxic shock, PSGN
Rx: Supportive and early dialysis; antibiotics not indicated; plt infusion not indicated (may worsen decr plt); may need blood transfusion; admit all. Careful fluid/electrolyte balance; antihypertensives

Gastroenteritis

Viral: 70%; rotavirus, adenovirus, norovirus
Bacterial: 15%; E coli, yersinia, virbio cholerae, campylobacter, salmonella, shigella
More likely if blood/mucus, significant AP, high fever
Parasitic: cryptosporidium (5%), giardia, entamoeba histolytica
Red flags: <6/12, high grade fever, bilious vomiting, abdo pain, no diarrhoea, blood in vomit/stool, drowsy

Meningitis

Meningococcal sepsis bimodal (0-4yrs, 15-25yrs)
Usually haematogenous spread from URTI; can also be direct (OM)

LP
Use non-styleted needle in small infants
Opening pressure: 5 in normal neonate, 8.5 in normal child
CSF Ag tests (Hib and N meningititis)
CT before LP if: FND, decr LOC
CI to LP: signs incr ICP, coma, FND, focal seizures, seizure >30mins, haemo unstable, purpura, coagulopathy, decr platelets, localised skin infection

Other Investigations
Bloods; meningococcal PCR; Ag studies on blood and urine; throat swab for N meningitidis

Management
Shock: 10-20ml/kg N saline (SIADH in 30% so use 50% maintenance after resus)
Treat seizure, fever, hypoG, hypoNa (fluid restriction if Na <135), incr ICP
Give Abx before LP if there will be >20min delay to LP
Dexamethasone: 0.25mg/kg IV/IM Q6h for 48hrs
<3/12: amoxyl 50mg/kg QID (TDS if <1/52) + cefotaxime 100mg/kg loading - 50mg/kg QID (BD if <1/52) or gentamicin 7.5mg/kg TDS (BD if <1/52)
>3/12: cefotaxime 100mg/kg loading dose - 50mg/kg QID or ceftriaxone IM 100mg/kg loading dose
Contact prophylaxis: Meningococcus/Hib – rifampicin 10mg/kg BD x4

NAI

Shaken Baby Syndrome
Suspect: coma, seizures; SDH, Retinal haemorrhages
Injuries
Bruises, Burns: immersion, #
Suspicious if multiple sites and ages; if history doesn't equal pattern and <1yrs ~ 75% NAI
Metaphyseal # long bones; scapula, spinous process, sternal, rib (multiple posterior), skull
Suspect
Child: detached, depressed, hostile, defensive, poor eye contact, delayed milestones (esp language)
History changing, Signs of neglect
Investigations
Bloods: coag; FTT work up
Urine
Imaging: CT head; skeletal survey (in all children <2yrs; in selective children 2-5yrs; not required >5yrs)
Management
Suspect - diagnose - treat injury - address safety issues, report, document - arrange FU

Neonatal Problems

APGAR Score
Designed to determine need for resus, NOT predict long term outcome

	0	**1**	**2**
Appearance (colour)	Blue/pale	Body pink/extremities blue	Pink all over
Pulse	Absent	<100	>100
Grimace (reflex irritability)	No response to stimulation	Grimace/feeble cry	Cry
Activity (tone)	None	Some flexion	Good flexion
Respiration	Absent	Weak cry	Strong cry

1 Minute: correlates with acidosis; survival
5 Minute: correlates with neurological outcome
<4: intubation required

Perinatal asphyxia
Umbilical artery pH <7; 5min Apgar <4; neuro probs; MOF
Premature Birth
VLBW <1500g; ELBW <1000g

Respiratory Distress Syndrome
aka Bronchopulmonary Dysplasia (BPD)
Most surfactant made >32 weeks
Features: tachypnoea, retractions, use accessory muscles, diffuse crackles or wheeze
BPD spells - sudden onset severe hypoxia and reduced chest wall movement

Apnoea of Prematurity
Respiratory pause >20 sec or any pause associated with cyanosis or bradycardia
Affects nearly all infants born <30/40, usually resolves by 37/40
Usually occurs at day 5-7 postpartum. May require caffeine or ventilation

Crying Baby
Median 2.75hrs/day, wide variety
Causes: feeding difficulty, GOR, sepsis, constipation, intussusception, NAI, corneal abrasion, hair tourniquet, metabolic crisis

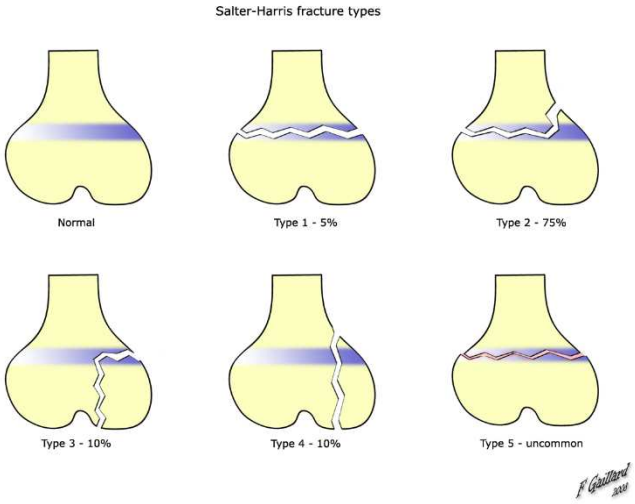
Neonatal Jaundice
Pathological if within 24 hrs or conjugated bilirubin
Due to biliary obstruction, incr haemoglobin load, or liver dysfunction
Unconjugated Hyperbilirubinaemia
< 24 hrs: (Rarely presents to ED)
- **Sepsis**
- **A**BO/Rh incompatibility
- **B**irth trauma/bruising
- **C**ongenital Infection (TORCH) - Toxo, Rubella, CMV, Herpes

Day 2 to 7:
- **SEPSIS**
- Physiologic (peak date 2-4, decr by day 7) = Haemolysis of fetal RBC
- Infection (TORCH)

> 1 week:
- **SEPSIS**
- Other infections; Congential - Rubella; Hepatitis
- Haematological - Sickle cell, spherocytosis, G6PD
- Surgical - Biliary Atresia
- Endocrine - hypothyroidism
- Breast Milk Jaundice
  - Substances that inhibit glucuronyl transferase
  - Ceasing feeding - decrease in Bilirubin in 2-3 days
  - Unlikely to cause kernicterus
  - Can treat with Photo-Rx

Investigations
In a well baby with jaundice, and no signs of serious underlying illness:
ie none of: onset <24hrs, pallor, unwell, hepatomegaly, abdo distension, failure to thrive, poor feeding
RCH guidelines - NO investigation, review if not improving by day 14
If any of above present investigate:
1. glucose
2. SBR
   - Conjugated
     - often dark urine/pale stool
     - always pathological
     - >25% total or >25umol/L
     - Causes: Biliary atresia, hepatitis, galactosemia
   - Unconjugated
     - associated with neurotoxicity
     - Early Prematurity, bruising, Rh/ABO Incompatibilty
     - Late Breast Milk, Haemolysis, Sepsis, Hypothyroidism
     - >350 admit
3. FBC + film + retics - Haemolysis, incr WCC in sepsis
4. TFTs
5. Urine culture + reducing substances

Paediatric Orthopaedic Injuries



Salter Harris

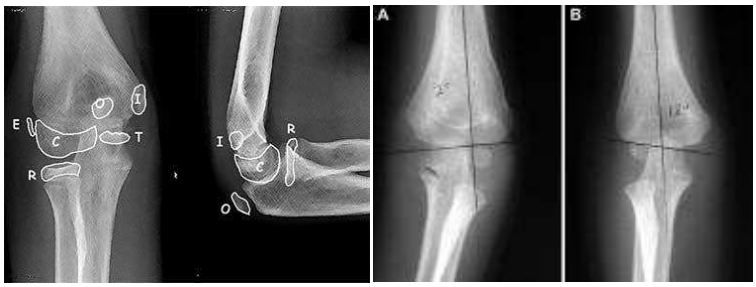
I: **Separate**: through epiphysis
II: **Above**: through epiphysis/metaphysis
III: **Low:** intra-articular into epiphysis.
IV: **Thru:** intra-articular into epiphysis/metaphysis
V: **Rammed:** crush/axial loading to epiphysis

Paediatric elbow

Capitellum	1-3 years
Radial head	3-4 years
Int epicondyle	5-6 years
Trochlea	7-9 years
Olecranon	9-10 years
Lat epicondyle	11-12 years

XR interpretation

Ant humeral line bisects capitellum middle ⅓; abnormal in supracondylar #, lat condyle
Radio-capitellar line: abnormal in lat condyle, radial neck, Monteggia, elbow dislocation
Baumann angle: angle between physeal line lat condyle humerus and line perpendicular to long axis humeral shaft = 8-28 deg; decr angle varus deformity; abnormal in supracondylar #
5. Bowing of anterior fat pad
6. Any posterior fat pad



Supracondylar fracture humerus

Significantly displaced # surgical emergency (brachial artery, median/radial/ulnar nerve at risk; Volkmann's ischaemic contracture; risk of compartment syndrome)

Gartland classification

distal 1/3 humerus - Type I, II, III
Type I: undisplaced #, evidence of joint effusion

Lateral condyle

Appears at 11-12yrs
Unstable, OT if displaced
Milch I = Salter Harris IV; Milch II = Salter Harris II (into joint and lateral part of trochlea)
Ulnar nerve involvement

?NAI

Clavicular # <2yrs
Mid-humerus # in small children
Femoral shaft # if not yet walking

Paediatrics Assessment

Airway Upper

Large occiput, short neck
Short mandible, posteriorly angled epiglottis
Relatively large tongue, anterior larynx
Floor of mouth easily compressible
<6 months - obligate nose breathers; 3-8 years - adenoid/tonsil hypertrophy

Airway Lower

Larynx at C2-3 (C5-6 in adults)
Cricoid narrowest and prone to oedema
Trachea short and soft - over-extension may compress

Breathing
Upper and lower airway relatively small - more prone to obstruction (Resistance = 1/radius cubed)
Rely mainly on diaphragmatic breathing - less type I (slow twitch) fibres = more prone to fatigue
Ribs lie more horizontally, contribute less to chest expansion. Tolerate flails poorly
Large force required to cause fractures - can have serious pulmonary contusions with no #s
Incr metabolic rate, incr O2 consumption = incr RR
Chest wall compliance > lung compliance - causes sternal/intercostal recession
O2 dissociation curve shifted to left

Circulation
Blood volume 70-80ml/kg (more than adults); Actual volume small, small volume loss can be serious
BSA:Weight ratio decreases with age. ie small child: incr ratio = loss heat rapidly
Stroke volume low (1.5ml/kg at birth) but highest Cardiac Index (300ml/min/kg) (adult 70ml/kg/min)
As stroke volume small and relatively fixed, CO proprotional to HR
Bladder intraabdominal (more easily injured)

Immune System
Immature at birth - relatively prone to infection
Maternal Ab cross placenta - decreased protection over 1st 6/12
Receive some Ab from breast milk

Developmental milestones

Neonate:	lift head, fix for period	
6/52:	smile, follow past midline	
4/12:	roll over	
6/12:	sit, transfer toys between hands	
1yr:	walking	single words
2 yrs:	throw and kick ball, stack blocks, dress	word combinations
3yrs:	ride bike, climb, self feed, play in groups	simple sentences
4yrs:	hop, copy shapes, toilet trained	make conversation
6yrs:	tie shoes, skip, play team games	read and write

History Warning Bells
Child taking less than 50% of normal fluids
Prolonged lethargy
No urine output six hours
Prolonged irritability or inconsolability, lethargy
Report of cyanosis, pallor, seizures or significant apnoea
Nursing staff feel the child is 'just not right'
Unplanned re-presentations
Parental concerns out of proportion to child's illness
Brought in by ambulance
History not compatible with injury/ ?non-occidental injury

Examination Warning Bells
Pale, floppy, drowsy
Alteration in vital signs, early signs of compensated shock
Tiring child with respiratory distress
Never smiles despite appropriate prompting
Looks sicker than the usual child with gastroenteritis/croup/bronchiolitis/URTI
Non-blanching rash – petechiae/purpura-sepsis
Bulging or full fontanelle - raised ICP
Bilious vomiting - bowel obstruction
High pitched cry – meningitis; Grunting - respiratory distress

Observation Warning Bells
Decreased level of alertness, activity, eye contact
Drowsiness or decreased interaction with the environment/parents
Abnormal posture, Abnormal quality of cry
Prolonged irritability or inconsolability
Ongoing pallor
Decreased peripheral perfusion or hydration appearance
Persistence of abnormal recorded vital signs
Respiratory distress/tachypnoea ('quiet' or 'noisy')
Persistence of examination warning bells
Confounders - post vomit/seizure, high fever, normal sleep, anxiety

Paed specific history

Perinatal history: antenatal history, birth details, prematurity, neonatal probs
Developmental milestones: height, weight and head circumference
Immunisations, feeding, nappies, siblings
HEADSS screening questions: Home, Education, Activity, Drugs, Sexuality, Suicide, Self determination

Pneumonia

Strep pneumoniae most common bacterial cause; Mycoplasma up to 30%
Atypical pneumonia (Mycoplasma, C pneumoniae)
Staph - Rapidly progressive - high fever, toxic, abscesses, cavitations, pleural effusions, empyema
C trachomatis - Staccato cough
B pertussis - Paroxysmal coughing, gasping, colour change (apnoeas and bradycardias), URTI
Pneumococcal - Round pneumonia
Apnoeas: more common in RSV, chlamydia, B pertussis
Effusions: strep pneumoniae most common cause; also mycoplasma, Hib

Antibiotics

<3/12: amoxicillin 50mg/kg QID (TDS if <1/52) + cefotaxime 100mg/kg loading - 50mg/kg QID (or gent)
>3/12: amoxicillin 30-50mg/kg TDS
>3/12, complicated: augmentin 30mg/kg TDS + clarithromycin if severe (for atypicals, mycoplasma)
>3/12, unwell: fluclox 50mg/kg QID IV (cover staph) + cefotaxime 50mg/kg QID IV
Mycoplasma: roxithromycin 4mg/kg BD PO for 7-10/7
Staph: flucloxacillin 50mg/kg QID IV

Scarlet Fever

Group A beta-haemolytic strep - erythrogenic toxin
Incubation: 2-4/7 (short)
Acute onset fever, sore throat, headache, V, AP - exanthem develops over 1-2/7
Red tonsils and pharynx covered in exudates
Strawberry tongue
Haemorrhagic spots on soft palate
After 12-48hrs - Red, finely punctate 1-2mm blanching papules (rough sandpaper) on neck, axillae, groin Rapidly spreads to trunk and extremities
Fades at 6/7. Desquamates at 2/52
Complications: OM, sinusitis, rheumatic fever, post-strep GN
Investigations: ASOT, swab
Management: Penicillin 10/7

Kawasaki disease

<5yrs
Most common cause of acquired paediatric heart disease
Systemic vasculitis medium sized vessels of unknown cause (likely post-infectious)
Diagnostic Criteria
Fever >5 days
⅘ of: bilateral non-exudative bulbar conjunctival injection
pharyngeal oedema/red cracked lips/strawberry tongue
cervical lymphadenopathy
diffuse erythema and swelling of hands and feet, then desquamation
polymorphous generalised rash
Also: arthritis, hepatitis, AP, D+V, urethritis, aseptic meningitis, pericardial effusion, arrhythmias, carditis, CCF
Phases
Acute febrile phase: weeks 0 - 2; myocarditis, pericarditis, pericardial effusion, valvular dysfunction, LV dysfunction, arrhythmias; MI; conduction defects; coronary arteritis begins
Subacute phase: weeks 2 -3
Convalescent phase: weeks 4 - 6
Investigations
ECG: non-specific ST-T waves changes; CXR, ECHO
Bloods (anaemia, decr alb, incr plt/WBC/ALT/ESR/CRP), ASOT / anti-DNAase B
Urine (sterile pyuria)
Complications: Coronary artery aneurysms
Treatment: Supportive, IVIG 2g/kg over 12hrs, High dose aspirin

Measles

Incubation average 10/7, Patient infectious 5/7 pre-rash to 4/7 after rash
Fever >38
Rash: starts behind ears/hairline, spreads downwards, incl palms/soles
Erythematous maculopapular, red blanching, confluent, desquamates after 3/7
1 of cough, coryza, conjunctivitis, Koplick spots
Complications: OM, pneumonia, encephalitis, subacute sclerosing panencephalitis; myocarditis, nephritis
Investigations: Swab for PCR, blood for serology (IgM = infection, IgG = immunity)
Treatment: Supportive; need infection control measures; notifiable disease
Prophylaxis: Non-immune: MMR if <72hrs (not pregnant); if immunocomp/pregnant/>72hrs, consider Ig

Henoch Schonlein Purpura

Most common vasculitis of childhood
Triad: Non-thrombocytopaenic purpuric rash + Abdominal pain + Arthralgia
Age 3 - 15 (peak 5 years)
Hx preceding viral infection or group A strep
WELL appearing - afebrile
Palpable purpura - extensor surface buttocks and leggs
AP (+N/V/D), 50% bloody diarrhoea, Migratory polyarthralgia, Renal failure, Generalised oedema
Investigations: Urine analysis (haematuria, proteinuria). Check for HTN (nephritis)
FBC (normal or high platelets, renal function, strep testing), creatinine
Management: NSAIDs for pain; Steroids if GI bleed, severe abdo pain
Complications: Renal, GI bleed, intussusception, orchitis
DDx: Meningococcaemia, Kawasaki disease, endocarditis, infectious, rubeola, strep infection, RMSF

Enteroviruses

Hand, foot and mouth disease
Fever, anorexia, malaise, sore mouth - 1-2/7 later, oral lesions - then cutaneous lesions
Oral lesions: painful 4-8mm vesicles on erythematous base on buccal mucosa, tongue, soft palate, gingiva
Cutaneous lesions: 3-7mm red papules - grey vesicles on palms and soles - heal in 7-10/7
Hydration, analgesia, mouthwash
Coxsackievirus (herpangina)
Fever, mouth pain, oral ulcers
Similar ulcers to hand, foot and mouth; but no skin lesions

Rubella

Incubation 12-25/7
Fever, malaise, headache, sore throat, pink macules and papules on face, spreading to neck/trunk/arms
Supportive management

Erythema Infectiosum (Fifth disease, Slapped Cheek)

Abrupt appearance of rash - fiery red rash on cheeks; diffuse erythema of closely grouped tiny papules on erythematous base; edges slightly raised; circumoral pallor; sparing of eyelids and chin; lasts 4-5/7
1-2/7 after face rash - non-pruritic macular/maculopapular erythema on trunk and upper limbs - spreads
Lasts 1/52; spares palms and soles; fades with central clearing
Assoc with fever, malaise, headache, sore throat, cough, coryza, N+V+D, myalgia
Supportive management

Herpes

Transmission: HSV-2 genital, HSV-1 oral
Herpes labialis, gingivostomatitis – painful umbilicated vesicles - unroof/crust over
Eczema herpiticum – break out on area previously affected by eczema
Herpetic whitlow – distal fingers
Management: Consider sexual abuse. Oral acyclovir; supportive

Chicken Pox

Starts on trunk/scalp as faint red macules - vesicular in 24hrs, on erythematous base - dry and crust
Palms and soles spared
Supportive if uncomplicated; antivirals only if immunocompromised

Roseola Infantum (Sixth Disease)

Fever, cough, coryza, anorexia, abdo pain

Fever settles - appearance of rash - Erythematous, blanching, maculopapular eruption, discrete rose/pale pink 2-5mm lesions; most on neck, trunk, buttocks
No MM involvement
Supportive management

Petechial rash differential

Infection - bacterial, viral, rickettsiae
Mechanical - coughing, vomiting, local pressure, tourniquet, NAI
Haematological - thrombocytopenia (ITP, leukaemia, hypersplenism), platelet dysfunction
Vascular - HSP, scurvy, drugs - steroids, Cushings, fat embolism

SUDI and ALTE

SUDI: sudden unexpected death of infant (<1yr)
ALTE: apparent life-threatening event

Risk factors SUDI

Maternal: young mum, maternal smoking during pregnancy, no prenatal care, substance abuse, smoking
Child: LBW, prem, twins, FH SIDS, prolonged QTc
Enviro: winter, URTI, warm room, tight blankets, prone sleep, soft surface, bed sharing, overheating

Causes apnoeas

NS: central, seizures
Infections: meningitis, encephalitis, pertussis, pneumonia, RSV
Metabolic: hypoG, hypoCa, inborn errors of met, GORD
Cardiac: SVT, congenital heart disease
Other: periodic breathing, NAI, breath holding attack, ICH, botulism, drugs

Investigations

Septic screen, apnoea monitoring

Do not attempt resuscitation if: Rigor Mortis, Livedo reticularis, pH <6, Significant hypothermia

Paediatric Surgical Problems

By Age

0-3/12: necrotising enterocolitis, malrotation, incarcerated hernia, testicular torsion
3/12 – 3yr: intussusception, testicular torsion, gastro, constipation, UTI, HSP, trauma, volvulus, appendicitis, toxic megacolon, vaso-occlusive crisis

Necrotising enterocolitis

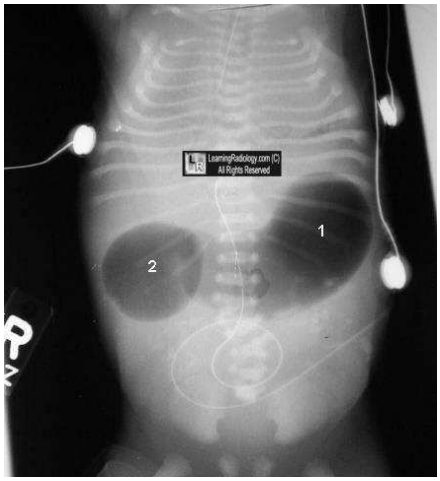
Usually affects prems/LBW, but can also occur in full term
Sx: non-specific, abdo distension, tenderness, pneumoperitoneum, sepsis, feed intolerance, bloody stools
Ix: septic screen; AXR (dilated loops bowel, pneumatosis intestinalis, hepatic portal air)
Management: bowel rest, aggressive IVF, broad spectrum Abx, ICU

Paediatric appendicitis score

Migration of pain, anorexia, N/V, fever, cough/percussion/hopping pain, RIF tenderness, WCC >10
>6 = 93% sens, 70% spec; <2 = not appendicitis

Malrotation/volvulus

<3/12, 2:1 M:F
Irreversible ischaemia after a few hours
Sudden, constant pain, bilious vomiting, distension, shock, peritonitis
Ix: AXR - double-bubble sign, paucity of gas with air bubbles in duodenum/stomach, loop of bowel overriding liver, obstruction; upper GI contrast series (narrowing at obstruction site = bird's beak); USS
Management: emergent OT



Intussusception

Most common cause of obstruction 3 months - 3 yrs
Peak 5-10/12; 4:1 M:F
Small bowel segment invaginates into lumen of more distal bowel - venous congestion - bowel ischaemia - wall necrosis - perforation; often assoc with adenovirus
Causes: 90% idiopathic; some due to Meckel's, polyps, lymphoma, HUS, CF
4 classic symptoms: vomiting, abdo pain, abdominal mass, bloody stool

Episodic severe distress, palpable sausage-shaped mass (RIF/RUQ; red-currant jelly stool, D/V
USS (sens 96%, spec 97%) – donut sign, target lesion
Indications for air enema: <24hrs duration, no peritonism/toxicity, no blood on PR
Management: IVF; NG; air enema works in 75%; if air enema not work, needs OT

Hirschprung's disease
4:1 M:F Absence parasympathetic cells from myenteric plexus; prox bowel hypertrophies and distends
Acute obstruction in neonatal period; failure to pass meconium within 24hrs, bilious vomiting
Rx: OT

Pyloric stenosis
4:1 M:F; usually 2-8/52
Non-bilious projectile vomiting of feeds; hungry - feeds after vomit; upper abdo distension with peristaltic wave and succussion splash; palpable olive shaped mass >1cm in RUQ; dehydration, failure to thrive
Ix: hypochloraemic hypoK metabolic alkalosis; USS
Management: IVF; trt electrolyte probs; OT - Ramstedt pyloromyotomy

Colic
Excessive unexplained paroxysms crying in healthy infant (cry >3hrs/day, >3 days/week, >3/52)
Starts in 1st week, peaks 2nd month, resolves by 3-4 months
Instruct in proper feeding practices; 1/52 trial of hypoallergic milk if severe; reassurance

Vomiting in Infants
Newborn with mucosy clear froth: oesophageal atresia - can't pass 10F feeding tube beyond 10cm
Newborn to 2 days with bilious vomiting: intestinal atresia or Hirschsprung's - rule out sepsis, AXR
Infant with bilious vomiting: malrotation - Surgical emergency - risk necrosis of small bowel
Other causes of bilious vomiting: Intestinal atresia, Anorectal anomalies, Meconium ileus, Hirschsprungs, Malrotation with volvulus, hernia, Intussusception, Inflammatory (appendicitis, Meckel's), Adhesions

UTI
Most common SBI
84% E coli, 6% proteus, 5% klebsiella, 3.5% enterococcus
Urine: Send for culture + microscopy if suspect UTI, bag spec (screen only), clean catch, CSU, SPA
SPA: must have at least 15ml on USS, 1cm superior to pubic symphysis with 23G needle, pref USS guided
Blood cultures: do if positive urine and <1yr, or ill enough to require admission
LP: consider if <1/12
Renal USS: as inpatient if atypical UTI/not responding/<3/12 admitted, as outpatient within 6/52 if <1 year DMSA scan: do if abnormal USS to look for scarring
MCU: do if <3/12 or if abnormal USS
Admit if: <6/12, septic, significant underlying disease, urinary obstruction, pyelo, failure to respond PO's
Antibiotics:
<3/12, CNS not excluded: amoxil 50mg/kg TDS + cefotaxime 100mg/kg loading - 50mg/kg QID
<3/12, CNS excluded: amoxil 25mg/kg TDS (ceftriaxone 25mg/kg BD if pen allergy) + gent 7.5mg/kg OD
>3/12: gent 7.5mg/kg OD (max 360mg) IV or cefuroxime 25mg/kg/dose IV
Well child: augmentin 10mg/kg TDS or cotrimoxazole 4mg/kg BD (10/7 <1 year, 7/7 older/pyelo, 3/7 well)

Psychiatry Summary

General Approach

SACCIT
S – Safety
A – Assessment
C – Confirm provisional diagnosis
C – Consult
I – Immediate treatment
T – Transfer of care

Agitated Patients

Safety
Self, staff, other patients, violent patient
Back-up - security/police
Prevent escalation – see early, show force, set limits, up triage, area
De-escalation/distraction
Legal issues - Duty of care allows for involuntary sedation/restraint if immediate danger to patient/others
Restraint - verbal, show of force, physical 6 pt arrow, chemical PO IM IV
Assessment
Exclude organic cause
Assess for precipitants of behavioural disturbance
Assess risk factors for violence (history, impulsive, young men, substance abuse, personality disorder, psychosis)
Look for signs of impending aggression (angry speech, pacing, restless, threats, agitation, delusions, drugs)
Confirmation of provisional diagnosis
Consultation
Immediate treatment
Transfer of care - likely to need inpatient admission

Sedation

Oral preferred, IV more predictable/faster but requires iv access
Aim for rousable sleep
Ideally in area where access to patient, monitoring and resus equip is maximized.
Staff to wear PPE.
Check for allergies, pregnancy, previous adverse reactions if possible
iv benzo +/- haloperidol or olanzapine
Beware hypotension, dystonic reactions, resp depression
Risk of injury to/from patient, restraint asphyxia, needle stick injury

DDx Behavioural Disturbance

Vascular (stroke, bleed)
Infection (encephalitis, UTI)
Neoplasm (cerebral mets)
Trauma (head injury)
Metabolic (Na, gluc, Ca)
Endocrine (thyroid, adrenal)
Degenerative (dementia, HD, PD)
Autoimmune (cerebral vasculitis)
Toxins (drugs, alcohol, withdrawal)
Idiopathic (temporal lobe epilepsy)

Schneider's First Rank Symptoms

(ABCD): Auditory hallucinations, Broadcasting of thought, Controlled thought, Delusional perception

Personality Disorders

Cluster A: odd and eccentric - Paranoid, Schizoid, Schizotypal (magical thinking)
Cluster B: dramatic, emotional, erratic - Histrionic, Narcissistic, Antisocial, Borderline
Cluster C: anxious or fearful - Avoidant, Dependent, Obsessive-Compulsive

Depression

IN SAD CAGES

Major depression >=5/9 for >=2 weeks

- Interest
- Sleep
- Appetite
- Depressed mood
- Concentration
- Activity
- Guilt
- Energy
- Suicidal ideation

Admit if:

- MDD with risk of harm to patient and others
- Psychotic features
- Suicidality or inability to care for self
- ECT indicated

Anorexia

- Morbid fear of weight gain/fatness
- Restricted dietary intake
- Amenorrhoea
- BMI≤17.5

Bulimia

- Preoccupation with food, weight and shape
- Cycles of binge - purging

SCOFF Questionnaire (>1 positive response → possible disorder):

- Sick after eating
- Control lost when eating
- Over 6kg wt loss in 3 months
- Fat - consider self fat when others would think them thin
- Food dominates life

Admit if:

Severe malnutrition (wt <75%)
Dehydration + electrolyte abnormalities
Physiological instability (HR <50, BP < 80/50 or postural drop, hypothermia)
Arrested growth/development
Failure of outpatient treatment
Acute medical complications of malnutrition (syncope, seizures, CHF, arrhythmias, pancreatitis)
Acute psychiatric emergency
Co-morbid diagnosis interfering with treatment (severe depression, OCD, family dysfunction)

Triage codes

Australian triage scale (ATS)
Triage 1- immediate threat to self or others - violent, weapon, self-harm, extreme agitation
Triage 2 - probable threat to self or others - severe agitation, confused, psychotic
Triage 3 - probable danger to self or others - severe distress, moderately agitated
Triage 4 - moderate distress, no immediate risk (no agitation, cooperative, willing to wait)
Triage 5 - no danger, no acute distress or behavioural disturbance (eg social crisis)

Possible reasons for psychiatric admission

Danger to self/others
Unable to care for self
Extreme distress
Problems/diagnoses uncertain but behaviour causes concern – further assessment/observation needed
Need for stabilisation/treatment of condition
Treatment failure or resistance
Exacerbation of illness coupled with failure of usual supports

Clues to an organic cause

First presentation age > 40
Acute onset
Fluctuating course
Attentional deficits
Generalised severe disorganisation of behaviour
Disturbances of consciousness
Perceptual deficits (hallucinations, illusions)
Altered sleep-wake cycle
Drug use
Recent or new medical problems
Neurological signs or symptoms
Visual hallucinations
Abnormal vital signs

The Psychiatric mental state examination

Level of Consciousness and Orientation
Appearance and Behaviour
Speech
Mood and affect
Thought Form
Thought Content
Perception
Cognition: Attention/concentration (serial 7's), orientation, language (name objects), memory, abstract thinking
Insight

Deliberate Self Harm

Safety
MDT approach
Resuscitation
Treatment of immediate life threats
Preventing complications
Risk assessment

Aims of Medical Clearance

Misnomer
It is not possible to predict whether a patient will develop medical illness during psychiatric admission
Rule out organic disease as cause of behavioural disturbance
Ensure patient has no unresolved medical issues/is medically stable for transfer to psychiatric unit
Does not mean no ongoing medical problems

Risk of Suicide - Sad Person's index:

S	Sex (M>F)		<6 low risk
A	Age (>55yrs or 15-25yrs)		6-8 intermediate risk
D	Depression	(2 points)	>8 high risk
P	PMH suicide attempt		
E	ETOH and drug abuse		
R	Rationality (psychosis)	(2 points)	2 point items = DROS
S	Spouse absent		
O	Organised attempt	(2 points)	
N	No support		
S	Stated future intent	(2 points)	

Radiology Summary

CXR

Alveolar Opacity

Associated with fluid filling of the airspaces - soft, fluffy, cotton wool like
Inflammatory exudate: Pneumonia
Pulmonary oedema: Cardiogenic vs Non-cardiogenic
Blood: Goodpastures
Neoplastic (usually interstitial): Lung cancer, Lymphoma

Interstitial Opacity

4 basic interstitial lung patterns:

- linear: septal lines (Kerley lines)
  - thickening of interlobular septa
    - caused by: pulmonary oedema, mitral stenosis, lymphangitis carcinomatosis, pulmonary fibrosis, lymphoma, pneumoconiosis, sarcoidosis
- reticular: mesh-like appearance, lines in all directions
  - fine, medium or coarse
    - Fine Reticular Pattern
      - Acute = pulmonary oedema or pneumonitis (viral, mycoplasma)
      - Chronic = neoplasm (lymphangitis), sarcoid, connective tissue, fibrosis
- nodular: discrete opacities - granulomatous conditions - inflammatory, neoplastic infiltration
- reticulonodular

CXR signs of LVF

CXR changes lag 6 hours behind clinical signs
Most common to least common:
1. Upper lobe diversion (= pulmonary venous congestion)
2. Cardiomegaly
3. Interstitial oedema
4. Enlarged pulmonary artery
5. Pleural effusions
6. Alveolar oedema (“bats wing”)
7. Prominent SVC
8. Kerley B Lines

Aortic Dissection/traumatic aortic injury CXR Findings

Mediastinal widening >8cm
Aortic knob obliteration
Left effusion
“Calcium sign” (separation of rim of calcium from aortic knob >5mm) (14%)
Left apical pleural cap
Trachea/NG dsplacement to right
Obliteration AP window
Depression L mainstem bronchus
Widened right paratracheal stripe
Displacement paravertebral stripe
Signs of severe chest trauma in aortic injury - 1st rib #, haemo/pneumothorax, pulmonary contusion

Cavitating Lesions

Lung abscess
- Aspiration - anaerobes
- Necrotizing pneumonia - Staph, Klebsiella, E Coli, Pseudomonas
- Septic emboli - endocarditis
- Fungal - aspergillosis
- Pneumocystis

TB
Neoplasm - Primary, Secondary, Lymphoma
Inflammatory - Wegeners, Sarcoidosis
Infected bullae
Pulmonary infarction
Congenital lesions

Metastases

Brain **"2 B's, 2 C's, 2 oma's"**
Breast, Bronchus
Colon, Kidney
Lymphoma, Melanoma

Bone **"2 B's, 2 C's, 2 glands"**
Breast, Bronchus
Colon, Kidney
Prostate, Thyroid

Lung **"BCG"**
B = breast, bowel
Childhood = sarcoma, neuroblastoma, Wilms
Genito-urinary = prostate, bladder

MRI

T1-weighted images – Water low intensity signal. Fat, subacute haemorrhage high intensity signals. Good brain white/grey matter differentiation (NB. white matter appears darker than grey).
T2 - Water and fluid are bright, good for tissue oedema.

MRI vs CT in ED

MRI indicated for:
1. spinal cord compression
2. posterior fossa pathology
3. occult # NOF

Other uses:
1. Aortic dissection (MRI better than CT, possibly better than TOE)
2. Paeds growth plate #
3. scaphoid #

Radiation in Imaging

Effective dose: Effect of radiation on organism as a whole. Unit: Sievert
Cancer Risk: Estimated lifetime cancer mortality risk
1yo child: ~0.05% (head) & 0.1% (abdominal)
Adult >35 yrs: <0.01% & 0.02%
Additional risk is still low (≤1%) compared to background risk.
Lifetime risk of cancer in Aus ~25-33%, and lifetime cancer mortality ~10-15%

Equivalent period of background radiation

Limb and joints (except hip) - <1.5 days
CXR - 3 days (equivalent risk 1 cigarette)
Thoracic spine, pelvis, abdo - 4 months
Lumbar spine - 6 months
CT head - 15 months
CT C spine - 2.3 years
CT chest or abdo or pelvis - 3-4 years
CT chest/abdo/pelvis - 11 years (1:500 adult fatal cancer risk)

Ultrasound

Clinician-performed USS in ED

Limited scope
Targeted at answering a specific question eg "Is there a AAA?"
An extension of the clinical exam

Advantages

No ionising radiation
Used quite freely for antenatal scanning, children
Safe for repeated examinations
No evidence that it break chromosomes, damages tissues or predisposes to malignancy
Non-invasive
Painless
Equipment much cheaper than MRI scanners and more portable
Possibly the best imaging modality for soft tissues.
Has some therapeutic uses too – soft tissue injury etc

AAA

As accurate as CT in measurement
Diameter >3cm = abnormal (outside wall - outside wall
Indications: hypotensive; elderly + abdo/back/flank pain
>95% sensitivity and specificity for assessing aortic diameter

Limitations

Pain or bowel gas may prevent adequate imaging
Obesity
Mistaking IVC or SMA for Ao
Measuring lumen without including mural thrombus
AAA may be incidental and not cause of symptoms

FAST

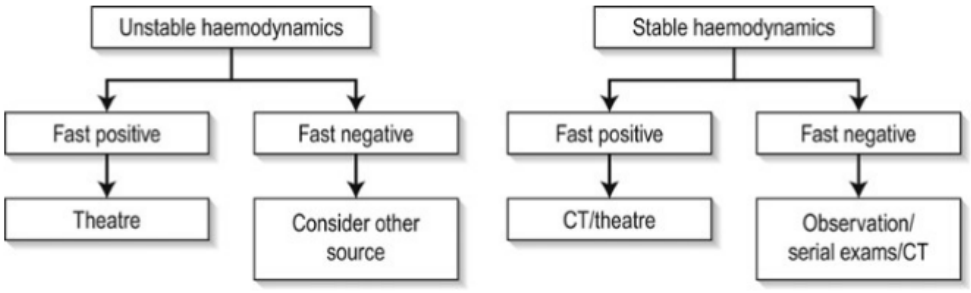
Accuracy = DPL, less complications
90% sens, 99% specific
Advantages: rapid, portable, accurate, repeatable, non-invasive, don't have to leave dept
Positive FAST + unstable = OT

1. Pericardial
2. Perihepatic (Morrison's pouch)
3. Perisplenic
4. Pelvic

+/- pleural spaces

Limitations

User dependent
Inadequate views in up to 10% - esp if bladder empty or subcut emphysema
Cannot distinguish between blood and other fluid (ascites)
May miss retroperitoneal haemorrhage
Solid organ, hollow viscus and diaphragmatic injuries can occur without free fluid
Small amounts free fluid may not be detected
Small amounts pelvic FF can be normal in women
Fluid-filled bowel may be misinterpreted as free fluid
Pericardial fluid can decompress into pleural cavity



1st trimester pregnancy

hCG > discriminatory zone (1500 for TV, 6000 for TA) + negative USS = high risk for ectopic
TV >4.5 weeks
TA >5-6 weeks

Ultrasound finding	Accuracy (%)
Absent IUP	5
Any free fluid (no IUP)	50
Mod–large free fluid (no IUP)	60–85
Adnexal mass (no IUP)	75
Adnexal mass+free fluid (no IUP)	97
Ectopic pregnancy seen	100

Gallbladder
Gallstones + probe tenderness = 92% PPV for gallbladder disease
Wall thickness >3mm in 50-75% cholecystitis
Venous access
Cardiac PEA, cardiac trauma, tamponade
Other Thoracocentesis, Abdominal paracentesis
DVT

Renal Summary

Renal Transplant

Graft rejection
Tender over graft (LIF/RIF), decr UO/incr Cr, oedema, low grade fever

Post-transplant abdo pain and ARF
Graft rejection
Renal artery or vein thrombosis
UTI
Ureteric obstruction
Wound infection
Non-urological cause

Macroscopic haematuria

Causes: Trauma, Infection, Tumour (renal, TCC, prostate), Calculi, Polycystic, Post-op, Glomerular disease

Glomerulonephritis and Nephritic Syndrome

Causes: systemic disease, infection, drugs, intrinsic renal disease, autoimmune
Sx: proteinuria; haematuria; oedema; hypertension, renal failure (AKI)
Post-Streptococcal Glomerulonephritis = common cause of glomerulonephritis

Nephrotic Syndrome

Oedema, hyperlipidaemia, hypertension
Proteinuria, low albumin
Increased risk VTE (loss of anticoagulant proteins in urine) [nephrotic syndrome + sudden SOB = PE]
Most common causes: Focal Segmental Glomerulosclerosis (adults), Minimal Change Disease (kids)

Haemolytic Uraemic Syndrome

Usually paediatrics, 6 months - 4 years
Commonest cause ARF in children <5 years
Triad: MAHA, thrombocytopenia, ARD
E.coli O157:H7 from contaminated food/water and Shigella-toxin mediated
Child looks unwell, oliguric, with diarrhoea - bloody after 2-3/7. 50% have HTN
Clinical: fever, GI bleeding, bloody diarrhoea, abdominal pain, neurologic, seizures
Normal Coags and DIC panel
Elevated urea and creatinine
Tx: Supportive care, dialysis

Rhabdomyolysis

- Exertional
- Drugs (statins, alcohol, cocaine, methamphetamines, serotonin syndrome, NMS, carbon monoxide)
- Metabolic (esp hypokalaemia and hypophosphataemia)
- Toxins (snakes, mushrooms)
- Infections (viral - influenza, coxsackie, adenovirus, EBV, CMV, HIV; bacterial; malaria
- Trauma
- Vascular (vasculitis, ischaemic, sickle-cell)

ARF in paeds

Causes: GN, sepsis, HUS, post-op complication
70% nephrotoxic, 30% ischaemic

Indications for haemodialysis

Hyperkalaemia >7.5
Fluid overload
Severe acidosis <7.1
Uraemia (>35mmol/L, pericarditis, encephalopathy, myopathy, neuropathy)
Sodium <115 ro >160
Toxins: salicylates, lithium, metformin, valproate, carbamazepine, toxic alcohols, phenobarb, K+, dabigatran

Hypotensive dialysis patient

Sepsis - immunocompromised, recurrent vascular access, exposure to MDR-organisms
Rx: culture everything, broad-spectrum Abs + source control (?remove hardware), cautious volume-loading
Haemorrhage - internal vs external
Rx: reverse coagulopathy (protamine 1mg per 100U+DDAVP 0.3mcg/kg in 50ml over 30min, consider TXA)
Tamponade - bedside USS
Hyper or Hypokalaemia - urgent ECG and VBG
Dialysis-hypotension syndrome - from autonomic dysfunction; diagnosis of exclusion

Dialysis patient with altered mental state

1. intracranial bleed (secondary to anticoagulation)
2. seizures (secondary to osmotic shifts)
3. thrombotic CVA (secondary to accelerated atherosclerosis)

Uncommon: disequilibrium syndrome - N/V, restless, agitation - seizures, coma; secondary to CNS fluid shift

Peritoneal dialysis

Fluid: cloudy, WCC >100/cm3, >50% PMN, organisms on gram stain
Organisms: Staph epidermidis, Staph aureus, enterobacter, pseudomonas
Mixed organisms suggest bowel source (eg perforation, appendicitis, diverticulitis)
Given in fluid: cephazolin/cephalexin
Known MRSA or systemic sepsis - vancomycin
Gram negatives in fluid - gentamicin
Mixed organisms - add metronidazole

Cardiac arrest in dialysis patient

1. If a candidate for resuscitation give calcium gluconate 20ml of 10% for presumed hyperK.
2. If no response give 100mmol of of HCO3.
3. Consider tamponade - USS

Haemodialysis complications

- Access related: local infection, endocarditis, osteomyelitis, creation of stenosis, thrombosis or aneurysm
- Hypotension (common), cardiac arrhythmias, air embolism
- Nausea and vomiting, headache, cramps
- Fever: infected central lines
- Dialyser reactions: anaphylactic reaction to sterilising agents
- Heparin-induced thrombocytopenia, haemolysis
- Disequilibration syndrome: restlessness, headache, tremors, fits and coma o Dialysis dementia

RIFLE Classification of ARF

Risk:	Cr incr 1.5x	UO <0.5ml/kg/hr for 6 hrs
Injury:	Cr incr 2x	UO <0.5ml/kg/hr for 12 hrs
Failure:	Cr incr 3x or >355 or anuria 12hrs	UO <0.3ml/kg/hr
Loss:	Persistent ARF, complete loss kidney function >4/52	
ESRD:	End stage renal disease >3/12	

Urology Summary

Renal Colic

90% stones radio-opaque (25% gallstones)
70% Ca phosphate/Ca oxalate
10-15% infection stones (struvites; PO4, CaPO4, MgNH4PO4)
10% urate stones (radiolucent)
1% cysteine stones

4mm	90% passage rate
5mm	80%
5-8mm	15%
>8mm	5%

Admit urology if:
Obstructed solitary kidney or transplanted kidney
High grade obstruction
Decr renal function (Cr>200)
Persistent pain (despite 24hrs in SSU)
Large proximal stone >6mm

Imaging in renal colic
CT: sens 95%, spec 99%
- Pros: fast, no contrast, detect other diagnoses, can measure stone size, can detect obstruction
- Cons: radiation, higher cost

IVP: sens 60-90%, spec 90-100%
- Pros: info re size/position of stone, measures renal function
- Cons: contrast reaction, radiation, time-consuming, can't rule out other diagnoses

KUB: sens 30-60%, spec 70-75%
- Pros: readily available, fast, good for monitoring
- Cons: low sens/spec, radiation

USS: sens 60-85%, spec 80-100%
- Pros: non-invasive, no radiation, best in pregnancy, no contrast, will detect AA
- Cons: may miss small stones, insensitive middle 1/3 ureter, operator dependent, not always available

Priapism

5-10yrs (sickle cell, Ca); 20-25yrs (idiopathic); >25yrs (impotence treatment)
Low flow (drugs, hypercoagulability - sickle cell/leukaemia, spinal cord injury)
- painful = ischaemic = thrombotic: obstruction to outflow; most common
- pH <7.25, pO2 <30, pCO2 >60, dark blood

High flow (trauma, AV fistula)
- painless = non-ischaemic = non-thrombotic: uncommon
- bright red blood
- usually treated conservatively

Management Low Flow
Analgesia
Early urology consultation
Terbutaline 500mcg sc; Pseudoephedrine 120mg po
Intracavernosal aspiration or injection intracorporeal adrenaline/phenylephrine
SCD: IVF, O2, exchange blood transfusion
Phimosis: Inability to retract foreskin
Paraphimosis: Inability to replace retracted foreskin - venous obstruction and oedema; uro emergency
Balanitis: Candida, Staph aureus, gardnerella, anaerobes

Scrotal Emergencies

<10yrs: torsion of appendix testis
10-19yrs: testicular torsion; 20-40% torsion of appendix testis
20-29yrs: 75% epididymitis > 20% testicular torsion
>30yrs: nearly all epididymitis > hernia, referred pain

Testicular torsion
2 peaks: newborns (extravaginal), 12-16yrs (intravaginal)
USS 88% sens, 90% spec
100% salvage <4hrs 80-90% salvage <6hrs 20% salvage 10-24hrs 0% salvage >24hrs

Epididymitis
Pre-pubertal = coliforms
19-35yrs = 30-50% chlamydia > gonorrhoea > ureaplasma urealyticum
>40yrs = coliforms, E coli, klebsiella from urine; post-procedural
If STD: ceftriaxone 250mg IM stat + doxycycline 100mg BD 14/7 + roxithyromycin 300mg OD 14/7
If unwell: ampicillin 2g Q6h IV + gentamicin 4-6mg/kg OD

Fournier's gangrene
Mixed aerobic/anaerobic necrotising subcutaneous infection of scrotum and perineum
Bacteroides and E coli most common; anaerobic Strep, G-ive rods, anaerobes
RF: obesity, immunocomp, DM in 20-70%, ETOH in 25-50%, chronic steroid use
Ceftriaxone 2g IV + metronidazole 500mg IV + gentamicin 4-6mg IV; OT

Testicular Cancer
Common metastatic sites: lumbar spine, inguinal/para-aortic LNs, lungs

Renal carcinoma
85% clear cell carcinoma (peaks 60s-70s), 10% papillary carcinoma

Bladder tumours
1. Transitional-cell: 90% bladder cancer; links: smoking, aniline dyes, artificial sweeteners, cyclophosphamide
2. Squamous-cell: <5% bladder cancer; links: schistosomiasis, chronic bladder irritation, long term IDC
3. Adenocarcinoma: <2%

Prostate Cancer
Can metastasize to bone - osteoblastic
>95% adenocarcinoma

UTI
E coli (70-80%)
Staph saprophyticus in sexually active women (5-15%)
5-20% other (proteus (suggested by high urinary pH), strep faecalis, enterobacter, pseudomonas)
<5% other (grp D strep, chlamydia, TB)
Klebsiella and staph aureus in neonates
LR's: self diagnosis of UTI > haematuria > frequency > fever > dysuria > suprapubic pain

Pyelonephritis
Nitrites: 95% PPV, 70% NPV for UTI
Leucs: 70% PPV, 85% NPV for UTI

Paediatrics
84% E coli, 6% proteus, 5% klebsiella, 3.5% enterococcus; G+ives in older boys/underlying medical conditions
Always check BP

Nitrites:	60% sens (doesn't develop with G+ives)	95-99% spec
WBC dipstick:	70-80% sens; Gram stain 80-97% sens	80-90% spec; sens decr if <2yrs
WBC:	50-90% sens	50-90% spec
Bacteria:	50-90% sens	10-90% spec

Renal USS: all children with 1st UTI, 3-6/52 after infection
DMSA scan: after 6/12 or at age 3-4yrs to look for scarring if required hospitalisation
MCU: <3/12 or if abnormal USS
Admit if:
<6/12
septic
underlying disease
urinary obstruction
pyelonephritis
failure to respond to PO's

Prostatitis

<35yrs: usually STD

>35yrs or homosexual: usually E coli >80%; 20% other G –ives or haematogenous spread or post biopsy

Treat as per UTI; if <35yrs, treat as STD

If severe: systemic features/urinary retention: amp 2g IV QID + gent 4-6mg/kg OD for 14/7

Respiratory Summary

ARDS

Causes

Common: Sepsis, massive trauma, multiple transfusions, hypovolaemic shock, Pneumonia, aspiration
Other: Smoke inhalation, Burns, Near drowning, DKA, eclampsia, amniotic fluid/fat embolus, drugs (paraquat, heroin, aspirin), pancreatitis, liver failure, DIC, head injury, transfusion, tumour lysis

Incr permeability pulmonary microvasculature - leakage of proteinaceous fluid - hypoxia and MOF

Diagnostic criteria

1. Acute onset
2. CXR: bilateral infiltrates
3. PCWP <18mmHg/lack of clinical evidence of LVF
4. Refractory hypoxaemia: PaO2: FiO2<200.

Indications for ventilation:

PaO2: <60mmHg despite 60% O2
PaCO2: >45mmHg
Approaches: low-tidal-volume techniques, permissive hypercapnia, prone position, prone ventilation
Lung protection settings: Volume Control or SIMV, TV 6-8ml/kg (aim Plateau P<30cmH2O), RR 16-18

Acute Asthma

Severity

Mild: Cough, wheeze, active, talks sentences, PEFR/FEV1 >60% pred, SaO2 >94%
Moderate: Cough, wheeze, mild resp distress, talks phrases, PEFR/FEV1 40-60%, SaO2 90-94%
Severe: Marked resp distress, single words, decr breath sounds, pulsus paradoxus, cyanosis, PEFR/FEV1 <40%, SaO2 <90%
Life-threatening: Exhaustion, decreased LOC, silent chest, bradycardia, hypotension, SaO2 <80%

Drugs

IV salbutamol - kids 15mcg/kg over 10mins then 1mcg/kg/min; adults 5mcg/kg 1min then 5-10mcg/kg/hr
Adrenaline - 0.1ml/kg 1:10000 slow iv
Corticosteroids - 1-2mg/kg po prednisone or 1mg/kg q6h iv hydrocortisone 4mg/kg (max 200mg) q6h
Anticholinergics - ipratropium bromide
IV MgSO4 - 2.4g bolus over 20-60mins (hypotension, decr reflexes, weakness)
IV aminophylline - 5mg/kg over 30mins then 0.6mh/kg/hr
Intubation: ketamine or sevoflurane

Indications for Intubation

Apnoea/cardiac arrest
Decr LOC
Exhaustion or rising CO2 despite maximal therapy
Severe hypoxia or acidosis

Airway management in life-threatening asthma

Preparation

Most experienced intubator
Largest diameter ETT (minimise resistance to flow)
Anticipate CVS collapse on intubation
- Preload with normal saline 10-20ml/kg
- Avoid hyperventilation
- Prepare push-dose vasopressor (eg metoraminol 0.5-1mg bolus)

Drugs

Ketamine 2mg/kg
Sux 1.5mg/kg

Post-intubation

Manually ventilate to assess compliance
Use volume-controlled ventilation
- RR 6-10 breaths/min
- TV 6-8ml/kg

Long exp time
I:E ratio 1:4 – 1:5
Minimal PEEP <5cm H20
Keep plateau pressure <20cm H20
Expect high pressures (aim for <40cm H20)

Adjust settings to avoid breath stacking/dynamic hyperinflation
Employ permissive hypercapnia – aim for:
SaO2 >90%
pH >7.1
Keep heavily sedated and paralysed

Crashing asthmatic post intubation/high pressures
Assess for reversible causes (DOPES)
Displacement of ETT (oesophageal or RMB intubation)
Obstruction of ETT = kinking, secretions
Pneumothorax
Equipment failure
Stacked breaths
Ventilator dyssynchrony
Worsening bronchospasm
Take patient off ventilator, ensure complete exhalation
Manually ventilate with 100% O2
Suction ETT
Paralyse
Maximise medical therapy for asthma
It pneumothorax suspected - Palpate for tracheal deviation, Bedside USS, Decompress then ICC
Portable CXR once stabilised

Haemoptysis

Sites
Spurious from nasopharynx/GIT
Bronchial tract (high pressure) - common, responds well to embolisation
Pulmonary circulation (low pressure) – uncommon

Massive haemoptysis >500ml/24hrs or >100ml/hr
With/without abnormal gas exchange (hypoxia/hypercapnia) or abnormal circulatory (tachy/hypotension)

Causes
Infection – TB, bronchitis, lung abscess, bronchiectasis, fungal (aspergillus)
Neoplastic – Ca lung, 2° Ca, R main stem erosion from oesophageal Ca
Cardiovascular – PE, APO, mitral stenosis, AVM
Immunologic – SLE, Wegeners, Goodpasture's
Congenital - CF
Post-infectious - HUS
Other – Trauma, coagulopathy, FB
Drugs: amiodarone, penicillamine

Investigations
ECG: evidence of mitral stenosis or raised pulm pressures (P mitrale, RVH)
FBC: thrombocytopenia
Sputum MCS: infectious cause
Haemolysis screen: HUS/TTP
Autoimmune screen: ANA, ENA, cANCA (Wegeners)
CRP for evidence of systemic inflammation
ECHO: valvulopathy or pulm HTN

Management
Position - sit up, bleeding lung down after intubation
Airway - large ETT (suction, bronch). Intubate early as mortality due to asphyxiation
Oxygenation - high flow and high conc O2
Haemorrhage control - angio, bronchial artery embolisation, bronchoscopy, surgery
Avoid hypertension (?permissive hypotension)
Reverse anticoagulation (FFP, cryoprecipitate etc)

Lung Tumours

Primary

Small-cell lung cancers (SCLC)

Non-small-cell lung cancers (NSCLC)

- Squamous - Central, variable differentiation, may cavitate
- Adenocarcinoma - Less smoking related, small, peripheral
- Large cell - Giant cell & Clear cell, peripheral
- Mesothelioma

Secondary:

Solitary or multiple (cannon ball) nodules: colon, breast, renal, testis, TCC, melanoma

Diffuse: prostate, stomach, pancreas, lymphoma, thyroid (follicular cell)

Paraneoplastic syndromes

Hypercalcaemia (PTH-RP), hyponatraemia (SIADH), ectopic ACTH, carcinoid, gynaecomastia, hypoglycaemia (insulin like protein), Eaton Lambert syndrome, peripheral neuropathy, polymyositis, clubbing, hypertrophic pulmonary osteoarthropathy, thrombosis, DIC, nephrotic syndrome, dermatomyositis, acanthosis nigricans

Sarcoidosis

Multiorgan disease of idiopathic cause

Noncaseating granulomas in affected organs

CXR: prominent bilateral hilar and right paratracheal adenopathy

SX: cough, dyspnea, chest pain, malaise, fever, rash (erythema nodosum)

Labs: leukopenia, eosinophilia, elevated ESR, hypercalcemia; elevated ACE level; noncaseating granulomas

Tx: steroids; antibiotics if suspect secondary pneumonia

PE

Simplified Well's score:

3 pts	DVT Sx or OE	PE most or as likely diagnosis	
1.5 pts	HR >100	Immobilisation / OT in 4/52	Prev VTE
1pt	haemoptysis	malignancy	

5+ = likely 4 or less = unlikely

Pros: good for low risk; good for inpatient/ED; good when used with D dimer; extensively validated; simple

Cons: less objectivity

Revised Geneva score:

5 pts	HR >95			
4 pts	Leg pain on palpation / unilat oedema			
3pts	HR 75-94	Unilat lower limb pain		Prev DVT / PE
2pts	Haemoptysis	OT/leg # in 1/12	Active Ca	
1pt	>65yrs			

11+ = high = 74% likelihood 4-10 = mod = 28% likelihood 0-3 = low = 8% likelihood

Pros: easy; reliable; objective; performs equivalent to Well's; incr accuracy when used with D dimer

Cons: less extensively validated than Well's

PERC Rule-Out Criteria:

"3,3,2,2"

3 numbers

- Age <50 HR <100 SaO2 >94%

3 risk factors

- No hx VTE No recent trauma/surgery No exogenous oestrogen

2 clinical features

- No haemoptysis No unilateral leg swelling

Less than 2% change of PE if all 8 criteria satisfied *and* low risk of PE

If low clinical suspicious and PERC-ive, sens 97.5%, spec 22%

D-dimer: very low PPP

Marker of fibrin degradation

Not site-specific

Most accepted application is in conjunction with Wells score - not useful if high risk Wells

If low pre-test prob and negative = NO PE (<0.4% risk at 3/12)

Classifying severity

1. Haemodynamics
    - Massive (arrest, SBP <90 for >15mins)
    - Sub-massive (abnormal haemodynamics not meeting massive criteria)
2. Pulmonary Embolism Severity Index (PESI and simplified PESI)
3. RV dysfunction (2 fold incr mortality) (BNP/trop/ECHO)

Simplified PESI

Age >80
Hx cancer
Chronic cardiopulmonary disease
HR >110
SBP <100
SpO2 <90% on RA
Each 1 point
Low risk (1% 30 day mortality) = 0; High risk (11% 30 day mortality) >/=1

Imaging

Do if: +ive D dimer/high pre-test prob

CTPA Pros: high sens, other pathology, fast, RV function, available
Cons: radiation (2-10mSv = 100-400 CXR - significant breast radiation), contrast, out of dept
In pregnancy: use breast shields; low radiation dose to fetus (similar/lower than VQ); theoretical risk of iodine to fetus; may be incr non-diagnostic rate due to physiological changes of pregnancy

VQ Pros: can use perfusion only, if renal failure or contrast allergy
Cons: radiation, equivocal
Intermediate prob VQ + low pretest prob = no PE; mod-high pretest prob = further Ix

USS limbs Pros: non-invasive
Cons: operator- dependent, if negative can't rule out PE

ECHO Pros: non-invasive, RV function
Cons: can't rule out small PE, availability

Pulmonary Angiogram Pros: gold std
Cons: Availability, contrast

MRI

CXR: cardiomegaly, atelectasis, elevated hemidiaphragm, pleural effusion, wedge shaped infarction, Westermark's sign (prominent PA, abrupt cut off of peri vessels), Hampton's hump (pleural based opacity)

Management of Massive PE

Thrombolytics
- Alteplase: 0.9mg/kg max 90, 10% bolus then 90% infusion over 60mins (same as CVA)
- Ind: massive PE and delay to alternative, cardiogenic shock, cardiac arrest, ?RV dysfxn
- CI: normal CIs to thrombolytics
- Complications: fatal haemorrhage (0.3-2%); ICH (4%); major bleeding (9-13%), minor bleeding (23%)

Thoracotomy:
- Ind: massive PE and access to cardiac surgery
- CI: no timely access

Interventional radiology:
- Ind: massive PE + can lie flat (may need intubation)
- CI: contrast allergy, renal failure, no timely access

DVT

Risk factors

Acquired: surgery, immobility/travel, cancer, hormones, smoking, pregnancy, prev DVT, intravasc device
Inherited: Factor V Leiden, Prot C/S def, fam hx VTE, SLE/RA, AT III def

Diagnosing DVT

Doppler USS
- Non-invasive, highly sensitive
- Operator dependent

D-dimer
- In low risk patients -ve excludes diagnosis - do if Well's 1 or less
- False +: infection, Ca, tissue inj, CCF, ACS, CVA, preg, ARF, SCD, aortic dissection

Venography
- Gold std
- Painful and invasive

MRI/CT venography
- Highly sensitive
- Limited availability, high cost, radiation

Well's score: -2 for: alternative diagnosis
+1 for: Ca in 6/12, immobilisation, major OT <12/52, tender along veins, entire leg swelling, >3cm incr diameter, pitting oedema, collaterals

Low prob:	0	5% incidence of DVT
Mod prob:	1-2	14% incidence of DVT
High prob:	3+	50-80% incidence of DVT

Modified Well's score: as above but +1 for PMH DVT

DVT unlikely:	1 or less	3-9% incidence of DVT
DVT likely:	2+	20-35% incidence of DVT

Below knee DVT Rx options
Treat if RF continues (eg thrombophilia, ongoing POP)
Propogation occurs in 20% below knee DVT's therefore do rpt USS at 3-7/7
1. Aspirin with followup
2. LMWH Enoxaparin 1.5mg/kg sc
3. Warfarin for 3/12: INR 2-3

Management
Elevation; ambulation; analgesia; stockings
Thrombolysis: can decr incidence of post-phlebitic syndrome,
Indicated if massive iliofemoral thrombosis or young patient with extensive venous thrombosis <1/52
IVC filter: if high risk from anticoagulation
Thrombectomy: if vital function of lower limb threatened

Axillary Vein Thrombosis
Risks same as DVT, plus: central line, pacemaker, IVDU, XR exercise, malignancy, trauma, cervical rib
PE risk: 5-10% (up to 36% with CVC)
Options:
1. anticoagulation
2. direct thrombolysis (urokinase)
3. correct underlying cause eg cervical rib
4. surgery - embolectomy, angio/stent, SVC filter

Pertussis

Bordatella pertussis (G –ive); parapertussis as common in 2-6yrs, but less common outside these
1-2/52 catarrhal phase: URTI sx, coryza, fever, conjunctivits
4-6/52 paroxysmal phase: coughing paroxysms (assoc with vomiting, cyanosis; apnoea in young infants)
1-2/52 convalescent phase: decreasing cough (but may last weeks to months)

Investigations
NPA: do within 2/52 onset of cough
Other: PCR, ELISA
CXR: perihilar infiltrates, secondary pneumonia

Management
O2, suction
Abx: azithromycin: 10mg/kg (max 500mg)PO for 5/7
Consider admit if: <6/12 (risk of apnoea)
Contact prophylaxis: if <3 doses vaccine, >36/40, or attends their daycare; give azithromycin as above

Pneumonia

Strep pneumonia (most common, rusty sputum)
- Gram positive, encapsulated diplococcus
- Xray: lobar, but can be multilobar
- Tx: IV vs oral abx (macrolides, fluoroquinolones, cephalosporin + macrolide)

Haemophilus influenza
- Gram-negative rod
- Elderly, debilitated, diabetic, alcoholic, post-viral

Klebsiella
- Encapsulated gram negative bacillus in pairs
- Alcoholics, diabetics, COPD, nursing home
- Currant jelly sputum
- Tx: IV cephalosporin

Pseudomonas
- Cystic fibrosis, COPD

Staphylococcus aureus
- Post-flu, IV drug users, hospitalized/nursing home patients, debilitated - very unwell
- CXR: multilobar pneumonia; empyema
- Tx: antistaph antibiotics

'Atypicals'
- Mycoplasma pneumoniae
  - Bullous myringitis, conjunctivitis
  - CXR: dense consolidation or diffuse interstitial pattern
  - Cold agglutinin test
  - Complications: aseptic meningitis, haemolytic anemia, Guillain Barre, erythema multiforme
  - Rx: macrolide
- Legionella pneumophilia
  - Gram negative
  - Rigors, high fever, headache, malaise, cough, dyspnea, diarrhea, n/v, hyponatraemia
  - Dx: urinary antigen testing, serological studies
  - Tx: macrolides, quinolones
- Pertussis
- Chlamydia pneumoniae/psittaci
  - Rx: doxy/tetracycline

Viruses - Influenza A, RSV, adenovirus, parainfluenza

Fungal - Histoplasmosis

PCP/PJP
- Immunosuppressed; Most common opportunistic pathogen in HIV patients (CD4 <200)
- Dx: incr LDH, sputum, bronchoscopy
- Tx: Bactrim, IV Pentamidine, oral dapsone and Bactrim → tx with steroids concomitantly

Pneumonia Severity: CURB-65
- Confusion
- Urea >42 mg/dl
- Respiratory rate > 30
- Hypotension (SBP <90 or DBP <60)
- Age > 65

If 0-1: Low mort (<1%) - Home Rx
2: Mod mort (7.6%) - Short stay or hospital outpatient
>=3: High Mortality (>21%) - Adm hospital
>=4: (>42%) - Consider ICU

Pneumonia Severity Index
Based on demographics, comorbidities, physical exam/vital signs and lab/radiology → places patients in risk class with recommendation about treatment site (inpt vs outpt)

Complications
Pleural effusion and empyema
Lung abscess: staphylococcal, klebsiella, pneumococcal
Pneumatocoele, pneumothorax, pyopneumothorax
Postinfective bronchiectasis.
ARF, DVT, septicaemia, pericarditis, endocarditis, osteomyelitis, septic arthritis, cerebral abscess, meningitis

Management
Supportive: O2/ventilation PRN, fluids, analgesics/antipyretics, ?bronchodilators. ??Chest physio. Abs 7 days

Paediatric Community-acquired pneumonia
Admission general indications: age<1y, hypoxia, poor feeding, underlying disease, social situation.
≤3mo: ampicillin 50mg or benzylpenicillin 60mg/kg IV q6h PLUS gentamicin 7.5mg/kg IV OD

If pertussis suspected add: azithromycin 10 mg/kg PO OD for 5d
>3mo: Mild - amoxycillin 25mg/kg orally q8h x 7d
Moderate - benzylpenicillin 30mg/kg IV q6h
Severe - cefotaxime 25mg/kg IV q8h x 7d PLUS flucloxacillin 50mg/kg IV q6h

Adult Community-acquired pneumonia
Amoxicillin 1g PO q8h x 7d or augmentin plus azithromycin for atypicals

Pleural Effusion
Transudate (↑capillary pressure), protein <30g/L
Exudate (↑capillaries permeability), protein >30g/L

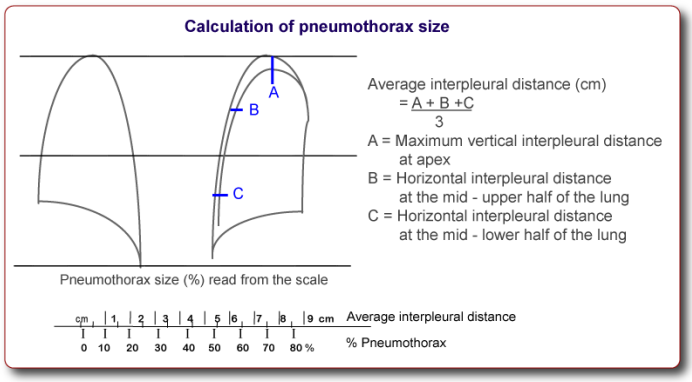
Exudates (protein >30g/L)
Causes: Malignancy, Pneumonia, post-CABG. TB, PE, autoimmune (RA/SLE), pancreatitis
Light's criteria for exudate:
• Pleural fluid : serum protein ratio > 0.5
• Pleural fluid : serum LDH > 0.6
• Pleural LDH > 2⁄3 upper limit of normal for serum LDH

Empyema
Fluid: pH<7.2, glu<2.2mmol/L, WCC>100,000/mm3.
Mx: Requires drainage by ICC or thoracoscopy. SK via ICC to break down pleural adhesions

Transudates (protein <30g/L)
Causes: CCF [right-sided], Cirrhosis, PE, Peritoneal dialysis, hypothyroidism, nephrotic syndrome, MS
CXR: ~250ml visible on PA, 50ml for costophrenic blunting on lateral
Pleural aspirate: culture, protein, LDH, pH (low=infection), glucose(low=empyema), Gram/ZN stain, cytology
Pleural biopsy, Bronchoscopy

Needle thoracocentesis
Absolute CI: Uncooperative pt, coagulopathy
Relative CI: Pleural fluid thickness < 10 mm on lat decubitus CXR
Cases where complication would be catastrophic - bullous lung disease, patients receiving PEEP, single lung
Complications: Pneumothorax, bleeding, infection, re-expansion pulm oedema, visceral injury, cough, pain

Pneumothorax
Risk factors primary PTX
Body habitus - tall/thin
Smoking
Subpleural blebs
Previous PTX
Underlying lung disease



Management
IV access + O2
Tension pneumothorax - immediate decompression with 16G cannula in 2icsmcl, then insert chest drain.
Traumatic pneumothorax - ICC
Spontaneous pneumothorax
- conservative: re-expansion ~2% per day – ↑4x by receiving O2
- needle aspiration
  - Minimally invasive, early discharge
  - Higher failure rate, need for other procedure
- small bore catheter
  - Ongoing drainage, less pain/scar
  - Prone to kinking/occlusion, high complication rate
- large bore catheter (if failure of above or development of tension)
  - Gold std, most effective drainage
  - More pain/scarring, needs procedural sedation

Consider operative management/pleurodesis

Discharge instructions
Analgesia
Education (recurrence rate 20-30%)

Return if: more breathless, more pain
Avoidance of activities: no flying 1/12 post confirmed resolution; no diving for life
Confirm follow-up

Respiratory Failure

Type I - Hypoxaemic respiratory failure:
Ventilation-perfusion mismatch with either/both:
- Under-ventilated alveoli (APO, pneumonia or acute asthma)
- Venous blood bypasses ventilated alveoli (right to left shunts)
Insufficient FiO2 removal but not ↑PaO2 e.g. Altitude hypoxaemia
Type II - Hypercapnoeic respiratory failure: PaCO2 >50mmHg - inadequate alveolar ventilation

Upper Airway Obstruction

Causes
Altered consciousness - HI, CVA, Drugs & toxins, metabolic (↓BSL, hypoNa+)
Foreign Bodies
Infections - Tonsillitis, quinsy, epiglottitis, tracheitis, croup, Ludwig's angina, retropharyngeal abscess, others
Trauma - Blunt or penetrating→ haematoma, uncontrolled haemorrhage
Burns - thermal or chemical, gases or liquid/solids
Neoplasms - Larynx, trachea, thyroid, tongue
Allergic reactions - angioedema, anaphylaxis
Reflex - laryngospasm
Anatomical - laryngomalacia, tracheomalacia – congenital/acquired (post-intubation), congenital
Management
Sit upright, Keep patient calm, minimal unnecessary interventions
Most experienced personnel available
Assess airway: patency & protection. Opening manoeuvres + adjuncts. Secure if necessary.
Assess breathing: effort & efficacy. Give O2
Secure airway if not patent or protected or likely to become deteriorate rapidly
Stridor - nebulised adrenaline, steroids
Treat infections – benzylpenicillin + metronidazole, sometimes ceftriaxone most often used.
Tracheostomy

CXR Ddx

Infection - pyogenic, TB, fungal
Carcinoma - primary, met
Infarction - PE, AVM
FB, Trauma
Congenital lesion

Reticular-nodular pattern
Infectious:
- TB
- Pneumocystis jiroveci
- Viral - influenza, SARS, CMV
- Bacterial - Staph, Haemophilus, Psittacosis

Non-infectious:
- Idiopathic pulmonary fibrosis
- Connective tissue disorders
- Pneumonconioses
- Lymphangitis Carcinomatosis

Multiple bilateral "fluffy" confluent airspace opacities
DDx: blood, fluid, cellular debris

Coin Lesions
Solitary secondary
Benign – hamartoma adenoma, chrondroma
Infectious – granuloma (TB, fungal - aspergilloma), round pneumonia [paeds], abscess, N hydatids
Non-infective – RA, Wegener's
Vascular – AVM, infarct, haematoma
Congenital – bronchial atresia, sequestration
Other – artefact, FB, pseudotumour (fissure fluid)

Lung Cavitation
Bronchogenic carcinoma
Necrotic pneumonia/abscess – Bacterial (S.aureus, Klebsiella sp), TB, fungal (PCP, Histoplasmosis)
Aspergillus
Helminths - hydatids
Emphysema
PE

Resuscitation Summary

Adult Resus

Effective therapies
Uninterrupted CPR
Early defib
?Therapeutic hypothermia/normothermia in VT/VF, avoid overoxygenation

CPR
Centre of chest
Depth >5cm
Rate 100-120
50% compression/relaxation ratio
Minimise interruptions
Change operator every 2 mins
Ratios Adult 30:2
Child 15:2 (2 rescuers), 30:2 (single rescuer)
Neonate 3:1

Monitoring
Waveform capnography for
Confirming ETT placement
Quality of CPR

Adrenaline
Incr ROSC
No effect on survival to hospital discharge or neurological outcomes

Amiodarone
Incr survival to hospital admission for VT/VF
No effect on survival to discharge or neurological outcomes

BLS/ALS

Aim: to provide oxygenation of vital organs until restoration of normal CO
Danger
Response
Send for help
A: recovery position, basic airway opening manoeuvres
B: look, listen, feel 10sec
C: if not breathing normally and no signs of life: start CPR, 30:2 for 2mins
D: Defibrillate - 200J biphasic single shock
Adrenaline 1mg every 2nd cycle, amiodarone 300mg after 3rd shock
Correct 4Hs 4Ts
Hypoxia, hypovolaemia, hypo/hyperthermia, hypo/hyperkalaemia
Tension pneumothorax, tamponade, toxins, thrombosis

Prolonged CPR if: poisoning, asthma, hypothermia, pregnancy if plan postmortem CS
Contraindications
Unsuccessful pre-hospital ACLS, known terminal illness, unsurvivable inj, advance directive, rescuers at risk

Intraosseous access

Child: 2cm below medial tibial tuberosity
Adult: med malleolus, distal femur, sternum, humeral head, ileum
CI: prox ipsilateral #, ipsilateral vasc inj, OP, osteogenesis

Prognosis

Time to CPR/defib: Strongest determinants of survival
Resus at scene
Level of consciousness post event
Initial rhythm asystole - poor prognosis
Significant acidosis <7 - poor prognosis
Survival unlikely if CPR long enough for drugs to be given

Better prognosis if drug/arrhythmia cause
Absence of cardiac kinetic activity = <5% probability of ROSC
Cardiac kinetic activity = 80% chance of ROSC

Resus Drug Doses

Incr dose 3-10x if via ETT

Adrenaline 1mg aka 1ml 1:1000 Q3min (10mcg/kg)
Amiodarone 300mg (5mg/kg)
MgSO4 5mmol bolus, 20mmol over 4hrs
NaHCO3 1mmol/kg
Ca Glu 10% 10ml (1ml/kg)
Atropine 1mg (up to 3mg) (20mcg/kg, max 600)
Adenosine 6,12,18mg (50-100-250mcg/kg max 12mg)
Midazolam 0.15mg/kg
Glucose 5ml/kg 10%
Naloxone 20-400mcg (0.01mg/kg)

Paediatric Resus

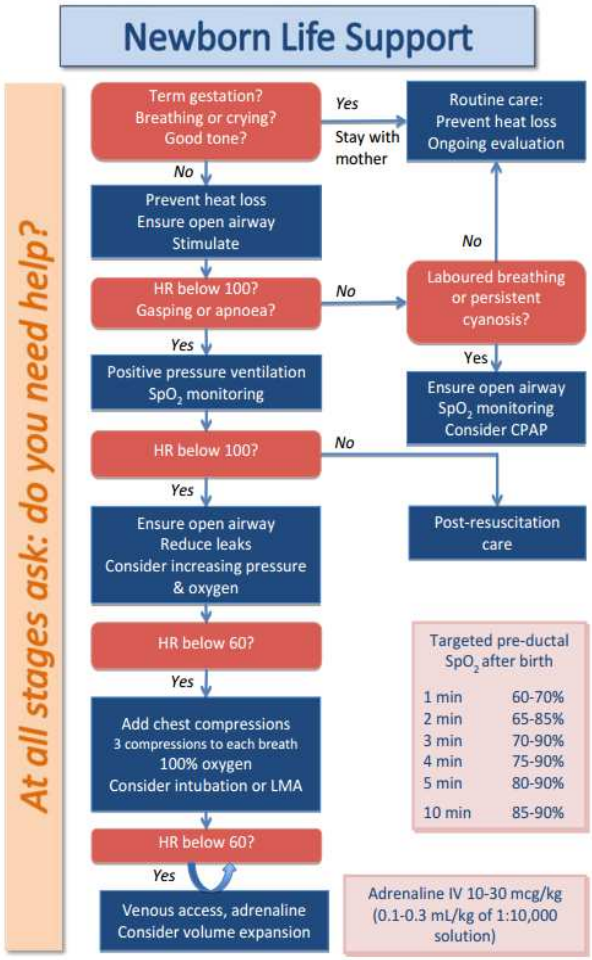
Most arrests are due to hypoxia, hypotension, acidosis, underlying illness
Most common dysrhythmias severe bradycardia, asystole

Weight

Newborn: 3.5kg
1yr: 10kg
1-10yrs: (age + 4) x 2
BP = (age x 2) + 70
UO = 2ml/kg/hr in infant, 1ml/kg/hr in child

BLS / ALS

A: infant = neutral, child = sniff
B: look, listen, feel 10secs; do 2 rescue breaths
C: pulse check - start CPR if no pulse or <60bpm with poor perfusion
Pauses should be <10secs
Swap providers Q2min; depth ⅓ AP diameter; lower ½ sternum, 100/min
3:1 in neonate, 15:2 in children; 30:2 in adult/1 health care provider
Paddle size: 4.5cm infant, 8cm child; All shocks 4J/kg
Help 1st as likely cardiac if: witnessed collapse or known cardiac condition in child (and all adults)
BLS 1st as likely respiratory: unwitnessed arrest in child (not in adults) - get help after 1min CPR
ETT:
mm: (age/4) + 4 (uncuffed)
(age/4)+ 3.5 (cuffed)
Length: (age/2) + 12
ICC (4x ETT)
Surgical: use cricothyroid puncture if <12yrs
Ventilator: have small air leak; NG mandatory; use p control ventilation for infants



Shock: 20ml/kg IVF - if still shocked after 40ml/kg, use inotropes/blood products 4ml/kg PRBC
Maintenance: use 0.45% saline + 2.5-5% dex in children
Use 0.18% saline + 10% dex in neonates

DCC: unstable SVT: 0.5-1J/kg; pulsatile VT 0.5-2J/kg

Neonatal resus

1. Stimulate, dry, warm
2. Assess colour/tone/breathing/HR (C/T/B/HR)
3. Open airway, suction mouth and nose
   - do Apgar after this
4. Blue/floppy/not breathing/decr HR:

- open airway
- suction if meconium
- 5 inflation breaths (2-3sec, 30cm H20)

5. After 30sec reassess C/T/B/HR.
   - If HR <100: further 30sec vent
   - If HR <60: start CPR 3:1, 120/min
   ⅓ depth of chest. lower ½ sternum
   100% O2, consider intubation
6. Venous access
   - umbilical vein: insert 10-12cm
   - IO
7. Consider drugs:
   - adrenaline 0.1ml/kg 1:10,000
   - dextrose 10% 2.5ml/kg
   - fluid bolus 20ml/kg

Indications for intubation

Prolonged resus/CPR
Prematurity
Meconium aspiration
Apgar <4
?congenital diaphragmatic hernia
VLBW

Apgar score	**0**	**1**	**2**
Appearance	Blue/pale	Acrocyanotic	Pink
Pulse	Absent	<100/min	>100/min
Grimace (reflex irritability)	No response	Grimace	Cry/withdraw
Activity (tone)	Limp	Some flexion	Active
Respiration	Absent	Weak	Good, crying

Measured at 1 and 5 mins
If <7 at 5mins, continue Q5min until >7
1min correlates with acidosis and survival
5mins correlates with neuro outcome

If >8: no resus needed
If 4-7:IPPV - intubate if no improvement at 30secs
If <4: intubate

Causes of neonatal arrest

i**N**born errors of metabolism
Electrolytes
OD
Seizures
Enteric
Cardiac
Recipe (formula etc...)
Endocrine
Trauma
Sepsis

Causes of neonatal cyanosis

Airway obstruction (laryngeal web)
Pulmonary disorders (aspiration, pneumonia, diaphragmatic hernia)
Congenital heart disease
CNS (ICH)
Hypoglycaemia
Sepsis/shock
MetHb

Perinatal asphyxia

Umbilical artery pH <7 or 5 min Apgar <4

Meconium aspiration

25-50% require mechanical ventilation
If stained, suction as soon as head delivered
Intubate and perform tracheal suctioning if meconium staining + decr RR/decr tone/HR <100

Post-Arrest Care

Continue respiratory support
Maintain cerebral perfusion
Avoid secondary injury
- Normocapnoea
- Oxygenate, maintain sats 94-98%, avoig hyperoxaemia
- Normoglycaemia, treat >10
- SBP >100

Seek and treat cause
- Hypoxia, Hypovolaemia, Hypo/Hyperthermia, Hypo/Hyperkalaemia
- Tamponade, Tension PTX, Toxins, Thromboembolism (PE/MI)
- Early PCI If ACS possible (even nondiagnostic ECG)
- Treat/prevent cardiac arrhythmia

The Morbidly Obese Patient

Difficult Intubation
- Estimate by neck circumference
- Short neck, breast, pharngeal fat

Difficult BVM
- Higher pressures

Intubation
- Pre-oxygentaion critical (desaturate quicker) – pre-oxygenate ?NIV
- Position: elevation of shoulders (fat/breasts away from neck)
- Short handled laryngoscope
- Consider: Awake intubation, Nasal, Fibreoptic
- Incr incidence GORD

LMA
- May be harder to obtain seal/high pressures

Surgical Airway
- Landmarks obscured
- Require higher pressures - may be ineffective

Optimise positioning

Post-intubation

Clinical findings less useful to confirm ETT placement
TV based on IBW
Pulse oximetry may be inaccurate
Add 10cm H2O PEEP whenever possible
Decr FRC - smaller oxygen reserve with pre-oxygenation, 50% shorter time to desaturation
Incr O2 consumption and CO2 production
Higher ventilation pressures
Tilt bed feet-down

Drugs

IBW Males = 50kg + 2.3kg for each inch over 5 foot
IBW Females = 45kg + 2.3kg for each inch over 5 foot
LBW = IBW x 1.3
Dose by IBW: propofol, ketamine, rocuronium, vecuronium, benzos, morphine, paracetamol
Dose by TBW: sux
Dose by LBW: fentanyl, thio, clexane
Incr renal clearance of drugs
Higher Vd - Dose lipophilic drugs on TBW, Dose hydrophilic drugs on IBW

Imaging

Standard X-ray - plates may be too small for standard abdo/chest
Weight limits
Ultrasound less effective

Lumbar Puncture

Sit up

Trauma
Obscured physical signs
Less likely to wear seatbelts
Markedly increased mortality from trauma
DPL may be required due to weight limits on CT, USS difficulties

Therapeutic hypothermia

Mild to moderate hypothermia (32-34C)
Thought to:
- Reduce neuronal damage following cardiac arrest
- Improve survival after OOHCA
- Increase systemic vascular resistance without reducing EF
- Reduce myocardial O2 consumption
- Only of benefit following VF/VT

Nielsen et al. 2013 Targeted Temperature Management at 33C versus 36C after Cardiac Arrest.
No benefit from cooling to 33C cf 36C

Criteria for therapeutic hypothermia
ROSC< 60 minutes after initiation of resuscitation
Persistent absence of response to verbal commands

Complications
Arrhythmia: VF, AF, extreme brady, CV instability, Coagulopathy, infection, hyperG, decr K/phos/Mg, diuresis

Contraindications
Cardiogenic shock
Pregnancy
Active bleeding
Traumatic arrest
Recent major surgery
Severe sepsis

Problems
Cold diuresis and hypovolaemia
Coagulopathy and platelet dysfunction
Shivering – requires sedation and paralysis
CV instability
Arrhythmia

ACLS in Hypothermia

BLS: Pulse and breathing check 60sec**;** Gentle handling
Defibrillation: Up to 3 attempts, Then withhold until temp >30
Drugs: Withhold until temp >30, Double interval between doses when temp 30-35
Rewarming: ECMO/bypass most effective**;** Warmed fluids 42 deg**;** Warmed, humidified oxygen**;** Bair hugger**;** Body cavity lavage

Arrest post-intubation

Oesophageal intubation
Main bronchus intubation
Hyperventilation - incr intrathoracic pressure - decr venous return; tension PTX
Hypovolaemia
Air embolism

Anaesthetics Summary

Airway Risk Assessment

Anaesthetic Hx/Fhx
PMHs, meds, allergies, past anaesthesia

Mallampati Classification:

1. soft palate, uvula, pillars
2. no pillars
3. soft palate and base of uvula
4. only hard palate

Cormack score during previous intubation:

Grade 1 - vocal cords
Grade 2 - only posterior commisure fissure
Grade 3 - only arytenoids
Grade 4 - only epiglottis

Difficult BVM (MOANS)

Mask Seal (Especially Facial Hair and Trauma)
Obese
Advanced Age
No Teeth
Stiff lungs/snoring

Difficult intubation (LEMONS)

Look externally
Evaluate incisor distance (2-3 fingers), hyoid-mental, thyromental "3,3,2"
Mallampati
Obstruction/obesity
Neck mobility
Situation

Difficult Cricothyroidotomy (SHORT)

Surgery
Haematoma
Obesity
Radiation
Trauma

Paediatric Airway

Physiology

Incr chest wall compliance and reduced lung compliance - promotes collapse - rapid desaturation
Incr vagal tone - bradycardia and hypotension common post induction
Cardiovascular stability dependent on HR (stroke volume fixed)

Anatomy

Cricothyroidotomy not indicated <10 years
Narrowest part of airway is cricoid cartilage <5 years
Large occiput, large tongue, large epiglottis
Larynx anterior - BURP may be helpful

Pregnant Airway

Need optimum positioning and preparation
Third trimester - placed in left lateral position to avoid aorto-caval compression syndrome

Physiology

Rapid desaturation
Incr O2 consumption, incr MV, decr FRC and TV
Reduced LOS tone, incr aspiration risk, reduced gastric empyting, GORD
Incr circulating volume, anaemai, reduced BP, reduced TPR
Avoid hypotension - decr perfusion to placenta in low flow states

Anatomy

Large breast, engorged and friable tissues in airway - incr bleeding
Difficult BVM ventilation

Obese Airway

Difficult BVM - airway adjuncts, 2 person BVM
Difficult intubation - optimum positioning - consider ramping, reverse trendelenberg
Prepare for difficult airway incl intubating LMA, diff size blades, video laryngoscope, surgical airway
Rapid hypoxia during intubation - optimise pre-ox with NIV or BVM with PEEP valve, HFNP apnoeic ox, avoid apnoea during induction with manual bag ventilation, most skilled intubator
Difficult ventilation -TV based on IBW, sit head up slightly to unload diaphragms, keep sedated/paralysed
Drugs - use ideal body weight, except Sux/fentanyl use TBW

Guedel airway: Size from central incisors to angle of jaw
NPA: Female size 6, Male size 7, Tall male size 8

LMA

Indications: Spontaneous ventilation anaesthesia; Convenience; can't intubate/can't ventilate

Advantages
Atraumatic
Doesn't require intubation
Easy to learn method - eg pre-hospital
Can buy time in difficult airway, May allow intubation down the LMA

Limitations/Contraindications
Does not protect airway
Causes pharyngeal discomfort
Insertion may cause pharyngeal trauma
Limited use for IPPV - risk gastric distension, leak
Obstruction of upper ariway
May leak with high pressures
Some anatomies don't fit
May contribute to laryngospams (esp with bronchial secretions irritating cords)

Sizes
1. Neonate to 6.5kg (5ml) = infant
2. 6.5 - 25kg (10ml) = child
3. >25kg (25ml) = small adult
4. Normal/large adult = 35ml
5. Large adult

Laryngoscopy

MacIntosh: size 3 normal, size 4 large
Miller: straight
Video: improved glottic visualisation in inexperienced hands, can supervise
expensive, fogging, secretions, slow setup

Drugs via ETT

Epinephrine 100mcg/kg
Atropine 30mcg/kg
Lignocaine 2-3mg/kg

Intraosseous access

Uninjured extremity, proximal tibial route
Knee 30 degree flexed
Anteromedial surface of upper tibia, 1-3 cm below the tubercle
Insert EZIO at 90 degree angle (with the needle directed away from the growth plate)
Confirm placement by aspirating bone marrow, flush with NS
Commence fluid/medication infusion as appropriate

Complications
Infection
Through and through penetration of the bone
Haematoma formation
Pressure necrosis of skin
SC infiltration/compartment syndrome
Growth plate damage

Analgesia

Non-pharmacological pain management

RICE, splint, reassurance/distraction, Sucrose for infants
Treat underlying source (relocate joints, GTN for angina, drain abscess)

Local Anaesthetics

Amides (contain two 'i's) - lignocaine, prilocaine, bupivacaine - True allergy extremely rare
Reducing pain of LA:

- Distraction, Topical anaesthesia
- Warm, Buffer
- Smaller needle, Slower injection, Smallest volume possible, Inject through open wound
- Regional nerve blocks

Peripheral Nerve Blocks

Pros - Smaller doses, less painful, doesn't distort wound, USS increases success rate
Cons - Operator dependent, not always successful

IV regional anaesthesia (Biers block)

Pros

Quick and complete anaesthesia
Muscle relaxation
Bloodless operating field

Contraindications

LA allergy
Sickle Cell Disease, PVD/Raynaud's
Compromised circulation or compartment syndrome; Ipsilateral # humerus
Severe Hypertension (sBP>200), Severe Liver disease, Uncontrolled Epilepsy
Uncooperative patient/refusal, Lack of staff/area/equipment availability

Procedure

Consent - ideally written
Area/staff/monitoring/resus equipment
Bilateral iv access
Check equipment
Exsanguination of limb, Inflate cuff >100mmHg above SBP, Lower limb
Inject LA: prilocaine 0.5ml/kg of 0.5% (2.5mg.kg) over 90 secs
Perform procedure
Deflate cuff - minimum 20mins, maximum 60mins
Post-procedure monitoring

Extubation in ED

Requires appropriate staff, equipment, department and patient conditions.
Patients with temporary/reversible pathology (eg drug overdose) often suitable
Patients with a high risk of failure of extubation should not be extubated in ED

Staff: At least 2, one to remove tube, one to suction/document/give drugs/O2

Equipment

- Suction, scissors (to cut tube & deflate balloon if needed)
- Monitoring: ETCO2 & Sats
- Intubation equipment: including BVM & drugs; OPA
- Difficult airway trolley

Department

- Avoid extubation at shift changeover, busy times

Drugs

- In case of need for re-intubation. Paralysis reversal eg Neostigmine; Other: Naloxone, Flumazenil

Patient

- No contraindications as above
- Adequate spontaneous ventilation
  - Aim: RR >8-10/min < 20/min
  - TV > 8-10ml/kg, or VC breath 10-15ml/kg
  - PEEP < 10cm H20
  - PaCO2 not rising
- Adequate Oxygenation, FiO2 <50%

Adequate Conscious state - ability to protect airway and clear secretions
Maintained eye opening = equates to return of airway reflexes; Obeying commands

Process
Ensure patient meets criteria
Staffing, drugs, equipment, area, monitoring
Explanation
Preparation: stop sedation, +/- reverse paralysis, empty stomach (NGT), OPA to prevent biting, 100% O2
Suction ETT and mouth, patient upright
Removal: tape/OPA, deflate cuff, remove ETT on end deep inspiration, suction, O2 via mask, positioning
Complications: Obstruction, Aspiration, Laryngospasm, Residual drugs, Unable to deflate cuff

Induction Drugs

Propofol
Induction: 1-2mg/kg
Procedural sedation: 0.5 – 1mg/kg
Infusion: 1.5-3mg/kg/hr
SE: Hypotension, –ive inotropic effects, Apnoea, Pain on injection
CI: egg allergy

Etomidate
0.1 – 0.3mg/kg - boluses 0.05mg/kg
SE: Pain on injection; myoclonic activity (20%); post-op N+V; similar resp depression to propofol

Ketamine
Induction: 1.5-2mg/kg IV - additional doses of 0.5-1mg/kg to prolong sedation
Procedural sedation: 0.5-1mg/kg IV; 4mg/kg IM
Analgesia: 5mg IV Q5minly - 2-10mg/hr infusion
SE:
Dose-related CV stimulation
?Incr IOP/ICP
Salivation, bronchorrhoea; laryngospasm rare
Vomiting; purposeless movements; emergence phenomena
CI: HI, URTI, incr ICP, glaucoma, globe penetration, HTN, CCF, thyrotoxicosis, IHD

Midazolam
0.05mg/kg in older children and adults

Fentanyl
Induction: 2-10mcg/kg
Analgesia/PSA: 1-2mcg/kg
SE: chest wall rigidity; hypotension; bradycardia; resp depression; N+V; facial pruritis

Inotropes

Effects
α - vasoC - incr SBP
β1 - inotrope/chronotrope - incr SBP and CO
β2 - inotrope/chronotrope, vasoD in muscles - decr PVR, decr DBP
D1 - vasoD inc renal and splanchnic bed - decr peripheral resistance

Adrenaline
α+++; β1++++ = β2+++
Indication: in LA to decr blood flow; complete HB ; septic shock; cardiac arrest; anaphylaxis; asthma;
0.1 – 2mcg/kg/min or 1-20mcg/min or 0.3 - 3mg/hr 1mg in 1L = 1mcg/ml
Cardiac arrest: 1mg Q3mins. Anaphylaxis: IM: 1:1000; Adult: 0.3-0.5ml (Children: 0.01ml/kg)

Noradrenaline
α; β1
vasoC (renal and mesenteric), no vasoD - incr SBP and DBP, incr SVR
ino and chrono - incr HR; improved renal blood flow and UO in sepsis
Indication: vasoD shock; cardiogenic shock
2mcg/kg/min

Dopamine
D1, D2 and β2 at low dose; β1++++ at mod dose; α at high doses
Indication: Anaphylaxis, hypotension, cardiogenic shock w mild hypotension, trauma, sepsis, CHB
2 –50mcg/kg/min

Dobutamine
β1++++ >> β2++; some α + - vasoC
Indication: anaphylaxis, mild hypotension; 1st line in CCF; cardiogenic shock, RV infarct
2 – 20mcg/kg/min

Phenylephrine/metaraminol
pure α agonist - vasoC - incr SBP
Indication: hypotension; useful in severe AS and HOCM as not a chronotrope
100-200mcg/min or boluses phenylephrine; 1mg boluses or 1-5mg/hr INF metaraminol

Isoprenaline
β1++++ = β2++++; no α affect - ino, chrono (incr HR), incr CO, vasoD
Indications: refractory bradycardia, TdP
Dose: 20-40mcg IV bolus - 0.5-20mcg/min

Intubation

Indications for ETT
Airway protection - create, maintain, protect
Hypoventilation not treatable with NIV
Hypoxia not treatable with NIV
Hyperventilation required (coning, TCA OD)
Selective lung ventilation (massive haemoptysis)
HC ingestion
Hyperthermia
Drug delivery (surfactant in neonates)
Likely to deteriorate - prophylactically - airway burns, neck haematoma

Contraindications
Total upper airway obstruction
Total loss of facial/pharyngeal landmarks
Anticipated difficult airway, likely to result in CICO situation, especially if drugs given

Complications
Dental/oropharyngeal trauma
Aspiration 1:7000; Death 1:100,000
Oesophageal perf; gastric distension
Decr BP (drugs, autoPEEP), incr BP (inadequate sedation)
PneumoT, atelectasis, hypoxaemia
Arrhythmia
Incr ICP
SE of drugs
Bradycardia common in children so consider atropine
Laryngospasm - small dose propofol/thio + sustained positive airway pressure to break spasm

Rapid Sequence Intubation

Preparation
Staff – assemble skilled team, call for expert help if required (anaesthetics/ENT)
Equipment – laryngoscope, ETT, syringe, tape, suction, oxygen, airway adjuncts, rescue plan
Drugs – induction and paralysis agents, pressor, IV fluids with multiple, secure access.
Patient – assess airway/C-spine, fasting status, allergies, medications; pre-oxygenate, optimise position
Monitoring – continuous ECG monitoring, pulse oximetry, BP monitoring and end-tidal CO2 monitor

Position
Optimise, sniffing, ramping
Preoxygenation
Maximise pre-oxygenation - BVM with FiO2 100%, supplement with HFNP
Bag-mask 3 minutes or 6 tidal breaths >15L NRB
PEEP/NIV
Pretreatment
Fentanyl 3mcg/kg for tight head, tight heart, dissection/aneurysm
Child: atropine 20mcg/kg
Paralysis + induction
Etomidate 0.3mg/kg or Ketamine 2mg/kg, Suxamethonium 1.5mg/kg

Protection
Cricoid +/- in-line manual stabilisation of head
Placement with proof
Wait one minute after sux / until fasiculations stop; intubation
ETCO2, oesophageal detector device, misting
direct inspection of tube passing though cords
auscultation of lungs and stomach
normal airway pressures
CXR
Postintubation Management
Stabilise tube; paralysis; sedation; ventilation; NGT or OGT; IDC

Upper Airway Obstruction
Dual preparation - laryngoscopy + surgical airway setup
Have surgical airway person scrubbed and ready
Small amount sedation - 30mg ketamine
No paralysis, attempt laryngoscopy with bougie, paralyse if able to view cords
Back up - BVM
Back up - intubating LMA
Back up - surgical airway

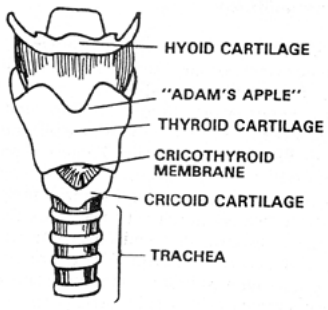
Intubation - head injury
Prepare for difficult airway - experienced intubator, video laryngoscopy, bougie
Manual in-line immobilisation
Treatment/avoid raised ICP
Fentanyl to blunt response to intubation
Ketamine 2mg/kg - avoids hypotension, no evidence raises ICP
Sux 1.5mg/kg - good intubating conditions/rapid onset - less risk hypoxia
Maintain oxygenation - pre-ox + apnoeic ox
Avoid hypoxia and hypotension

Failed Intubation

1. **HELP! Get difficult airway trolley**
2. **STOP** and BVM with 100% O2
3. **Make change**: position of head, adequate relaxation, BURP
4. **Stylet / bougie**
5. **LMA**
6. **Fibreoptic** if breathing spontaneously
7. **Or BVM and allow to wake up**
8. **Surgica**l

Surgical airway

Contraindications: Neck mass, No neck, Bleeding diathesis
Complications
Haematoma/bleeding
Pre-tracheal placement
Pneumothorax, subcut emphysema, tracheal tear
Oesophageal damage
Recurrent laryngeal nerve damage



Open cricothyroidotomy
Vertical incision skin - horizontal incision CT membrane - open with arterial forceps/bougie - use 6mm tube
Needle cricothyroidotomy
14G IVL - insert at 90deg - when aspirate air angle 45deg, go caudally - connect to 2ml syringe then 7.5 ETT
Allows oxygenation but not ventilation with 15L O2; occlude 1/release 4; airway not protected

Non-Invasive Ventilation

Works to splint airway, reduce WOB, improve compliance, reduces preload (hypotension)
CPAP: For improvement of hypoxaemia **BiPAP:** For improvement of hypercarbia
Goals: TV 5-7ml/kg, RR<25/min, SaO2>90%

Indications
Type I resp failure with RR >30 or Type II resp failure with RR >24
+ awake, cooperative, breathing spontaneously, no XS secretions
IPAP - decr WOB; EPAP - prevents alveolar collapse during expiration, incr oxygenation/CO2 elimination

Absolute contraindications
Need for urgent endotracheal intubation
Decreased LOC - unable to protect airway
Excess respiratory secretions and risk of vomiting and aspiration
Past facial surgery precluding mask fitting
Upper airway obstruction, facial fractures
Untreated PTX

Relative contraindications
Haemodynamic instability
Severe hypoxia and/or hypercapnia, PaO2/FiO2 ratio of <200mmHg, PaCO2> 60mmHg.
Poor patient cooperation
Lack of trained or experienced staff
Inability to protect airway - poor cough, decr LOC
Recent GI surgery

Complications
Problems related to pressure: Pneumothorax, Gastric insufflation, Sinus pain
Problems related to airflow: Dryness, Nasal congestion, Eye irritation
Major complications: Severe hypoxaemia, Aspiration, Hypotension, Mucous plugging
Other complications: Claustrophobia, Air leaks, Pressure sores

Pros
Decr need for intubation in 25% overall, 90% in APO; Decr intubation-related complications
Most benefit proven in severe COPD - Reduced ICU admissions/mortality/LOS, incr survival to discharge
Can treat patients not suitable for intubation
CPAP and BiPAP benefit in treatment of resp failure caused by APO, COPD, immunosupp

Cons
Less evidence in pneumonia, ARDS, asthma (uncertain, needs more trials), children
No significant benefit in ED without resp failure
BiPAP uncertain in APO (assoc with incr rate MI)
Not tolerated by 20-30% patients

Initial IPAP/EPAP settings
10/5cm of water to achieve tidal volumes desired
Increase increments of 2cm of water until IPAP 20-25 and EPAP 10-15 cm water
    Increase EPAP if hypoxic, titrate to pO2
    Increase IPAP if hypercarbic, titrate to TV/pH/RR/PaCO2
FiO2 at 1.0 then titrate to sats

IV Fluids

Targets
Physiological – SBP 90, MAP > 65mmHg, HR <100
Perfusion – UOP > 0.5ml/kg/hour, Lactate <2mmol, resolving base deficit, Cap refill < 4s

Complications of fluid therapy
Hypothermia after large volumes of fluid therapy
Coagulopathy due to dilution
Tissue oedema – limb and abdominal compartment syndrome
Pulmonary oedema
Hyperchloraemic acidosis with NS
Anaphylaxis to synthetic colloids/blood transfusion

Crystalloids vs colloids - SAFE study
No sig difference albumin/saline in ICU patients in ICU/hospital LOS, duration of mechanical ventilation
Incr mortality in HI

Hypertonic saline (7.5%)
Interstitial dehydration - decr ICP/cerebral oedema. 250ml dose

Paralysis Drugs

Train-of-four:
TOF ratio is magnitude of 4^{th} twitch : 1^{st} twitch
Depolarising block (succ): all 4 twitches reduced proportional to dose
Non-depolarising block (roc): decr TOF ratio (fades), inversely proportional to dose

Depolarising - Suxamethonium
Onset: 45-60secs
Offset: 8 – 11mins
Metabolism: rapid hydrolysis by pseudocholinesterase in liver and plasma
Dose: 1 – 1.5mg/kg IV (decr dose in pregnancy, malignancy, old age, malnutrition; 1.5mg/kg in infants)
SE: hyperK (burns, renal failure, NMD, spinal cord transection, closed HI, trauma)
bradycardia
incr IGP, IOP, ICP
loss of muscle tone - cervical spine injury, loss of tamponade on AAA
malignant hyperthermia
prolonged paralysis
muscle pain
CI: Burns (9-66 days from injury,>20% TBSA), incr K
Neuro conditions (10/7 SC inj, UMN lesions, neuropathy, tetanus, muscular dystrophy, CVA)
Congenital myopathies
Crush injury
Infection

Non-depolarising - Rocuronium
Onset: <60secs ; Offset: 30-40mins
Dose: 1mg/kg
Sugammadex: reversal

Physiological Monitoring

Pulse Oximetry
Decr accuracy:
movement; <70%
False decr SaO2:
met-Hb (reads 85%)
methylene blue
poor perfusion at sensor site
external light interference
severe anaemia
false fingernails, dirt, nail polish
False incr SaO2:
CO poisoning (probe mistakes CO for O2)
COHb curve:
R shift = give up O2 = acidosis, 2,3 DPG, fever
L shift = hold on to O2 = CO, Met-Hb, HbF, alkalosis, hypothermia

ETCO2
Normal ETCO2 = 35-40
Incr ETCO2:
incr CO2 production (fever, sepsis, seizure, thyroid, HCO3)
incr CO (ROSC)
decr alveolar ventilation
Decr ETCO2:
decr CO2 production (Paralysis, sedation, hypothermia)
decr pulm blood flow (CCF, PE, hypovolaemia)
incr alveolar ventilation
equipment malfunction
Arterial line
Indications: Cuff pressure unreliable or not possible, gas/blood sampling, Continuous monitoring
MAP = DBP + (PP/3). MAP <60 compromises organ perfusion

CVP
Marker of preload = RAP; <5 = hypovolaemia, >12 = RV failure

Procedural Sedation

Indications
Very painful procedure
Moderately painful protracted procedure
Extreme anxiety when anxiolysis fails
Need for complete motionlessness
Emergency: cardioversion, # with NVI, intractable pain
Urgent: dirty wounds, lacs, dislocation, LP, CT
Semi-urgent: FB, clean wounds

Classification
Minimal: respond normally
Mod: responds purposefully to verbal commands
Dissociative sedation: patient cannot be easily roused; respond purposefully to painful stimulation; A/RS maybe affected; CV usually OK
GA: LOC, not rousable

Technique
Preparation

Patient	Explain, reassure; Informed consent
Staff	1 airway doctor (appropriately trained and credentialed)
	1 procedure doctor
	1-2 nurses
Area	Resus bay; Full monitoring (ECG, SaO2, NIBP, ETCO2)
	Enough room to perform procedure; Rest of ED not too busy
Equipment	O2, suction, airway equipment; Stuff for procedure eg plaster trolley
Drugs	Analgesia – fentanyl; Sedative – propofol or ketamine

Procedure

PPE	Gloves, Aprons if messy
Pre-med Fentanyl	1mcg/kg 3-5mins before procedure; midazolam if anxious
Positioning	30 degrees head up; Head down for CVC, Left lateral for LP
Prep/drape	Ensure all equipment ready; Sterile prep for LP/chest drain/CVC
Perform	Pre-oxygenate 3 mins or 8 VC breaths
	Initial dose sedative
	Propofol 0.5-1mg/kg Ketamine 1-1.5mg/kg
	Use reduced doses in elderly/low BP
	Further doses 20-30mg propofol every 30 secs until appropriate depth of sedation achieved
	Endpoints:
	Propofol: eyes closed, V or P on AVPU, eyelash reflex disappears
	Ketamine: dissociative state, eyes open and staring, lies still
	Perform procedure

Post-procedure
Observe in resus until fully awake
Seek and treat complications
Airway obstruction – jaw thrust, airway adjunct
Desaturation – stimulate patient, BVM if no response
Hypotension – small boluses metaraminol 0.5-1mg
Laryngospasm – get help, BVM with 100% O2 + CPAP, jaw thrust, sedate, paralyse, intubate
Anaphylaxis – adrenaline
Confirm success of procedure with post-reduction xrays
Document – details of procedure, drug doses used

Patient selection: current condition, intended procedure, PMH, DH, A, prev GA, fasting, airway anatomy, CV and RS status, vitals

Contraindications
Allergy to sedatives used
Unstable patient: seizures, vomiting, hypotension
Inadequate staffing/area/equipment
Non-urgent procedure

Significant medical comorbidities - ASA grade III or IV
Predicted difficult airway or BVM
Pregnancy or morbidly obese
Not fasted (depending on urgency)
Refusal
Ketamine - psychosis, active pulm infection or asthma

Discharge
At least 1hr after; pt alert, orientated and returned to pre-procedure state; ambulates safely; comfortable; accompanying person and transport; no driving 8hrs, appropriate FU organised, written instructions, warn about post-procedure Sx (eg. Pain, dizziness); discharge analgesia; avoid ETOH/CNS depressants 12-24hrs

	Propofol	**Ketamine**
Type of agent	GA	Dissociative
Initial dose	0.5-1mg/kg	Child 1-1.5mg/kg (im 3-4), adult 0.5-1mg/kg
Top-up dose	0.5mg/kg	0.5mg/kg
Onset	<40 sec	Iv 60 sec, im 5mins
Duration	5mins	Iv 15min, im 30min
Adjuncts	Fentanyl 1mcg/kg analgesia	Atropine 10mcg/kg dry secretions
Role	Adults	Children, elderly
CIs	Egg/soy allergy, hypotension	Eye inj, glaucoma, raised ICP
Pros	Short, antiemetic, familiar, available, rapid onset, titratable	Analgesia, airway reflexes, haem stable, bronchodilation
Cons	Pain, resp depression, apnoea, hypotension	Vomiting, tachy/hypertension, salivation, laryngospasm, emergence phenomenon, ICP/IOP, myoclonic jerks, nystagmus

Midazolam: Amnestic and sedative but Respiratory depression

Ventilation

Lung protection
Vol A/C or SIMV
TV 6ml/kg
Insp Flow 60-80ml/min
RR 12-20
I:E 1:2
FiO2 1.0 - 0.4, aim sats 88-95%
PEEP 0-5cmH2O
Plateau Pressure<30cmH2O to avoid barotrauma

Obstructive lung disease
Vol A/C or SIMV
TV 8ml/Kg
Insp Flow 60- 80ml/min.
RR 8-10
I:E 1:4-5
PEEP 0

Complications
Hypotension (incr intrathoracic pressure - decr VR)
Intubation trauma
Barotrauma
Air-trapping/intrinsic PEEP
↑WOB if asynchrony
Nosocomial infections
Bronchospasm
Mucosal drying and cilial paralysis

PEEP
Improves oxygenation
Recruits collapsed alveoli, prevents collapse of alveoli
Improves alveolar fluid distribution - decr distance between capillary and alveolar space
Indications: paO2 <60 despite FiO2 >50%; diffuse acute pul disease; non-compliant lungs

Problems

1. Hypoxia

Low ventilation - incr TV and/or RR
Low FiO2 - incr FiO2
V/Q mismatch (mainstem intubation, PTX, PE) - find and treat cause
Diffusion impairment (emphysema, fibrosis) - pressure control
Shunt (alveolar collapse or filling - pneumonia, ARDS, collapse, CCF) - add PEEP

2. Not ventilating

Disconnect from ventilator
BVM 100% FiO2
Check patient - ETT position, tension, PTX, agitation
Check tube - suction, cuff
Check ventilator

3. Auto-PEEP (breath stacking in asthma)

Diagnosis: decr sats, decr BP, PTX excluded, check exp flow curves
Disconnect from ventilator
Connect BVM but do not ventilate
100% FiO2
Allow to exhale (up to 1-2mins)

4. Low system pressure

Check circuit connections, check seal with patients

5. High system pressure

Check neck position, check for obstruction

6. Low airway pressure

Cuff leak, pilot balloon rupture, check connections

7. High airway pressure

Check patency of ETT, suction ETT, check for kinking or jaw clamping, check for cuff prolapse, spontaneous respiration, epigastric distension, bilateral BS's, wheeze (?asthma, anaphylaxis, LVF, aspiration, pneumoT)

Post-Intubation Care

Fluid therapy and feeding
Analgesia, antiemetics, ADT (AAA)
Sedation and Spontaneous breathing trial
Thromboembolism prophylaxis
Head up (30 degrees)
Ulcer prophylaxis
Glucose control
Skin/eye care and suctioning
IDC
NGT
Bowel cares
Environment - temp control
De-escalation
Psychosocial support and paralysis

Considerations for different anaesthetic techniques

Patient (+/- parent)
- Stability and neurovascular status
- Comorbidities
- Fasting status
- Consent
- Preference

Departmental
- Staffing level and seniority
- Current state of ED
- Available specialist assistance eg ortho
- Local guidelines

Surgery Summary

AAA

Risk of rupture: 40% >6cm; 20% <6cm
Prognosis elective repair: <10% mortality using open technique; 5% mortality EVAR
Prognosis ruptured: 80% mortality overall; 45% mortality if reach hospital, 50% mortality for emergent OT
Poor prognostic features: incr age, pre-op renal impairment/hypotension/anaemia, massive transfusion
Causes: Atherosclerosis – smoking, HTN; CT disorder (Marfans); inflamm; mycotic Salmonella, Staph aureus
Complications
Of aneurysm: Rupture; aorto-enteric fistula; aorto-venous fistula; Infected aneurysm - haematogenous source (bacterial endocarditis, transient bacteraemia); Strep, Haemophilus, Staph, E coli,
Of repair: 5-10% elective complication rate; higher if emergent; 2Y haem, endoleaks, ARF, AMI, CVA, graft infection, limb loss, mesenteric ischaemia, impotence, paraplegia
Investigations
USS: ED docs 90-100% sens >3cm, >95% spec; difficult to assess branches; can't reliably diagnose rupture
CT: can diagnose aneurysm, site, extent, rupture, leakage, do graft measurements; unsafe in CT
AXR: egg shell appearance; 60% AAA's calcified; can't tell if ruptured
Management
Priority is OT; aim SBP 90; beta-blocker if unruptured/incr BP (labetalol 10mg and repeat to max 300mg)

Acute Limb Ischaemia

True vascular emergency
Usually acute thrombotic or embolic occlusion of a previously partially occluded artery.
Without surgical revascularisation <6h complete acute ischaemia → irrev tissue necrosis.
ABI. 6 P's (pale, pulseless, painful, paralysed, paraesthetic and 'perishingly cold').
Causes
Embolism: 90% cardiac (LA in AF, mural thrombus post-MI, valves), aneurysm, tumour, FB.
Thrombosis
Trauma
Compartment syndrome: orthopaedic, vascular (massive DVT), soft-tissue injury (crush injury)
Raynaud's syndrome, vasospasm, vasculitis
Thoracic outlet syndrome
Vascular dissection
Investigations
Bloods: FBC, UEC, ESR, BSL, G&H, Trop+CK, ± thrombophilia screen
ECG: ?AF
Imaging: Hand held Doppler ?pulse. Formal Doppler USS, angiography, CXR, Echo.
Management
Supportive: ABCs, O2, position extremity in dependent position, analgesia
UF heparin ± Aspirin
If evidence of compartment syndrome → fasciotomy.
If embolic → surgical embolectomy or local intra-arterial thrombolysis.
If thrombotic → intra-arterial thrombolysis, angioplasty or bypass surgery.
If limb is irreversibly ischaemic, amputation will be required.
Treat AF or other underlying conditions

Aneurysms

Popliteal aneurysms - 80% of all peripheral aneurysms. Assoc with aortic aneurysms & often bilateral.
Femoral aneurysms - second commonest peripheral aneurysm.
Mycotic aneurysms
Infected aneurysms resulting from bacterial endocarditis
Affects aorta, visceral, intracranial and peripheral vessels
Usually Gram positive cocci, Strep viridans most commonly
Mortality 25%
Management: long term antibiotics and surgical repair

Vascular complications of IV drug use

Intra-arterial injection - Risk of limb ischaemia and tissue necrosis
Additives may cause transient vasospasm and microembolism - microvascular occlusion
Chemical arteritis, venospasm and venous thrombosis
Compartment syndrome

Arterial false aneurysm
Venous thrombosis and thrombophlebitis

Complications of angiography

Pseudoaneurysm - May lead to embolisation, occlusion, rupture and haemorrhage, compression
Vessel occlusion, Haematoma, AV Fistula, DVT, Arterial embolisation, Contrast induced nephropathy

Aortic Dissection

Risk factors
HTN; atherosclerosis; CT disorders (Marfans, Ehlers Danlos); coarctation; congenital AV disease (eg. AS); prev cardiac OT; arteritis; syphilis; pregnancy; cocaine; GCA

Debakey
I: Asc + desc
II: Asc
III: Desc

Stanford
A: proximal aorta +/- distal aorta: 60-70%
B: distal aorta only; 30%
Distal = distal to L subclavian artery

Prognosis
Stanford A: 56-87% 5yr survival with OT
Stanford B: 80% survival with medical trt; 90% 30/7 survival with aggressive BP mng, 55% 10yr survival
Worse prognosis if: old, tamponade, pleural effusion, ECG changes, anticoagulated

Investigation
CXR: 81% sens, 85% spec;
Widened mediastinum (>8cm at carina); blurred aortic knob; double density aorta; separation aortic intimal calcification>1cm; cardiomegaly; L pleural effusion; apical cap; loss of aorto-pulm window; R tracheal/NG deviation; depression L main bronchus
ECG: normal; ACS; non-specific T/ST changes; LVH
D-dimer: 97% sens, 50% spec
CT angiography: Sens 83-90%, spec 90-100%; Modality of choice if unstable
Pros: quick, high sens/spec, readily available; alternate diagnosis/surrounding structures
Cons: can't look for AR; less accurate than TOE (but equivalent survival); contrast, out of ED
Angiography: Gold standard; 88% sens, 94% spec
Pros: detail, branches and AR identified
Cons: delay, contrast load, invasive, lengthy, out of ED/in angio suite, need specialised team, can't assess surrounding structures, false lumen thrombosed - can miss diagnosis
TOE:
Sens 95-100%, spec 70-95%; shows double lumen, flow patterns, intimal tears
Pros: very sens for prox aorta, AR, pericardium, LV, CA's; can be done at bedside in critically ill, can identify complications
Cons: less sens for distal; CI if oesophageal pathology; operator dependent, need sedation, not available small hospitals, invasive
TTE:
A = sens 78-100%; B = sens 30-55%; spec 63-96%; very poor for distal; OK for prox etc.. as above
MRI:
100% sens and spec
Pros: Comparable sens/spec, Identifies side branches
Cons: Not easily available, Safety; lengthy, compatible equipment, Can't assess valves. CI: unstable patient

Complications
Dissection (esp R CA, spinal, carotids, mesenteric, limb, renal); rupture (haemothorax, sudden death), AR, haemopericardium and tamponade, aneurysm, CVA, acute limb ischaemia

Medical Management
Aim SBP 100-110 (aim SBP 90 in AAA) without incr HR; will need life-long beta-blockers

- **Labetalol:** 10mg IV bolus - rpt Q10mins to max 300mg
- **Esmolol:** 500mcg/kg over 1min - rpt Q5mins - 50mcg/kg/min titrated (max 200mcg/kg/min)
- **Metoprolol:** 5mg IV boluses - 2-5mg/hr
- **Nitroprusside:** 0.25-10mcg/kg/min; risk cyanide toxicity; use with beta-blockers- risk reflex incr HR
- **GTN:** 5-20mcg/min (5-50) - titrate up every 5-10mins to max 300; use with beta-blockers

Appendicitis

7% lifetime risk; peak 11-20yrs
Pregnancy: most common abdo surgical emergency; fetal loss 20% overall, 1-5% in uncomplicated
Alvarado scoring system:
Mantrels
Migration of pain
Anorexia
Nausea/vomiting
Tenderness RIF (2)
Rebound pain
Elevated temp
Leucocytosis (2)
Shift of WCC to left
<5 - unlikely
5-6 - possible (observe)
7-8 likely
9-10 - highly likely (7-10 OT)
Complications
Acute: perf, abscess, peritonitis
Post-op: wound infection, pelvic collection, peritonitis
Long term: infertility, adhesions
Investigations
Bloods: WCC 70-90% sens, low spec; neutrophilia >75% (abnormal early); CRP >8 70-100% (N early)
Incr CRP and WCC and neutrophils = 100% sens, 50% spec
Urine: >5 WBC / RBC in 30%; bacteruria in 15% (esp if retrocaecal or Sx for >48hrs)
USS: 80-90% sens (sens 30% if gangrenous/perf), 90-100% spec; finds alternate cause in 40-50%
CT abdo: 90-95% sens, 95% spec; reduces –ive lap rate by <10%
MRI: 90-95% sens, 95% spec; consider in pregnancy

Biliary Disease

Ascending cholangitis
Charcot's triad = pain + jaundice + incr T = present in 25%
Large (cholesterol) stones: 70% - radiolucent
Small (pigment) stones: 30% - radio-opaque
Complications
Gallstones: Cholecystitis; pancreatitis (5%); ascending cholangitis; gallstone ileus; perf; fistula formation
Cholecystitis: perf (10%); subphrenic abscess; gallstone ileus (rare, usually in elderly after longstanding inflamm of GB - erodes into 3rd part of duodenum - fistula - gallstone lodges in terminal ileum), ascending cholangitis, pancreatitis, biliary-enteric fistula, emphystematous cholecystitis (esp if DM) - gangrenous cholecystitis
Cholecystitis Bugs: 74% G-ive (eg. E coli, Klebsiella); 15% G+ive (eg. Staph, strep, enterococcus)
Discharge criteria: resolution of pain; no fever; no upper abdo tenderness when pain free; no features of biliary obstruction; PO intake; pain not returned after eating

Bowel Obstruction

SBO: adhesions > hernias > CD, intussusception, tumours, SMA syndrome
LBO: Ca > diverticulitis > volvulus (10%) > adhesions > hernia
- Sigmoid volvulus: 2/3; chronic constipation; elderly; presents late; 90% recurrence rate
- Caecal volvulus: 1/3; young adults; perf common; gangrene in 20%; mortality 10-40%

Paralytic ileus: post-op, decr K/Na/Mg/alb, TCA, opiates, antiH, beta-blockers, quinidine
Neonatal/paediatric: congenital atresia, volvulus, meconium ileus in CF, Hirschsprung's, intussusception

Complications
Dehydration, electrolyte disturbance, mesenteric ischaemia, perforation
AXR: sens 75-80%, spec 50% (for SBO); >5 AF levels abnormal; dilated bowel loops
SBO: >2.5cm; plicae circulares - cross whole lumen
LBO: >5cm; peripheral; larger; haustra - do not cross lumen
Sigmoid Volvulus: single dilated LOB; both end of loops orientated towards pelvis in sigmoid
Caecal volvulus: dilated caecum in mid-abdomen/LUQ; empty distal bowel

Management
Volvulus: sigmoidoscopy if sigmoid volvulus
Do laparotomy if: guarding, rigidity, incr WBC ++, ?mesenteric ischaemia, ?perf, ? strangulation, failure to improve in 24hrs, LBO >13cm

Indications for NG tube
Upper GI bleed
Bowel Obstruction
Poor gag reflex to prevent aspiration (sedated/intubated patients)

Complications of NG tube
Epistaxis
Pain
Intracranial, bronchial, pharyngeal placement
Oesophageal obstruction or rupture
Pneumothorax
Charcoal/feed installation into lungs
Gastric or duodenal rupture
Vocal cord paralysis
Pneumomediastinum
Laryngeal injury
Knotting preventing removal

Breast carcinoma
Metastatic spread
- Bone - osteolytic; to vertebrae, upper femur, upper humerus - hypercalcaemia
- Liver
- Brain

Diverticulitis
Usually anaerobes (bacteriodes, clostridium, peptostreptococcus) and G-ive rods (E coli)
Complications
Haemorrhage (5-15%; significant bleeding usually from R side), diverticulitis (15-25%), perforation
Management
Conservative if: abscess <2-5cm; liquid diet, augmentin + metronidazole; mild cases orals as OP
OT if: perf, abscess >5cm, uncontrolled sepsis, fistula, obstruction

Hernias
Complications
Adhesion, obstruction, strangulation (most likely in indirect inguinal)
Inguinal 75%
Strangulation more common in infants - OT should be ASAP
Most common hernia (including in women)
Indirect:
2/3; persistent tunica vaginalis; through internal inguinal ring - scrotum
Lateral to mid-point on inguinal ligament, Lateral to inferior epigastric artery
Usually reducible; frequent strangulation
Direct:
Progressive weakening of transversalis fascia and muscular wall, does not go to scrotum
Medial to inferior epigastric artery
Less complications
Femoral 25%
Prone to ischaemia, symptoms early, complications common
Needs urgent OT
Umbilical
Usually resolve spontaneously in children (refer if still present at 4yrs); usually progress in adults, prone to complications, need OT

Ischaemic Colitis
Mortality >50%
Impaired blood supply to intestine, bacterial translocation and SIRS.
Causes
Arterial obstruction: Embolism (eg. AF, transmural AMI); thrombus; aortic dissection
Other: bowel obstruction, bowel herniation, venous infarct (hyperviscosity, pro-coagulant states)
Investigations
Bloods: WCC >15, incr CK, lactic acidosis (poor prognosis), incr amylase, incr phosphate
ECG: AF, AMI
CT angio: 90% sens, 95% spec
AXR: ileus, multiple AF levels, thumb printing, pneumatosis intestinalis

Chronic mesenteric ischaemia
Intestinal angina
Chronic atherosclerotic disease of intestinal vessels, usually all 3 major mesenteric arteries.
Risk factors as for atherosclerosis - smoking, HTN, DM, hyperlipidaemia

Pancreatitis

Mortality 2-10% (20% if severe; mostly due to systemic effects)

Causes
Gallstones, ETOH, Trauma, Scorpion bite / toxins, Mumps, Autoimmune (SLE, Sjogrens, vasculitis), Steroids, HyperCa, ERCP , Drugs (5% - 3rd most common cause; sulphonamides, thiazides, valproate)

Ranson's criteria

At admission	**At 48 hours**
● **A**ge >55	● **C**a <2
● **W**BC >16	● **H**CT fall >10%
● **G**lucose >10	● **H**ypoxia <60
● **A**ST >250	● **U**rea rise >5
● **L**DH>350	● **B**ase deficit >4
	● **S**equestration of fluids >6L

>/=3 = severe
At 48hrs: 0-2 = 1% mortality; 3-4 = 15% mortality; 5-6 = 40% mortality; 7-8 = 100% mortality
Cons: Not clinically useful in ED as can only be completed at 48hrs
More accurate predictor for alcoholic pancreatitis than other causes
Doesn't alter treatment
Not relevant for 80% patients who have benign course

Other predictors in pancreatitis
APACHE II score >8
- Age
- Physiology (T, MAP, HR, GCS, pH, WBC, Na, K, Cr, Hct, PaO2, AA gradient)
- Chronic health (chronic organ insufficiency/immune compromise/ARF)

Glasgow scoring system >/=3
- **P**O2 <60
- **A**ge >55
- **N**eutrophils >15
- **C**alcium <2
- **R**enal dysfunction
- **E**nzymes (raised AST, LDH)
- **A**lbumin <32
- **S**ugar >10

CRP >150
Pancreatic necrosis >30% (Balthazar criteria)
MOF

Complications
Intravascular volume depletion, Infection, ARDS, Pseudocysts, Chronic, DM, splenic vein thrombosis, duodenal obstruction, MOF, hypoCa, coagulopathy

Perianal abscess

Cause: Staph, E coli, Proteus; from anal fissure, perianal haematoma, hair follicle, anal gland
RF: UC, CD, DM, Ca

Peripheral Vascular Disease

ABPI (ankle-brachial pressure index)
N=1, claudication 0.9-0.6, rest pain 0.3-0.6, impending gangrene ≤0.3

Toxicology Summary

1. Resuscitation

A, B

C - Fluid bolus, may need inotropes; beware pulm oedema in Ca antagonist OD

D - Detect & Correct: Hypoglycaemia, Seizures, Hyper/Hypo-thermia

E - Emergency decontamination: paraquat, OP's

Emergency antidote: digibind, calcium, cyanide

2. Risk Assessment

Agent, Dose, Time, Coingestants, Clinical features, Patient factors, Suicide risk

3. Supportive care and monitoring

Document a comprehensive management plan - Expected clinical course, Potential complications
Fluids, pressure area care, ventilatory support
Invasive lines - CVC, art line, IDC<NGTA, pacing wire
Inform next of kin/gain collateral history
Initiate psych care ?guard, psych review when stable
Consider NAI/neglect

4. Investigations

Screening: ECG, paracetamol, glucose, VBG

Specific: Levels, markers of toxicity (U+E, CK, lactate)

5. Decontamination

Charcoal - doesn't bind alcohols, acids/alkalis, metals, hydrocarbons. 50g or 1g/kg

Complications: vomiting, aspiration, impaired absorption subsequent oral antidotes, obstruction

CI: decr LOC, seizures, bowel obstruction, corrosives

Whole bowel irrigation - ties up staff, aspiration risk. For SR preps or don't bind charcoal

For life-threatening: verapamil, diltiazem XR, iron >60mg/kg, K >2.5mmol/kg, arsenic, lead, packers

Complications: N+V, NAGMA, aspiration, abdo cramps, rectal irritation

Technique: NGT, charcoal, PEG 2L/hr, metoclopramide, on commode, continue until clear effluent

Ipecac and gastric lavage - not recommended

Endoscopy/surgery - specific indications

6. Enhanced Elimination

MDAC - Interrupts enterohepatic circulation, GI dialysis. 1g/kg then 0.5g/kg q2h

Risk charcoal bezoar, aspiration. Need: small molecule, small Vd, low PB

Aminophylline/aspirin
Barbiturates
Carbamazepine
Dapsone
Mushrooms
Quinine

Urinary alkalinisation

Indications: phenobarb coma, aspirin, methotrexate, rhabdo

Technique: 1-2 mmol/kg bicarb bolus, infusion 100mmol in 1L 5% dex at 250mL/hour

Check HCO3 and K Q4hrly; aim urine pH >7.5/serum pH 7.5-7.55

CI: fluid overload, hypoK, renal failure

Complications: alkaemia, hypoK, hypoCa, vol overload, pH shifts

Haemodialysis/filtration

Need small molecule, small Vd, rapid redistribution from tissues, slow endogenous elimination

CI: CV instability (fluid shift, electrolyte imbalance), very small children, profound bleeding

Lithium
Metformin lactic acidosis
Potassium
Salicylates
Theophylline
Toxic alcohols
Valproate/CBZ

7. Antidotes

8. Disposition

Criteria for admission to Emergency Observation:

1. Ongoing cardiac monitoring not required
2. Adequate sedation achieved
3. Clinical deterioration not anticipated.

Criteria for admission to ICU:

1. Airway control
2. Ventilation
3. Prolonged or invasive haemodynamic monitoring or support
4. Haemodialysis

In paeds

2 tabs can kill: amphetamines, CCB, chloroquine, opioids, propanolol, sulfonylureas, theophylline, TCA
A sip can kill: OP's, paraquat, HC's, camphor, mothball
2 tabs is fine: paracetamol, Fe, colchicine, digoxin, rodenticide

Hyperinsulinaemia - Euglycaemia Therapy

CCB, BB OD - Improves myocardial metabolism, BP, contractility and PVR
50ml of 50% dextrose + 50IU insulin
End point: cardiovascular stability
Check BSL q 30min, Maintain normokalaemia
Complications: Hypoglycaemia (hyperglycaemia with CCB OD), Hypokalaemia

Lipid partitioning therapy

Indication: LA's, propanolol, TCA, verapamil; life-threatening OD lipid-soluble drug where trt failed
Dose: 1ml/kg 20% intralipid over 1min (max 100ml) - rpt if needed - 10ml/hr infusion

NaHCO3

1. Hydrofluoric acid toxicity
2. Correction of severe metabolic acidosis
3. Cardiotoxicity secondary to fast Na channel blockade
100ml IV, rpt. 100mmol in 1L N saline at 250ml/hr; aim pH 7.5-7.55
TCA; Type 1a/1c antiarrhythmics: flecainide, quinine; Chloroquine; Propanolol
4. Urinary alkalinisation
5. Prevention of drug redistribution to CNS – incr unionized salicylate
Contraindications: HypoK, hypoCa, alkalosis, acute pulm oedema, renal failure, severe hyperNa

SS vs NMS

Both present with:
Altered mental status
Fever
Muscle rigidity and elevated CK
Untreated both can progress to:
Severe hyperthermia
Rhabdo
Renal failure + metabolic acidosis
DIC/MOF/death

	SS	NMS
Mechanism	Excess serotonin	Dopamine blockade
Dose related?	Yes	No (idiosyncratic)
Onset	Hours	Days
Mental state	Agitation, anxiety, seizures	Confusion, catatonia, coma
Neuromuscular	Rigidity (lower>upper), clonus, hyper-reflexia, akathisia	Lead pipe rigidity, bradyreflexia
Autonomic	HTN, tachycardia, sweating, mydriasis	Instability, tachycardia, sweating
Rhabdo	Only in severe	More common
Labs	Low Na in MDMA	Incr WCC
Treatment	Benzos, stop drugs, cooling, fluids, cyprohepatidine, intubate/paralysis if severe hyperthermia	Supportive, stop drug, cooling, fluids, bromocriptine, intubate/paralyse if severe
Disposition	ICU unless mild	ICU unless mild
Duration	Days	Days to weeks

Goals: early recognition, withdrawal of precipitants
Aggressive supportive care - cooling, IVF, treat rhabdo, monitor electrolytes, cardiovascular support
Bromocriptine: 2.5mg PO TDS - incr to max 5mg Q4h; dopamine agonist; in mod/severe cases
Cyproheptadine: 8mg PO - 4mg PO Q4h; 5-HT receptor antagonist

Malignant Hyperthermia

Disorder of skeletal muscle - increased free Ca2+ ions in muscle cells
Causes: Sux, Inhaled General Anaesthetics (not NO), Amide Local Anaesthetics (lignocaine, bupivacaine)
Symptoms
Fever: >38.8, Muscle rigidity, decr reflexes, Autonomic changes, Altered LOC
Resp acidosis and metabolic acidosis; rhabdo
CK >20,000, incr Ca/K/phos/Mg/BSL/Ur/Cr/coags
2-3x incr ETCO2 (early sign)
Late decr BSL/phos
Early met acidosis - late resp acidosis
Urine: myoglobin (+ive peroxidase test)
Muscle biopsy
Management
Cease Anaesthetic, 100% O2
If unable to cease switch to N20/opiates/benzos/propofol
Use non-depolarising NMJ blocker
Cooling
Correct electrolytes; IVF
Dantrolene: 1mg/kg bolus, Then 3mg/kg, Then 1-2mg/kg 6 hourly for 24-48hrs

Cholinergic Toxidrome

Mushrooms (inocybe, clitocybe), organophosphates, funnel web venom, betel nut, pilocarpine
Defecation
Urination
Meiosis
Bronchorrhoea
Bradycardia
Emesis
Lacrimation
Salivation

Staff protection
Decontamination
ABC: start at same time as decontamination; avoid sux (paralysis hrs-days); high flow O2; diazepam 5mg iv (prevents seizures, reduces resp depression)
Antidotes:
Atropine 1-2mg (0.05mg/kg in children) Q5min until drying of secretions, resolution of HR and good AE
Glycopyrolate: use if atropine run out, 0.05mg/kg IV
Pralidoxime: best given within few hrs (before aging) Indications: resistant to atropine
1-2g slow IV in 200ml 5% dex - INF 1g/hr

Anticholinergic Toxidrome

M1 – red, hot, dry, retention, constipation, mydriasis, confusion, seizures, hallucinations, MOF, rhabdo
H1 - Incr HR, hypotension, muscle weakness, postural hypotension, resp paralysis, sedation
Benztropine, antiparkinsons, atropine, hyoscine, glycopyrolate, antihistamines, TCA, CBZ, amanita muscaria
Decontamination: Charcoal, MDAC
Supportive: Supportive, benzo's, treat hyperT; NaHCO3 if wide complex tachy
Antidote: Physostigmine (acetylcholinesterase inhibitor)
Indication: if severe CNS toxicity esp if not responding to benzos/requiring physical restraint
Dose: 0.1mg IV - rpt Q5min to 2mg max; on cardiac monitor

Alcohol

Withdrawal

Onset 6-24hrs, length 2-7 days

Tremor, agitation, sweating, incr HR, incr BP, N+V, hyperthermia

Hyperreflexia, generalised TC seizures, nightmares, hallucinations

Delirium tremens

Mortality 8% . Peaks at 3-4/7

Sx: above + T 40deg, mydriasis, delirium, resp/CV collapse (usually late and assoc with other illnesses)

Supportive management: 5-20mg PO diazepam Q2h until AWS <10, then Q6h; quiet; thiamine

Wernicke's encephalopathy

Medical emergency, Due to thiamine deficit

Nystagmus, disorder of conjugate gaze (paresis of lateral gaze, bilaterally), ataxia, confusion/decr LOC

Decr/incr T, CV instability

Treatment: thiamine 500mg IV over 30mins TDS

Amiodarone

Acute toxicity rare, chronic common – pulm/hepatic toxicity, brady, AVB, TdP, hypotension, thyroid
Mostly III (K blockade); also I, II, IV; large VOD

Carbamazepine

Blocks: Na channel, NMDA; antimuscarinic/nicotinic; Increases: NE (decr re-uptake)
Peaks 2-8hrs; 24-96hrs if CR
1x 400mg tablet can cause significant toxicity in paeds - 20mg/kg observe 8 hours
Symptoms
Mild: dizzy, ataxia, mild confusion
Mod (<50mg/kg): choreoathetoid movements, decr GCS, tachy, nystagmus, dysarthria, ataxia, delirium, mydriasis/miosis, opthalmoplegia
Severe (>50mg/kg): seizures, GCS 3-5; arreflexia, anticholinergic sx
Hypotension, HypoNa, incr BSL
Investigations
Levels. ECG: 1st deg HB and wide QRS, long QTc, VT/VF/asystole (Na channel blockade)
Management
Difficult to eliminate as highly protein bound, large Vd, slow absorption, enterohepatic recirculation
Hypotension - IVF; Seizures - benzos
NaHCO3 if: decr BP despite IVF, QRS widening, significant arrhythmias
Charcoal <1hr, MDAC yes
Haemodialysis/filtration if severe toxicity, prolonged coma with rising levels at 48hrs or CV instability

Sodium valproate

Increases: GABA
Peak 4-17hrs
400-1000mg/kg = significant CNS depression; >1g/kg potentially fatal
Symptoms
May be delayed up to 12hrs
Lethargy, coma (>200mg/kg), Seizures, Respiratory depression, Decr BP, incr HR
Decr platelets, AGMA (lactate), hyperNH, decr WBC, metHb, hyperNa, decr BSL, incr LFT's, hypoCa/phos
Cerebral oedema, BM suppression
Management
Levels correlate well with symptoms
Charcoal if >400mg/kg, consider ETT 1st; can do rpt dose at 3-4hrs; MDAC/WBI yes if CR
Haemodialysis/perfusion if life-threatening

Phenytoin

Blocks: Na channels; K channels at high doses

Symptoms

Cerebellar: ataxia, dysarthria, nystagmus; Tremor, involuntary mvmts, opthalmoplegia, N+V

No cardiac problems if oral

If IV: decr HR, hypotension, asystole, V arrhythmia, AVN depression, incr PR, wide QRS, altered ST and T

Management

Levels (correlate with toxicity; coma >50mg/L; nystagmus >20mg/L)

Supportive: Charcoal if <4hrs; MDAC; benzos for seizures; if IV, may need atropine/pacing

Antihistamines

Sedating (1st generation): Block H1, M1, α, 5-HT, cardiac Na + K, Ca channels. Cross BBB (lipophilic)

Non-sedating (2nd generation): Block peripheral H1, cardiac K channels. Don't cross CNS

Management

Low BP responds to IVF, α1 agonist (NAd)

Wide QRS/VF/VT: NaHCO3

QT prolongation/TdP: MgSO4)

Antipsychotics

Olanzapine: 40-100mg = mild/mod, >300mg= coma

Quetiapine: <3g mild-mod, >3g severe

ECG: prolonged QRS and QTc, RAD, STD, TWI, TdP, incr PR

Decr BP: IVF + inotrope

Cardiotoxicity: NaHCO3 if incr QRS. MgSO4 and overdrive pacing if TdP

Seizures: benzos

EPSE: benztropine 1-2mg IV (1mg PO BD-QDS)

Aspirin

<100mg/kg – minimal Sx

>300mg/kg – severe

>500mg/kg – potentially lethal

<1.5 mmol/L = therapeutic

>2 mmol/L = toxic

>4 mmol/L = potentially lethal

Salicylism

N+V, Tinnitus, vertigo, seizures, hyperthermia, dehydration, coma, CV collapse

Investigations

Paracetamol level, often in same formulation

ABG – mixed lactic acidosis and resp alkalosis, AGMA

U+E (renal failure, hypoK)

FBC and coags (mild coagulopathy)

CXR – pulmonary oedema

Plasma salicylate level at 4hrs - poor correlation between levels and severity of toxicity; serial levels

Management

Hyperventilate, CPAP for pulmonary oedema

IVF for GI losses and to maintain high UO

K replacement; correct hypoglycaemia; treat seizure

Charcoal if: >150mg/kg and <8hrs; MDAC if significant tox

WBI: if SR prep

Urinary alkalinisation:

Incr urinary pH - drug ionised - cannot be reabsorbed - incr excretion

Indication: symptomatic; level >2.2mmol/L; pH <7.1

Endpoint: no symptoms; level <2.2mmol/L; acidosis resolved. SE: hypoK

Dose: 1-2mmol/kg HCO3 IV bolus - 100mmol/hr infusion if severe; aim urine pH >7.5

Haemodialysis if:

ARF

Acidosis refractory to UA

Severely toxic

Salicylate >4 despite treatment or salicylate >4 in chronic or salicylate >6-9 in acute

Beta-Blockers

Sotalol and propanolol dangerous - In paeds: Any dose propanolol or sotalol bad
Na channel blockade - propanolol (prolonged QRS, VF, VT, seizures)
K channel blockade - sotalol (prolonged QTc, VT, VF)
Alpha blockade - labetalol (worsened hypotension)
Highly lipid soluble - propanolol - worsened CNS Sx

Symptoms

Onset 1-4hrs (>6hrs if SR)
CV: decr BP, decr HR, conduction delays (VT, VF, asystole)
RS: pulmonary oedema, bronchospasm
Met: hypoG, hyperK
CNS: altered LOC, seizures

Investigations

ECG: bradycardia, AV block, long PR, wide QRS (propanolol), long QTc (sotalol), VT, TdP, RBBB
Bloods: monitor electrolytes and glucose

Management

Propanolol: treat like TCA OD
Bradycardia and hypotension: IVF, NAdr, Atropine
NaHCO3: if wide QRS
CaGlu: if refractory to other treatment
If TdP : MgSO4, overdrive pacing
Charcoal: give if <2hrs or after all SR's
MDAC: if significant sotalol OD
WBI: consider if SR prep
Dialysis/Charcoal haemoperfusion: can help in atenolol OD
Dextrose/insulin: propanolol OD with CV compromise
Glucagon: 5-10mg IV bolus - 2-5mg/hr in 5% dex
Intralipid: life-threatening OD propanolol

Disposition

Observe 4-6hrs, Sotalol 12hrs
Admit ICU: if any signs of toxicity
Cardiac arrest = prolonged CPR ie 4-8hrs ie put them on ecmo

Calcium Channel Blockers

>15mg/kg verapamil
>2mg/kg nifedipine
In paeds: 2+ of any SR verapamil/diltiazem potentially lethal

Signs of toxicity

CVS: bradycardia, hypotension, 1st deg block
Metabolic: hyperglycaemia, lactic acidosis, AGMA, hypokalaemia
ECG: Prolonged PR, AV dissoc and block, ST changes (ischaemia), Sinus arrest, asystole
Reflex sinus tachy (if not verapamil or diltiazem)/sinus brady; junctional and ventricular escape rhythms

Management

Rapidly escalating plan to manage hypotension - CVL and art line early
IVF: 10-20ml/kg (or up to 2L)
Calcium gluconate 60ml 10%, rpt 2-3 times
Inotropes: if not responding to IVF or Ca
Atropine: unlikely to be successful but can try 10-30mcg/kg to max 3mg
Pacing: ventricular; to bypass AVB. ECMO.
NaHCO3: give if QRS wide or for metabolic acidosis
Cardiac arrest: CPR, intralipid, bypass
Monitor gluc and temp
Charcoal: if <1hr (4hrs if SR)
WBI: if >10 tabs SR verapamil/diltiazem, presents <4hrs, and evidence of toxicity
Glucagon: 5mg IV stat - 1-5mg/hr; if resistant to Ca

Dextrose/insulin: if severe/resistant; has +ive inotrope action, incr EF; continue until CV toxicity resolved; aim to maintain normoG (monitor BSL hourly), may need KCl
Intralipid: consider if life-threatening OD

Carbon Monoxide

T1/2 depends on pO2. In room air: 4hr, 100% O2: 90min, hyperbaric O2 at 3atm: 23min.
CNS: headache, N&V, dizziness, confusion, cerebellar signs, seizures, syncope, coma
CVS: ↑HR, ↑BP, ischaemic ECG or MI, dysrhythmias, ↓BP
NCPO, lactic acidosis, rhabdo, ↑BSL, rhabdo, ARF, DIC
Hyperthermia, Cherry red skin
If metabolic acidosis - suspect cyanide
COHb levels (do not correlate well with Sx):

- 20%: Dizziness, nausea, SOB, weakness, decr cognitive function
- 30%: Vertigo, ataxia, visual disturbance
- 40%: Confusion, coma, seizures
- 50%: CV and RS failure, arrhythmias, death

CT head if symptoms not resolving
Neuropsychiatric testing at 3-12/12
Management
O2 via NRB
HBO Indications:

- **C**oma/decr LOC/neuro sx
- **O**ngoing sx after 100% O2 for 4hrs
- **M**yocardial ischaemia, Mum (pregnant)
- **A**cidosis

Cyanide

Potentially life-threatening - immediate intervention
Histiotoxic hypoxia: Binds Fe3+ (ferric) in cytochrome oxidase system - inhibits aerobic metabolism
Symptoms
Life threats: coma, seizures, shock, profound lactic acidosis
Investigation
Strongly suspect if altered LOC, lactate >10 - suggests cyanide >40, AGMA after smoke inhalation
ABG
Cyanide levels - lethal >100mmol/L; toxic >40mmol/L; symptomatic >20mmol/L
SaO2 measure high on pulse oximeter, high pO2 on VBG (decr cellular uptake), no cyanosis – but profoundly hypoxic due to cyanoHb
ECG: ST/T wave changes
Management
TIME CRITICAL
Staff PPE
Resuscitation takes priority over decontamination
ABC: high flow O2; HBO if assoc with CO poisoning; intubation/ventilation; correct acidosis
Antidotes: use immediately if severely poisoned (altered LOC, seizures, decr BP, significant lactic acidosis)
Endpoint: improved LOC, CV stability, improved AGMA
Na thiosulphate: transfers sulphur group to cyanide → thiocyanate: excreted by kidneys
Pros: fewer SE's than nitrates; good in cases where diagnosis is in doubt
Indication: mild/mod severe cases can be used alone; otherwise in conjuntion with below
Dose: 50ml 25% solution IV given after hydroxycobalamin or EDTA - can rpt at 30mins
SE: mild; N+V, decr BP, headache, AP
Hydroxycobalamin (Vit B12): stable compound with cyanide (cyanocobalamin) - excreted in urine
Pros: safe and non-toxic; treatment of choice
Cons: falsely elevates COHb and bil; not widely available in Aussie
Dose: 5g (70mg/kg in children) IV - rpt if no response at 15mins
SE: minor hypotension, decr/incr HR; orange-red discoloration of skin/MM/urine for 12-48hrs
Dicobalt EDTA: forms stable compound with cyanide (greater affinity than MetHb) - excreted in urine
Pros: most widely available in Aussie
Cons: severe SE esp if not poisoned
Dose: 300mg (7.5mg/kg) in 20ml dextrose over 1-5mins; rpt Q5mins if needed
SE: common/severe; hypotension, V, incr HR, anaphylaxis, seizures, facial oedema, CP, SOB
Amyl nitrite: forms MetHb which cyanide has a high affinity for
Cons: CI in CO poisoning as will decr O2 carrying capacity
Dose: INH via crushing under nose - MetHb levels 5%

Na nitrite: forms MetHb
Cons: CI in CO poisoning as will decr O2 carrying capacity
Dose: 10ml 3% solution (=300mg; 10mg/kg in children) over 2-3mins - metHb levels 25%

	SaO2	pO2	Cyanosis		
Cyanide	High	High	No	Yet profound cellular hypoxia	
Met-Hb	Lower	Normal	Yes	Unresponsive to O2	
CO	Higher	Normal	No	Yet profound cellular hypoxia	

Digoxin

Potentially lethal: K >5, Dose >10g, level >15 nmol/L

Symptoms

N+V, AP, ECG changes, lethargy, confusion, weakness

Life threats: K >5.5, decr BP, arrhythmia, cardiac arrest

Chronic OD - usually asymptomatic (yellow vision, decr VA, chromatopsia, xanthopsia)

Investigations

ECG: Worsened by hypoK/Mg, hyperCa

Digoxin effect:

- Scooped ST segment depression; reverse tick
- Inverted/biphasic T waves, short QT, long PR, prominent U waves, J point depression

Toxicity:

- Due to incr automaticity
- AF with slow V response <60
- Blocks, VT/VF/TdP, V ectopics (most common)

Bloods:

HyperK (marker of severity, occurs early, if >5.5 = 100% mortality without digibind)

Dig level

Incr Ur and Cr; Mg (worse toxicity if low)

Management

Refractory to conventional resus in cardiac arrest – continue 30mins after digibind given

HyperK: insulin/dextrose, NaHCO3; aim K <5; try not to use Ca (role unclear), salbutamol, frusemide

Arrhythmia: atropine for AVB, may need pacing; MgSO4 may help in ventricular arrhythmia

If ventricular arrhythmia: lignocaine 1mg/kg IV over 2mins (or phenytoin)

Charcoal: if <1hr; MDAC: if significant toxicity

Digibind Indications:

- Refractory arrhythmia/cardiac arrest
- Refractory hyperK >5
- Level >15
- >10mg (4mg in child) ingested

Acute: ingested dose (mg) x 0.8 x 2 = no. ampoules

5 ampoules if stable, 10 ampoules if unstable, 20 ampoules in cardiac arrest

Chronic: (dig level x weight)/100 = no. ampoules

Dilute in 100ml N saline, give over 30mins

40mg/ampoule = decr dig level by 1 = binds 500mcg dig

Hydrocarbons

Symptoms

RS: aspiration, pneumonitis, dry cough, NCPO, pleural effusions, wheeze, SOB, decr sats, haemoptysis

GU: RTA, ARF

CNS: similar to ETOH – rapid onset CNS depression, ataxia, euphoria, coma, seizures

GI: D/V; haematemesis; hepatic toxicity

CV: sensitises myocardium to catecholamines - arrhythmia; hypotension

Skin: eye and skin irritation

BM: incr WCC, aplastic anaemia

Met: toluene - rhabdo

Investigation

CXR: changes may lag 6hrs; may take 2-4/52 to resolve

Management
Decontamination
Indications for gastric lavage: all patients <1hr with any grp III/IV, or >1ml/kg grp II
ETT before lavage in all patients
ABC: O2
Reduce dose of adrenaline if needed
Withhold inotropes if possible (hypersensitive myocardium)
Give 5mg IV metoprolol for arrhythmia
Dialysis: may be used in severe
Discharge: if asymptomatic and normal CXR at 6hrs

Metformin (biguanide)

>10g ingested (same as dig except g rather than mg)
Symptoms
Lactic acidosis = N+V+D
SOB, incr HR, decr BP, coma
Hypoglycaemia minor and easily treated
Ix: Lactate, ABG, U+E
Management
NaHCO3 for metabolic acidosis
Charcoal: if <2hrs + >10g
Haemodialysis: normal dose: any unwell pt with lactic acidosis; OD: worsening lactate and clinical status
Observe 8hrs if >10g (>1700mg children)

Sulfonylureas

Symptoms
Sweating, incr HR, confusion, coma; profound prolonged hypoglycaemia (several days)
Can be delayed 8hrs (longer if CR)
Management
Charcoal
Dextrose
Octreotide: 25-50mcg IV (1mcg/kg in children)
Infusion 25-50mcg/hr (1mcg/kg/hr for children) for 24hrs

Iron

>20mg/kg GI sx: abdo pain, N/V/D, GI bleed, hypovolaemia due to fluid loss
>60mg/kg MOF (direct cellular toxicity) - shock, lactic acidosis (HAGMA), liver failure, coagulopathy
>120mg/kg Potentially lethal
>60mmol/L Toxic
>90mmol/L High risk
Iron content: Actual amount ingested = (mg x elemental %)/weight (kg)
Symptoms

Phase 1:	0-6hrs	GI
Phase 2:	6-12hrs	Quiescent
Phase 3:	12-48hrs	Systemic Sx (increasing lactic acidosis and shock state)
Phase 4:	2-5/7	Acute hepatic failure, coma, hypoG, coagulopathy
Phase 5:	2 weeks	Scarring and stricture formation

Investigation
FBC (WCC, Hb)
Glucose (initial incr, then decr)
ABG (lactic metabolic acidosis if severe; AGMA; metabolic alkalosis from GI losses)
U+E (ATN)
LFT; coag (incr INR + APTT); XM; Ca
Fe levels (do 4-6hrs post ingestion; falsely low if desferrioxamine)
AXR: 50% sens for Fe in stomach
Markers of toxicity: WCC >15, BSL >8, AGMA
Management
Support A + B
C - Restore circulatory volume (10-20mL/Kg boluses), assess response

Ongoing fluid replacement and monitoring (GI & 3rd space losses). Monitor UO
D - correct hypoglycaemia/electrolytes
Decontamination: WBI (if >60mg/kg confirmed on AXR)
Surgical or Endoscopic removal (if WBI unsuccessful/impractical)
Desferrioxamine chelation therapy

Indications:

1. Level >90 micromol/L at 4-6 hours post-ingestion
2. Evidence of systemic toxicity - Shock, Metabolic acidosis, Altered mental status

15 mg/kg/h

Adverse effects: Hypersensitivity, Hypotension, ARDS, toxic retinopathy, Yersinia sepsis
End point: Patient clinically stable and serum iron level is <60 micromol/L

Disposition
<20mg/kg: observe 6hrs; discharge if minimal GI symptoms + non-toxic levels + <60mg/kg + AXR negative

Isoniazid

Rare but potentially fatal
Severe poisoning - rapid onset seizures, coma, severe AGMA
Symptoms
>1.5g: dizzy, blurred vision, photophobia, N+V, incr HR, mydriasis, ataxia, hyperreflexia, hyperG
>3g: confusion, decr LOC, refractory seizures, lactic acid acidosis, decr BP, decr RR, incr T
>10g: uniformly fatal
Management
High dose benzos; aggressive supportive treatment
Charcoal once tubed
Haemodialysis in severe toxicity resistant to treatment
IV pyridoxine 5g (70mg/kg) IV over 3-5mins - rpt Q10-15minly until seizures controlled
If ingested dose known, use same dose of pyridoxine (1g for 1g)
Give with benzos for synergistic effect
SE: transiently worsens acidosis; incr RR; orthostatic hypotension

Local Anaesthetic Toxicity

Max Doses

Bupivacaine	2mg/kg
Ropivacaine	3mg/kg
Lignocaine	5mg/kg
Prilocaine	7mg/kg

Clinical Features
Early: tinnitus, dizziness, anxiety, confusion, perioral numbness
CNS: seizures, coma
CVS: initial hypertension and tachycardia, then hypotension, sinus brady, blocks, vent arrhythmias, asystole
Resp: respiratory depression, apnoea
Bupivacaine more cardiotoxic due to prolonged myocardial binding
Management
Limit LA exposure - stop injection, call for help
Prolonged normal resuscitation
Prevention acidosis (hyperventilate, bicarb), Treat seizures, Lipid emulsion (20% intralipid)
End points: ROSC, stabilisation of haemodynamic parameters

Lead

Symptoms
Acute or subacute lead toxicity:
- AP, N/V, haemolytic anaemia, hepatitis
- metallic taste
- cerebral oedema, encephalopathy, seizures, coma
- clinical effects correlate with levels

Chronic lead toxicity: vague constitutional sx, teratogenic
Investigations
Whole blood lead level
FBC: normochromic, normocytic anaemia with basophilic strippling of erythrocytes; U+Es, LFTs
AXR for ingested FB
Management
Mannitol 1g/kg + dexamethasone 10mg for cerebral oedema
Endoscopy if above GO junction, whole bowel irrigation if below and symptomatic
Chelation if symptomatic

Sodium calcium EDTA iv for acute encephalopathy
Succimer (DMSA) po if no encephalopathy or asymptomatic but high levels
Consider others exposed - notifiable; Identify source

Arsenic

>1mg/kg potentially lethal
Severe gastroenteritis with MOF - Rapid onset severe watery diarrhoea, vomiting, abdo pain, GI bleed
Encephalopathy, seizures, cardiovascular collapse
Hypersalivation, Garlic odour, Acute cardiomyopathy, prolonged QT, arrhythmias
ARDS, renal failure, hepatic injury, bone marrow suppression (max 2-3/52)
Spot urinary arsenic level or 24 hour urinary arsenic excretion

Management

ABC. Immediate life threats: hypovolaemia and shock due to GI losses
Cooperative patients, + XR - whole bowel irrigation
Chelation when acute, severe poisoning - Succimer po
Dimercaprol im if unable to give orally due to GI symptoms

Mercury

Inhaled elemental mercury aerosol or vapour: pneumonitis, NCPO, neurological injury; H/N/V, metal taste, salivation, visual disturbance
Ingestion inorganic mercury salts: haemorrhagic gastroenteritis, ARF, shock
Organic mercury ingestion/inhalation/skin contact: GI sx, dermatitis, ARF, delayed neurologic injury

Investigations

Whole blood or urinary mercury level - confirms recent exposure but not total body burden
XR - radio-opaque; Endoscopy

Management

Inhalational - close monitoring, supportive
Ingestion - aggressive fluid resus, supportive care for MOF.
Environmental - remove contaminated clothes, don't vacuum (aerosols)
Whole bowel irrigation for massive elemental mercury, Charcoal for organic mercury
Chelation if unwell - dimercaprol (not for elemental), penicillamine or succimer

Dimercaprol

Rarely used, toxic, im chelator for severe poisoning from lead, inorganic arsenic, mercury.
If possible use succimer - orally-active analogue of dimercaprol

Lithium

Therapeutic levels: 0.6-1.2mmol/L. Low therapeutic index; renal clearance; suitable for dialysis

Acute Toxicity

>2500mg (>40mg/kg) - GI Sx
CV Sx (HB, prolonged QTc; usually not assoc with significant CV effects)
Neuro Sx uncommon
Levels correlate poorly with toxicity
Indications for GI decontamination: Acute overdose + >40mg/kg ingested + within 1-2hrs ingestion

Management

Maintain hydration and sodium repletion with iv normal saline. Urine output >1 mL/kg/hour
Monitor fluid/electrolytes, renal function, serum lithium and clinical features of neurotoxicity
Haemodialysis if severe and renal failure with neurotoxicity

Disposition

Discharge if no evidence neurotoxicity, level <2.5 mmol/L and falling

Chronic Toxicity

More severe Sx at lower levels. >1.5mmol/L = toxicity
Effects of chronic use: nephrogenic DI, hypothyroidism. Tremor, hyperreflxia, ataxia, seizures, coma
Neurotoxicity more common; may be permanent.

Investigations

Li level, U+E (decr K, low AG, decr/incr Na, acidosis), FBC (chronic Li use - neutrophilia, WBC 10-15)
ECG (chronic Li use - T wave flattening and inversion; toxicity - long PR, QRS, QTc), AXR

Indications for dialysis

Li level >6mmol/L (acute), >2.5mmol/L (chronic)
Severe neuro Sx with high level; ARF even if lower level
Decr BP not responding to fluids

Methaemoglobinaemia

Cellular hypoxia

Presence of oxidised iron (ferric, Fe3+) in Hb - met-Hb - doesn't carry O2 - Shifts curve to L
Symptomatic: 20-50% ; Potentially lethal: >70%
Causes: Congenital; aniline dyes, chloroquine, dapsone, lignocaine, metoclopramide, nitroglycerin, sulphonamides; Recluse spider

Symptoms

Level 25-40% - chocolate brown blood, dark chocolate colour lips and tongue
Cyanosis out of proportion to resp distress and unresponsive to O2
Falsely decreased Sats but normal PaO2
Headache, weakness, anxiety, syncope, incr HR, SOB
Level 45-55% - decr LOC
Level 55-70% - coma, seizures, arrhythmias

Investigation

ABG (co-oximetry)

Management

High flow O2, HBO
Avoid/cease precipitants
Antidote: Methylene blue 1-2mg/kg over 5 mins, may need repeat
Decontamination: exchange transfusion if fails to respond to methylene blue

NSAIDs

Ibuprofen

<100mg/kg – asymptomatic
100-300mg/kg – mild GI and CNS Sx
>300mg/kg – risk of MOF – rapid onset shock, coma, seizure, ARF, AG metabolic acidosis

Symptoms

Often asymptomatic. Mild N+V+AP within 4hrs; mild drowsiness
Less severe metabolic/coag/thermal complications than aspirin
Massive (>300mg/kg) - shock, seizures, coma, ARF, met acidosis, headache, nystagmus, hyperK, hypoCa

Colchicine

Uncommon but potentially lethal. Toxicity characterised by GIT symptoms and delayed MOF

<0.5mg/kg	GI Sx
0.5-0.8mg/kg	Systemic toxicity, BM dep, 10% mortality (due to myelosupp)
>0.8mg/kg	CV collapse, coagulopathy, ARF; nearly 100% mortality

Symptoms

2-24hrs: N/V/D/AP, large GI fluid loss - hypotension. Neutrophilia
2-7/7: MOF: BM suppression; Rhabdo, ARF, haematuria, metabolic acidosis, DIC, ARDS, arrhythmias
>7/7: Incr WBC, alopecia - recovery

Management

If presents early, decontamination>resus
Early ICU and ventilatory/cardiovascular supportive care if >0.5mg/kg ingested
IVF++ (maintain high UO)
Charcoal asap if >0.5mg/kg, MDAC
Admit all, observe 24hrs - discharge is asymptomatic and normal WBC

Opiates

Tramadol: toxic dose >10mg/kg or >1.5g

μ/M/5-HT/NAD

Mild sedation (coma unusual), seizures, agitation, mydriasis, anaphylactoid reactions

Only partially antagonised by naloxone

Management

Charcoal yes, maybe in tramadol; MDAC in dextropropoxyphene, SR

Serum alkalinisation: in dextropropoxyphene

Naloxone if GCS <12, RR <6, SaO2 <90%

Onset: 1-2mins, DOA: 20-90mins. 100mcg IV (10mcg/kg in children); 400mcg IM bolus/800mcg SC/2mg IN

Dependence/withdrawal

Within hr, peaks at 36-72hrs**:** anxiety, yawning, craving, lacrimation, rhinorrhoea, diaphoresis, AP+N+V+D

Management*:* supportive; IVF; antiemetics, antidiarrhoeal; clonidine/benzos

Admit if: severe withdrawal, significant complications/intercurrent illness/psych prob

Organophosphates

Rapidly absorbed by dermal, oral and pulmonary routes

Inactivate acetylcholinesterase (AChE) - incr ACh at muscarinic/nicotinic receptors

Aging: After binding, the OP-AChE bond 'ages', making complex irreversibly bound (not carbamates)

Nerve gases (1-3mins); dimethyl compounds (2-9hrs), diethyl compounds (36-58hrs)

Symptoms

Life threats: coma, decr BP, seizures, resp failure

4 Typical clinical syndromes

1. Acute intoxication - Cholinergic/Muscarinic effects: DUMBELLS, Bradycardia and hypotension

Cholinergic/Nicotinic effects: Fasciculation, weakness, respiratory muscle paralysis, incr HR, incr BP
CNS: Agitation, coma, seizures
Respiratory: Chemical pneumonitis, NCPO, garlic smell

2. Intermediate syndrome - Delayed paralysis (2-4 days)
3. Delayed - Organophosphate-induced delayed neuropathy
4. Chronic organophosphate-induced neuropsychiatric disorder

Investigation

ECG (prolonged QTc, STE, TWI, prolonged PR, tachy, brady, AF, VF)

RBC acetylcholinesterase – indicates severity of poisoning and response to trt; result will take >24hrs

Plasma pseudocholinesterase – measure of acute exposure, but does not tell severity

Management

Staff protection: gloves, clothing, masks, eye shields, resp filter if INH

Decontamination; charcoal

ABC: start at same time as decontamination

Sux may cause paralysis for hrs-days; relative resistance to non-depolarising; atracurium good alternative

High flow O2; diazepam (prevents seizures, may improve survival, *reduces* resp depression; 5-10mg IV)

Atropine: 1-2mg (0.05mg/kg in children) Q5min until drying of secretions, resolution of HR and good AE

Glycopyrolate: reverses cholinergic Sx (not CNS); use if atropine run out; 0.05mg/kg IV

Pralidoxime: best given within few hrs (before aging)

Reverses some CNS toxicity (may initially worsen paralysis, but should reverse NM blockade)

Indications: severe Sx, resistant to atropine

Dose: 1-2g slow IV in 200ml 5% dex (25-50mg/kg in children) - INF 0.5 – 1g/hr 24-48hrs

FFP: increases plasma pseudocholinesterase levels; give 2iu/day until atropine no longer needed

Strychnine Poisoning

>15mg (accidental taste) may be fatal in children, >50mg may be fatal in adults, >100mg death common

Source

Rodenticides; adulterant of street drugs

Symptoms

Like tetanus

Life threats**:** muscle rigidity, resp failure, hyperthermia, rhabdomyolysis

Normal LOC until metabolic acidosis, resp failure, conjugate gaze palsy, mydriasis

Management

Time Critical

Decontaminate: give activated charcoal after airway secured

Other: avoid sensory stimulation; treat spasms (diazepam 5mg Q5-10min; paralysis); supportive

Paracetamol

Toxic dose:	Adult: 150mg/kg or >10g	Child: 200mg/kg
Chronic:	>200mg/kg/day	or >10g/day
	>150mg/kg/day for 48hrs	or >6g/day
	>100mg/kg/day for 72hrs	or >4g/day

Toxic levels:

4hrs -	150mg/L	1000mcmol/L
8hrs -	75mg/L	500mcmol/L
12hrs -	38 mg/L	250mcmol/L
16hrs -	19 mg/L	125 mcmol/L

Criteria for liver transplant
HE CRASH
Hypoglycaemia
Encephalopathy
Coagulopathy (INR >3.0 at 48hrs)
Renal failure
Acidaemia (pH <7.3)
Severe thrombocytopenia
Hypotension (BP<80)
Risk factors
Decr GSH: malnutrition, HIV, chronic hepatic diseases
Induction of cP450: ETOH, anticonvulsants
Symptoms
Phase 1 (<24hrs): mild N+V, anorexia, sweating; hypoK correlates with high 4hr lvl
Phase 2 (1-3/7): RUQ pain; ALT/AST peak at 48-72hrs (toxicity if >1000); incr PT, INR, bil; ARF
Phase 3 (3-4/7): fulminant hepatic failure, coagulopathy, encephalopathy, MOF, met acidosis, lactate, ARF
Phase 4 (4/7-2/52): recovery phase; complete resolution of hepatic dysfunction by 1-3/12
Investigations
Aussie/NZ Nomogram - valid for single ingestion, known time of ingestion, non-SR, non-rapid release
LFT's: toxicity = AST/ALT >1000 (>24hrs); also incr LDH, ALT good in risk assessment
Coag: INR and plt good at predicting risk of death from hepatic failure
Others: hypoG, lactic acidosis; ECG (ST/T changes); hypoK; ATN; decr Ur:Cr (due to hepatic necrosis)

Management
Acute OD Presents >8hrs: do LFTs (ALT) + paracetamol
If reported dose >200mg/kg/Sx of toxicity (AP+N+V), commence NAC immediately
- if normal, stop
- if abnormal continue + add on INR and plt - commence NAC if not already
Repeat bloods after 20hrs - if improving, OK, stop NAC
If not, continue infusion at 100mg/kg/16hrs and recheck ALT/AST Q12-24hrs until decreasing
Acute OD Presents >24hrs: do LFTs/INR/paracetamol/U+E/glu/ABG
If reported dose >200mg/kg/Sx of toxicity, commence NAC immediately
- if normal, stop
- if +ive level or abnormal LFT's/coag, continue NAC and trt as above
Acute OD Presents ?time: do LFTs/INR/paracetamol/U+E/glu/ABG
If reported dose >200mg/kg/Sx toxicity, commence NAC, continue 20hrs regardless 1st bloods
Repeat bloods after 20hrs
- if normal AST/ALT stop NAC; if abnormal, continue infusion
If SR: start NAC immediately if >200mg/kg or 10g ingested - do 4hr lvl
- if 4hr level +ive, continue treat
- if 4hr level below, rpt level **4hrs** later

Chronic OD (supratherapeutic/staggered OD >8hr period)
Essentially treated as >8hr grp
If reported dose toxic levels as above/Sx of toxicity, commence NAC immediately
Several ingestions at known time: take as having occurred at earliest time and use nomogram Several ingestions at unknown time:
ALT/AST <50 + paracetamol <120mmol/L: no treatment
ALT/AST >50 / paracetamol >120: NAC as above and stop when ALT normalises
N-acetylcysteine
Indication: plasma levels as above, half life >4hrs, history large OD and delay to levels, signs/Sx liver damage regardless of paracetamol level
Side effects: Anaphylactoid reaction, Fever, N+V
150mg/kg in 200ml 5% dex over 15mins
50mg/kg in 500ml 5% dex over 4hrs
100mg/kg in 1000ml 5% dex over 16hrs, repeat until LFTs improve

Paraquat
One of most lethal poisons known to man
Denatured when contact with earth
Concentrated in lung (type 2 cells) - late and irreversible pulmonary fibrosis
Excretion: renal - get ATN shortly after ingestion - delayed excretion

Symptoms
Immediate: N+V+D
Hours: skin and eye irritation; oral burns; metabolic acidosis
<48hrs: acidosis, hypotension, arrhythmia, ATN, liver necrosis, cough, haemoptysis, NCPO
>48hrs: NCPO, pul fibrosis (late), dysphagia, perf, mediastinitis, pancreatitis, coma, seizures
<10ml 20% or <30mg/kg - mild-mod GI effects, full recovery
10-18ml 20% or 30-50mg/kg - GI corrosive inj, MOF, pul fibrosis
>18ml 20% or >50mg/kg - MOF, alveolitis, metabolic acidosis, death
Investigation
Bloods: paraquat levels; urine dithionate test turns blue if exposure; CXR
Management
TIME CRITICAL
Staff protection. Decontamination priority over resus - aim to decr dose that reaches lungs
At scene, give food/soil ASAP
Fuller's earth (1000ml 15-30%) or Charcoal (1-2g/kg or 50g)
Cathartics (200ml 20% mannitol/MgSO4/sorbitol)
Lavage: <2hrs ingestion
Charcoal haemoperfusion: <2-4hrs ingestion
ABC: avoid O2 (worsens toxicity, aim SaO2 90-91%)
IVF, analgesia; consider NAC
Ingestion >6g - all patients die in 1-5/7; CV collapse, NS toxicity
Ingestion 3-6g - all patients die in several weeks; pulm, renal, hepatic toxicity
Ingestion 0.5-2g - may survive

Amanita phalloides
Death cap. Contains Amatoxin: not inactivated by cooking; single mushroom can cause death
Early aggressive treatment: mortality 10%; treatment delay >48hrs: mortality 75%
Symptoms
Amatoxin suggested if delayed onset (>6hrs) - N+V. Latent phase after 1-2/7
After 3-4/7 centrilobular hepatic necrosis, coagulopathy, GI bleeding, hepatic encephalopathy, renal failure
Investigation
Meixner test (on mushroom or GI contents; highly sens, poorly spec); amatoxin assay (on blood, urine, gastric contents); LFT, U+E, coag
Management
Admit all; get expert to identify mushroom
Decontamination: ipecac if <4hrs since ingestion; charcoal if <36hrs since ingestion + MDAC
Enhanced elimination: IVF; forced diuresis; charcoal haemoperfusion
Supportive care: supplemental glucose; treat complications; liver transplant
Antidotes: NAC, silibinin, penicillin Gm thioctic acid

Benzos
Incr GABA activity via incr frequency of opening of channels
Interactions: diazepam incr metabolism of ETOH and phenytoin
Sx: hypotonia, nystagmus, forced downward asymmetric movement with caloric testing; aspiration pneumonia, hypothermia, DVT, rhabdo
Charcoal: if significant toxicity (not usually required)
Flumazenil: antagonist; max effect 5mins; may cause withdrawal/seizures; 0.1-0.2mg/min to max 2mg

Barbiturates
Incr GABA activity via incr duration of opening of channels
Sx: Miosis, vertigo, nystagmus, decr tone, mimic brain death (unreactive pupils, loss dolls eye, arreflexia)
Decr RR/ BP/T/BSL, ARDS, decr bowel sounds
Ix: levels correlate well with CNS depression
Management:
Charcoal, MDAC if significant; Haemodialysis/perfusion/filtration if severe; ETT early if decreasing LOC
Disposition: observe 6hrs

GHB

25mg/kg - sleep, 50mg/kg - coma

Sx: cycling agitation and coma; vomiting; seizures; hypotonia and decr reflexes; nonreactive pupils/miosis; myoclonic movements; bradycardia; U waves on ECG; resp depression; hypothermia; loss of airway reflexes; Sx last 4-6hrs with sudden recovery characterised by delirium and vomiting

Management: ventilation may be needed for 3-6hrs; prognosis good

SSRIs

Much less toxic than TCA's

>1000mg usually significant (>5mg/kg in children)

Citalopram: >500mg significant; >4.5g cardiotoxicity (like TCA)

Symptoms

Begin 4hrs, peak 6-8hrs, resolve by 12hrs

Seizures uncommon, Incr HR; drowsiness; tremor; N+V, dizziness, euphoria, headache, BBB

Serotonin syndrome

Citalopram: drowsy, V, seizures, tremor, prolonged QTc and QRS; TdP rare

Investigations

Include CK if SS

Management

Benzos for seizures

Manage serotonin syndrome

Charcoal: if >600mg citalopram <4hrs; otherwise not usually needed

Venlafaxine (SNRI)

Peak levels 6-8hrs

Potentially life threatening

<1.5g = <5% seizures

<3g = 10% seizures

>3g = >30% seizures

>4.5g = 100% seizures, decr BP, minor QRS and QTc changes

>7g = decr BP, arrhythmias

Management

Early ETT if >7g

NaHCO3 for broad complex tachy; benzos for seizures

Manage serotonergic syndrome

Charcoal if <2hrs and >4.5g ingested; not later as risk of seizures

Observe 16hrs due to risk of delayed onset Sx; ECG monitoring 12hrs if >4.5g ingested, 6hrs otherwise

Monoamine Oxidase Inhibitors

Produces a hyperadrenergic syndrome from inability to inactivate noradrenaline

Symptoms

Mydriasis, flushing, diaphoresis, tachycardia, hypertension, hyperthermia, muscular rigidity, delirium, seizure

Then hypotension from adrenergic depletion

Management

Consider gastric lavage and activated charcoal if present within 1 hour

May require ETT

Seizures - benzos

Hypertension - phentolamine

Hypotension - fluids +/- NAdr

Hyperthermia - cool

Sympathomimetics

Withdrawal states, amphetamine, cocaine, theophylline, BZP, hypermetabolic syndromes (MH, NMS), MAOI

Symptoms

CV: Incr HR, incr BP, cardiomyopathy, arrhythmias, aortic dissection, long QTc/QRS, sudden death

Hyperadrenergic cardiac failure

Myocardial ischaemia/ACS: 50% due to thrombosis, 50% from vasospasm
NS: Mydriasis, nystagmus, hyperreflexia, muscle pains, myoclonic movements, seizures, ICH, CVA
GI/GU: AP, D, urinary retetion, hepatitis, NCPO, ischaemic colitis, GI ulceration
Met: Hyperthermia, hypoNa, metabolic acidosis, rhabdo, DIC, ARF, coagulopathy
RS: pulm haem, barotrauma, pneumonitis, asthma, NCPO
Amphetamine induced psychosis - Delusions, hallucinations; resolves within days

Investigations

ECG; U+E, CK, Trop, coags; CXR (dissection); CT head if LOC, seizure or headache

Management

Charcoal effective (but not advised as risk of seizures)
Benzos for incr HR/incr BP/seizures/agitation
Antihypertensives (GTN, nitroprusside, labetalol, hydralazine, phentolamine)
Benzos/phenobarb for seizures
iv fluids if rhabdo
Cooling
Arrhythmias - MgSO4 or NaHCO3 if wide QRS
Hypertonic saline if Na <120 + altered LOC / seizures (4ml/kg of 3% over 30mins aiming Na >120)

TCAs

>5mg/kg = toxic
>10mg/kg = potentially major
>30mg/kg = severe, coma
In paeds >10mg/kg potentially lethal. Dothiepin: 1 tablet fatal (NS Sx)

Symptoms

Peak level 1-2hrs - rapid onset and rapid deterioration
Coma and resp depression, Seizures (QRS >100-120), Arrhythmias (QRS >160), Decr BP
Anticholinergic Sx: mad, blind, hot, dry; bowel and bladder paralysis

Investigations

ECG: tachycardia; bradycardia = severe toxicity
long QTc (K), long PR, QRS>100 (Na) in limb leads
RAD, RBBB; large R waves >3mm in aVR, RS ratio >0.7 in aVR; R rabbit ear taller
Brugada type pattern in severe
ABG: acidosis enhances binding of drug so increases toxicity

Management

ABC: early ETT (GCS <12/wide QRS)
Hyperventilate to pCO2 <40 and pH 7.5-7.55
Hypotension: IVF; NAD 0.1-1mcg/kg/min
Seizures: benzos; if occur, expect CV toxicity
Arrhythmias: NaHCO3 100mmol, Rpt Q5mins to max 300mmol in 1st hr aim pH >7.5/narrow QRS
MgSO4 if resistant to above/TdP
Overdrive pacing; defibrillation unlikely to be effective
Charcoal: if >10mg/kg ingested; MDAC: for significant amitrip/nortrip OD
Charcoal haemoperfusion: in very severe refractory OD; less helpful though due to very large VOD
Intralipid

Disposition

Admit all symptomatic patients
Admit ICU if: GCS <8, QRS >100 in limb leads, seizures, hypotension, significant arrhythmia
Discharge if: 6hrs observation + HR <100, QRS <100, normal LOC, no complications

Theophylline

Causes beta-adrenergic toxidrome (like Irukanji syndrome). Life threatening
5-10mg/kg: therapeutic loading dose
>10mg/kg: Toxic. Anxiety, N+V, tremor, headache, agitation, confusion, incr HR
>50mg/kg: Life threatening. Arrhythmia (SVT, AF, flutter, VT), refractory hypotension, seizures, coma, hyperthermia, rhabdo, severe hypoK/Ph/Mg, hyperG/Ca

Investigations
Levels correlate well with Sx in acute
10-20mg/L – therapeutic >100mg/L – usually fatal
Bloods: elects; mixed metabolic (upper GI loss)/resp alkalosis; met acidosis if seizure/hypoT; WCC; CK
ECG: arrhythmia; sinus tachycardia
Management
Death may occur despite all treatment
Intubation likely; IVF; may need norad
Beta-blockers for SVT, Control seizures (benzos), K replacement
Charcoal indicated even in delayed presentation. MDAC. WBI: if SR
Haemodialysis: level >100mg/L acute/>60mg/L chronic/arrhythmia, hypoT, seizures
Charcoal haemoperfusion: level >500mmol/L/severe toxicity
Pyridoxine for refractory seizures
Observe 12hrs if CR – which is common prep

Ethylene Glycol

Toxicity
100ml (1ml/kg) 100%
Toxic metabolites (glycolic acid, lactate) inhibit oxidative phosphorylation and protein synthesis - AGMA
Oxalate precipitates with Ca - crystals - widespread tissue damage renal tubules, myocardium, muscle, brain
ARF within 12-24hrs, hypoCa
Symptoms
Phase 1: 1-12hrs; CNS Sx similar to ETOH - absent reflexes, nystagmus, myoclonic jerks, seizures, coma
Phase 2: 12-24hrs; cardioresp Sx (due to resp, vasc, CV deposition of crystals) - SOB, incr HR, HTN, CCF, APO, decr LOC, shock, coma, seizures, hypoCa - prolonged QTc, arrhythmias; most deaths here
Phase 3: 24-72hrs; renal Sx - AP, ATN, oliguric ARF
Phase 4: 5-20d - cranial neuropathies
Bloods: Incr osmolar gap then AGMA develops due to metabolites (with resp compensation)
Only ethylene glycol, meths and alcoholic ketoacidosis cause incr OG AND AG
Incr lactate, decr Ca, Incr Cr, ketones
Ethylene glycol level (rarely immediately available)
ECG: long QTc
Urine: Ca oxalate crystals in urine, renal epiT cells, protein, microscopic haematuria; urinary fluorescence
Treatment
Maintain hyperventilation; benzos for seizures; trt hypoG/hyperK/hypoMg
Pyridoxine: 100mg IV OD until AGMA resolved; helps convert toxic metabolites to non-toxic
Thiamine: 100mg IV OD until AGMA resolved; as above
NaHCO3: if pH <7.3; 1-2mmol/kg; correction of acidosis encourages metabolism by non-toxic pathways
Ca: if symptomatic of low Ca (eg. seizures, prolonged QTc)
Mg: helps conversion
Aggressive supportive care. Charcoal resistant
Haemodialysis indications:
OG >10
pH <7.25
ARF
Level >4-8mmol/L
Visual changes
Deteriorating vital signs despite
Endpoint: level <1.5-3mmol/L, correction of acidosis, OG <10
Antidote
Use until haemodialysis
ETOH: 1g/kg 10% ETOH IV in 5% dex - 150mg/kg/hr 10% ETOH), Aim conc 22-33mmol/L
Fomepizole: alcohol dehydrogenase inhibitor
Discharge
Child: well, bic >20, no OG, >4hrs
Adult: well, bic >20, no OG, no ETOH, >4hrs
Adult: symptoms - admit; ensure FU to make sure no CN probs develop

Methanol

>25ml 40%; lethal dose >1g/kg or >0.5-1ml/kg
Severe AGMA and direct cellular toxicity
1hr – like ETOH but N+V+AP
12-24hr (delayed even longer if ETOH co-ingested) – headache, dizzy, SOB; blurred vision, decr VA, photophobia, fixed dilated pupils, retinal oedema; coma and seizures; severe gastritis and pancreatitis, AP+N+V; oliguric ARF; CCF; pulm oedema

Investigations

Incr OG, AGMA (with resp compensation). Incr lactate, Meths level
CT head: >90% putamen hypodensity, 25% putamen haemorrhage, subcortical white matter haemorrhage

Management

Maintain hyperventilation; benzos for seizures; trt hypoG
NaHCO3: 1-2mmol/kg for urinary alkalinisation if pH <7.3
Folate: 50mg IV QID for 48hrs
Thiamine and pyridoxine and Mg
Haemodialysis: Indications: same as ethylene glycol except level >15mmol/L
Endpoints: meth level <6, correction of acidosis, OG <10,
ETOH or fomepizole: as above; continue until methanol level <6mmol/L
Folinic acid 2mg/kg IV Q6hrly helps

Disposition

Well, bic >20, no ETOH, >8hrs

Isopropanol

Augments GABAa receptor - CNS depression; causes ketonaemia; GI irritant; CV depression
As per ETOH but longer and more potent; onset in 30-60mins, peak in few hrs; smell ketosis; AP+N+V, haematemesis, haemorrhagic tracheobronchitis, ATN, haemolytic anaemia, myopathy, resp depression, decr BP; hypoG

Treatment

Supportive; thiamine
Haemodialysis: if profound coma, decr BP refractory to IVF, >65mmol/L

Warfarin

Toxic dose

>2mg/kg - significant incr in INR within 72hrs
If no therapeutic need: trt with Vit K and discharge; check INR in 48hrs as an OP
If therapeutic need: monitor INR Q6hrly

Treatment

Normal INR and no therapeutic need

If >0.5mg/kg ingested - give 10mg PO Vit K
Discharge; INR in 48hrs in adults, none in children

INR <5

Omit dose; if unintentional, consider 10% dose reduction

INR >5

If no therapeutic need

No bleeding: 10mg IV vit K - ?discharge, close FU
Active uncontrolled bleeding, clinically significant or major haemorrhage or INR >9
- give 150-300ml / 1-2iu / 10-15ml/kg FFP (works fastest)
- 50iu/kg PTX (contains II, IX, X; small vol, only takes few mins to give, doesn't need to be thawed, blood grouping not needed; CI'ed in active thrombosis and DIC; SE = allergy, thrombosis)
- 5-10mg Vit K IV over 2-3mins (risk anaphylaxis with IV vit K; rpt vit K BD if still incr INR; onset action 6-12hrs; XS vit K decreases effectiveness FFP and PTX, re-initiation warfarin difficult)

Endpoint: INR <1.4

If therapeutic need

Aim is to titrate Vit K; when trting, take into account risk categories
No bleeding: 1-2.5mg PO Vit K if INR 5-9
5mg PO if INR >9 - recheck INR in 6-12hr - give repeat doses until INR <5
stop warfarin 1-2/7 - restart at reduced dose once INR <5
start heparin if INR <2 if high risk
Life threatening bleeding: as above
High risk of bleeding (eg. active peptic ulcer, recent OT in 2/52, on aspirin, plt <50) (? If INR >9):
consider CF replacement (INR 2-4 = 25iu/kg PTX, INR 4-6 = 35iu/kg, INR >6 = 50iu/kg)

Decontamination
Charcoal if <1hr and patient usually on anticoagulants
Antidote: Vit K
Onset: 6-12hr PO, 3-6hrs IV (?1-3hrs)
Monitoring
Admit those usually on warfarin; can often give Vit K then discharge those not on warfarin

Superwarfarins

Long-acting anticoagulant rodenticides (e.g. brodifacoum)
Benign in single paediatric unintentional OD.
Repeated or massive deliberate OD → prolonged (weeks-months) effects
Serial INR (if normal @48h excludes toxicity)
Single accidental ingestion doesn't cause significant anticoagulation.
Massive OD>0.1mg/kg of brodifacoum (>2g/kg of 0.005% bait in adult)
Charcoal if <12hr post-OD if deliberate.
Vitamin K only if raised INR as otherwise may mask subsequent toxicity.

Trauma Summary

Assessment of Trauma

Preparation - Area, Staff, Equipment
Resus - Resus team, O2, large bore ivs, full non-invasive physiological monitoring
Primary Survey + Immediate life threats - seek and treat
= airway obstruction, tension, massive haemoT, flail, sucking chest wound, tamponade, exsanguinating
Focused History - AMPLE (allergies, meds, PMH, last oral intake, events prior)
Investigations - Bedside (urine, ECG, FAST); Labs (FBC, U+E, LFT, coag, XM); Imaging (trauma series, CT)
Secondary Survey
Specific treatment PRN
Supportive Care GOT FAST POEM
Complications Anticipate / prevent
Communication Subspecialties, patient, family, SW
Documentation Work certificate, consent, competency
Disposition Where and why, Additional FU required

Trauma team activation

Single tier: based on abnormal physio/MOI; call made before arrival in ED
Two tier: based on abnormal physio/physical signs - full team
based on MOI/ED assessment - partial team

Management

Aims: to prevent secondary injury; to maintain oxygenation
Permissive Hypotensive: aim SBP 80 if penetrating inj or surgically amenable bleeding point. CI in HI
Massive transfusion: PRBC:FFP:plt 1:1:1+ TXA, aim Fib >1, Ca+ >1, keep warm, control source/OT
Definitive care: Priority most significant source of blood loss (abdo/pelvis>chest>head>limbs)

Trauma scoring systems

Revised Trauma Score: physiological parameters (GCS, RR, SBP); lower scores worse; poorly predictive of mortality
Injury Severity Score: anatomically based (head + neck, face, chest, abdo + pelvis, extremities, external); <9 minor, 10-25 mod, >25 severe, >35 v severe; doesn't account for age/co-morbidities, no good for penetrating, retrospective
New Injury Severity Score: just 3 worst injuries; better mortality prediction than ISS
Apache score: acute physiology, age, chronic health evaluation (based on physio, coma scale, age, co-morbidities); widely used in critical care; allows comparisons between groups of patients

Abdominal Trauma

Lap belt mark (Chance #, SI inj, pancreatic inj)

Indications for imaging: abdo tenderness, macroscopic haematuria, unexplained hypoV assoc with altered LOC/lower rib #/multiple distracting injuries
FAST: FF and pericardial effusion
CT, DPL
CXR: free subdiaphragmatic gas, abdo viscera in chest, elevated hemidiaphragm, pleural effusion
AXR: FB's, free air, ileus; displacement splenic flexure/stomach/L hemidiaphragm, obliteration psoas shadow
Others: cystogram; NG contrast and XR for duodenal inj; ureteric contrast; angiography for pelvic

Management
Laparotomy in blunt trauma takes precedence over inj's above diaphragm
Indications for laparotomy in abdo trauma:
Blunt trauma with CV instability
Haemodynamic instability despite appropriate resus
Penetrating trauma breeching peritoneum (2/3 breech)
Peritonism
Evisceration
Fee gas of CXR
Ruptured diaphragm; GSW
Unstable patient with +ive FAST/DPL

Grading I - V (liver grade I - VI). Usually OT for Grade III+ (Grade II in colonic injury)

Splenic trauma
Most common organ injured from blunt trauma adults
L shoulder tip pain, 8-10th rib #'s
Usually non-operative management; angiography effective in 80%

Liver trauma
Most common organ injury from penetrating trauma
R shoulder tip pain; lower R rib fractures
AST >400 / ALT >250 = 90% sens for hepatic inj
Damage control laparotomy: if severe; perihepatic packing to temporarily control bleeding

SI injury: In 90% Chance # L spine
Colonic injury: Stoma if faecal contamination/shock/major destructive inj

Pancreatic trauma
Often penetrating injury
If blunt, assoc with duodenal inj/severe multi-organ inj
More common in children, with lap belts, with Chance #
Amylase – large no false +ives
Blunt – manage as pancreatitis
Penetrating – ERCP and OT

Renal trauma
Most common urological organ injured
Clinically significant = macroscopic haematuria, CV instability, loin tenderness
Microscopic haematuria - repeat 1-2/52
Investigate with contrast CT

FAST vs CT vs DPL

Speed:	FAST > DPL > CT
Sens:	DPL > CT/FAST
Spec:	CT > FAST > DPL
Localisation:	CT > FAST > DPL
Ease/portability:	FAST > DPL > CT
Safety:	FAST > CT > DPL
Cost:	CT > FAST > DPL

FAST
Aim to identify FF and pericardial effusion
100% sens, 96% spec, 100% NPV for determining need for laparotomy in hypotensive patient
Insufficient sens to rule out significant inj in stable patient
Pros
Bedside test, quick, cheap, repeatable, sensitive in experienced hands
Suitable for screening mass casualties
Non-invasive
Cons
Obese, unfasted, bowel gas, subC emphysema make hard
Operator dependent, not available in smaller centres
Low sens for less severe inj
FF non-specific
Poor view of retroperitoneum, hollow viscus, diaphragm

CT
Pros
Excludes intra-abdo bleed requiring OT
Grades inj to determine need for OT
Can be done with other CT
Lower complication rate than DPL - less false +ives
Good view of solid organs, retroperitoneum, bones, chest, pelvis
Non-invasive
Provides anatomical info
Gives indication of renal perfusion and function

Cons
Not suitable for unstable patients
False –ives for hollow organs, low sens for intestinal/pancreatic/bladder/diaphragm inj
Done in CT - out of dept, access to pt
Contrast scan
Cost

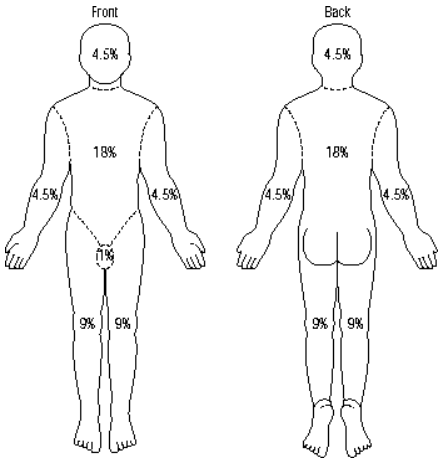
DPL
+ive = >20ml frank blood on free aspiration
>100,000 RBC/ml if blunt
>5000 RBC/ml if penetrating
>500 WBC/ml
exit of lavage fluid out of other catheters

Pros
98% sens for haemoperitoneum
Better than CT for SI inj
Bedside; quick; cheap; minimal training; good in mass casualties (can do on multiple patients)
Good in unstable patients

Cons
CI in pregnancy, multiple abdo scars, local contamination
Invasive
High sens, low spec
Misses retroperitoneal inj
Provides no anatomical info
1% complication rate; may introduce intraperitoneal air

Blast Injury
Primary – barotrauma. (lung, ear, GI tract)
Secondary – projectiles
Tertiary – effects of wind (person thrown)
Quaternary – burns, asphyxia, toxic inhalants

Burns
Burn area
Rule of nines:
>10: 18% leg/back torso/front torso, 9% arm/head, 1% perineum, 1% neck
<1: 18% back torso/front torso, 13% leg, 19% head, 9% arm
Lund and Browder chart: more specific for hands and digits
Palm area estimation: 1% each palm area
Major burn = >20% TBSA or complicated (electrical, inhalation, trauma)



Major Burns
Partial thickness >25% or full thickness >10%
Burns of special areas (hand, face, feet, ears, perineum, crossing major jts)
Inhalational/electrical burns
Circumferential burns
Complicated by #/trauma

Burn depth
Superficial: Epidermis only, No blisters, Red/pink, painful, Normal CRT
Partial: Epidermis/dermis, blisters, Red, moist, painful, Normal CRT
Full: Epidermis/dermis/subC tissue, No blisters, Pearl/charred, leathery, Insensate, No bleeding

Investigations
ABG (hypoxia, AGMA, COHb, cyanide, H2S
U+E (baseline - Na, incr K, AG, monitor renal)
FBC/LFTs (incr WBC, haemolysis)
Urinalysis (Hburia, myoglobinuria, urobilinogen, bilirubinaemia)
ECG (myocardial inj)
CXR (initially normal in 50% who have significant inhalational inj)
Bronchoscopy (if inhalational inj suspected)

Management
First aid: Stop burning process, remove jewellery, cool 20min running water, clingfilm
A:
Presume difficult airway (have ENT and anaesthetics present for intubation; surgical airway prep)
Sux OK if burn <5/7 old
If not immediate: gas induction, fibreoptic; humidified O2, bronchoD
HBO if severe CO poisoning
Indications for urgent ETT
Impending complete airway obstruction (stridor, oligophonia)
Hypoxia on high flow O2 via facial mask
Significant hypoventilation/decr LOC
Voice change; oral erythema/blistering; neck swelling; wheeze; brassy cough; stridor
Circumferential neck burns
Supraglottic oedema and inflamm on bronchoscopy
Full thickness burns face or perioral region
B:
O2; trt CO/H2S/cyanide poisoning if present
C:
IVF if >15% burns
IDC if >20% - aim UO 0.5-1ml/kg/hr (1-2ml/kg/hr in children)
Constantly monitor haemodynamic status, be careful not to worse pulm oedema
Parkland formula: Hartmanns 3-4ml/kg/%, 1st half in 8hrs (from time of burn), 2nd half in 16hrs
+ titrate to UO 0.5/kg/hr (1ml in child)
+ maintenance fluid for children <30kg 0.45% saline + 5% dextrose
D/E:
Analgesia, ADT
Protect burns (sterile saline soaked dressings, SSD dressings, skin grafting later)
Stress ulceration prophylaxis if >40%
Monitor T
Consider social + medical situation

Escharotomy
Circumferential limb injury with distal NV dysfunction
Circumferential neck injury
Chest wall injury with impaired ventilation
Incise as far as fat
Limb = volar aspect into dorsum of hand/lat aspect digit
Chest = anterior axillary line, rib 2 to lower margin rib cage, then join lateral incisions with 2 transverse incisions (level of manubriosternal joint, at lower border rib cage)
Disposition
Admit burns unit: partial thickness >10%; full thickness >5%; special areas; other major burn criteria

Chemical Burns
Acids: Coagulative necrosis - leathery eschar limiting penetration, immediate damage
Alkali: Liquefactive necrosis, saponification of lipids - deeper tissue penetration, incr systemic involvement
GI: oedema max in 48hrs - necrosis in 7-10/7 - strictures in 3/52
Indications for endoscopy: Persistent vomiting, oral burns, drooling, AP
Skin exposure:
Protect staff
Brush away dry bits, Remove clothing
Immediate dilution with water > 30mins - test pH to determine end
Debride and clean blisters (may contain contaminated fluid)
ADT
Admit if: >15% superficial burn; all partial and full thickness burns
GI exposure:
Do NOT induce vomiting, no charcoal. Milk or water to drink
Analgesia, Abx if perf, ADT
Observe 6 hrs - discharge if Sx free
Gastroscopy if symptomatic, at 12-24hrs to determine extent of injury
Eye exposure:
LA eye drops
Remove particulate matter; irrigate >30mins with saline, Continue until neutral (pH 7.4)
Cyclopentolate, Chloramphenicol ointment; pad
Indications for immediate referral: altered VA; corneal haziness

HFl acid

Weak acid, penetrates tissues well causing liquefactive necrosis (rather than coagulative), very toxic
Little pain initially (unless >50% conc - immediate pain and tissue destruction)
Pain out of proportion
Risk of systemic toxicity if >3-5% SA
HypoCa - coagulopathy, tetany, carpopedal spasm, hyperreflexia
HypoMg - QTc prolonged, arrhythmias
HyperK - arrhythmias
Metabolic acidosis

Management

Cardiac monitor at least 12hrs if extensive/PO
Systemic poisoning: give Ca and Mg before decr levels seen
60ml (0.1-0.6ml/kg in child) 10% Ca Glu IV - rpt Q5min until ROSC
10mmol IV $MgSO_4$
HyperK and arrhythmias often resistant to standard treatment
Topical: Ca Glu 2.5% gel (10ml 10% Ca Glu 40ml KY) Q15min for 1hr - 6x per day for 3-4/7
Oral: Ca Glu PO/NG if ingestion; Ca/Mg containing antacids, drink milk
Local injection: 0.5-1ml/cm^2 Ca Glu 10% SC -
IV regional: 10ml 10% Ca Glu (+ 5000iu heparin) made up to 40ml in 5% dex
IA regional: gold standard; same as above over 4hrs; radial or brachial artery
Neb: 1.5ml 10% Ca Glu in N saline
Eye: LA eye drop, analgesia, water irrigation, 1% Ca Glu irrigation, consider chloramphenicol/mydriatics

Chest Trauma

Grade I - VI (unilateral contusion to total transection pulmonary hilum)
CT: Pros: more sens than XR; can do CT angiogram; non-invasive; cheap
CXR: Pros: erect film can view haemothorax 200-300ml
Cons: supine film (may miss small haem/pneumothorax (800-1000ml needed); miss 50% rib #'s
TOE: Pros: can be done in resus, quick, minimally invasive, low complication rate
Cons: requires sedation, limited info on distal ascending aorta / aortic arch

Indications for ED thoracotomy

Cardiac arrest + penetrating chest trauma (30% survival)
Likely to arrest before reaching OT + vital signs present in ED
Do L thoracotomy regardless of findings (extend to R if needed) - long ant 5^{th} ICS incision - retractor
- release pericardial tamponade (incise vertically in front of phrenic nerve)
- suture cardiac lacs, clamp descending aorta, internal cardiac massage

Contraindications:

Asystole on arrival
No signs of life prehospital or ED
Cardiac arrest >15mins
Non-survivable head injury
No access to definitive surgical interventions

Rib fractures

Analgesia
Intercostal nerve block (bupivicaine 0.5% 2ml per segment, 20ml max, lasts 8-12hrs; 1.5% incidence PTX/rib
Epidural if multiple lower rib #
Local chest wall strapping
Admit if: 3+ rib #, resp comorbidity, complications of #, IV analgesia, flail, elderly

Sternal fracture

1.5% incidence arrhythmia
CXR + ECG
Admit for cardiac monitoring if: CV instability, >65yrs, IHD, on dig, other criteria as per rib #

Myocardial contusion

Usually of no clinical significance
Can cause localised contusion or cardiac rupture (immediate/delayed 4-5/7)
VF on impact, delayed AF (delayed ventricular arrhythmia rare), non-sig arrhythmias (ectopics)

Contusion excluded if normal trop and ECG at 8hrs
Bloods: do trop if abnormal ECG

Admit for ECG monitoring if: prev IHD / AF, transmural AMI on ECG, haemodynamically significant arrhythmia/conduction defect, Inotropes, IVF

Haemothorax
Small <350ml
Medium 350-1500ml - diffuse incr opacity on supine CXR
Large >1500ml
USS = 90% sens, 95% spec; CT gold standard, CXR: erect can detect 200-300ml; supine detect 800-1000ml
Indication for thoracotomy
Stable + blood loss >200ml/hr for >2hrs or >1500ml overall
Unstable + blood loss >100ml/hr for >2hrs or >1000ml overall
Indication for thoracoscopy: haemothorax failed to resolve after 3/7

Pneumothorax
USS: use linear transducer, loss of sliding lung sign; >90% sens, >95% spec
Small - mid clavicular point or 4th IC space ant axillary line
Medium - mid axially line
Large - post axillary line
If tension, finger thoracostomy then immediate chest drain
If IPPV and cardiac arrest - bilat pleural decompression

Diaphragm injury
L sided more common
Penetrating - CT (95% sens and spec), laparoscopy (100% sens)
50% present with delayed rupture - defect enlarges with time

Gas embolism
Arterial - Due to communication between pulm vessels and airways
Pulmonary - Iatrogenic from CVL insertion
Gas in heart - decr CO
Treat with 100% O2 and IVF

Oesophageal perforation
Usually lower ⅓
Associated with tracheal, T3-4 injuries
5% mortality, 25% infectious complications (mediastinitis)
CXR - pleural effusion on L
Gastrografin swallow (70% sens) or gastroscopy
NG, Abx, acid suppression, OT

Aortic injury
I = intramural haematoma, limited intimal flap
II = subadventitial rupture, altered shape of aorta
III = aortic transection with active bleeding/aortic obsturction with ischaemia
65-90% in isthmus (prox descending, between origin L subclavian and attachment of lig arteriosum)
CXR: Wide upper mediastinum (>8.5cm supine, >6cm erect)
Loss aortic knuckle
Incr paratracheal stripe >4mm
L apical cap
Massive haemothorax
Tracheal/oesophageal deviation (to R of T4 spinous process)
Depression L main bronchus
CT chest angiography, Aortic angiography, Transoesophageal echo if too unstable for CT
Unstable (SBP <90) - OT (mortality >85%)
If stable + CAD/>55yrs/intimal tear only - conservative with control HTN as for dissection

Genitourinary Trauma
Grades I - V (I = contusion, V = complete disruption)
Bladder
2nd most common GU injury
85% assoc with pelvic #
Dome inj - intraperitoneal leak - contrast into pericolic gutters and around liver
Body inj - intrapelvic (extraperitoneal) leak (assoc with pelvic #) - contrast into pelvis
Cystography

Urethra
May track over abdo wall, but not thigh
Urethrogram
If minor, manage conservatively; if major, SPC + OT
Ureter
CT or retrograde ureterogram
Scrotum
Intratesticular bleeding - pressure necrosis
Conservative trt if no testicular haematoma (RIcE)
Indications for OT = testicular haematoma, haematocoele, rupture of tunica albuginea, penetrating trauma

Crush Injury/Rhabdomyolysis

K+, myoglobin, CK and urate released into circulation.
Fluid & Ca2+ sequestered into injured muscle cells.
Results in hypovolaemia, hyperkalaemia, metabolic acidosis, ARF, DIC
Causes
Mechanical: trauma; electrocution, burns; prolonged immobilisation; compression (POP); severe exertion
Drugs: toluene, amphetamines, heroin, theophylline, simvastatin, arsenic, alcohol withdrawal
Toxins: snake/spider
Other: sepsis, post-ischaemic limb (tourniquet >1hr), NMS, MH, heatstroke, frost bite, SS, seizures, inflamm myopathy, thyroid storm, K <2.5
Clinical findings
Tender swollen muscles
Bloods: CK >10,000-100,000 usually (>75,000 predictive of ARF and death)
Incr K/phos/Ur; decr Ca (most common metabolic abnormality)/alb/pH
Urine: myoglobinuria (red/brown urine, Hb on dip)
ECG: arrhythmia cause of early death (otherwise death at 3-5/7 from ARF, DIC, sepsis)
Management
Treat cause
Aggressive fluid management - IDC, Maintain UO >2ml/kg/hour, Renal dialysis if anuric
Urinary alkalinisation with NaHCO3 may help to prevent myoglobin precip & ARF
Forced diuresis - mannitol
Treat hyperK+ (Ca2+, insulin/dextrose, resonium, salbutamol, bicarbonate)
Cool if needed, Control seizures, Avoid sux
Treat DIC with FFP, cryoprecipitate and platelets
Early fasciotomy if compartment syndrome, Amputation of crushed limbs

Compartment syndrome

Causes
Fractures – tibial, forearm
Vascular – bleed into compartment, ischaemia-reperfusion injury
Soft tissue injury – crush injury, burns
Iatrogenic – vascular puncture, constrictive casts
Risk Factors
Very muscly, young male, on steroids
Coagulopathy
Skin on one side and bone/IO membrane on other
Symptoms
Onset 6-24hrs after injury
Early: Pain out of proportion, throbbing, on passive movement, Incr pain even after reduction
Tender muscle compartment
Late: Paraesthesia/numbness (late)
Loss of vibration sense (earliest) - sensation - motor loss late
Decr distal pulses/CRT
Irreversible ischaemic injury - >8hrs - Volkmann's contracture
Management
Analgesia; elevation; remove compressive force
Indications for immediate fasciotomy: evidence of vascular compression
Indications for ASAP fasciotomy: significant neuro Sx; CP >30; delta p (DBP - CP) >30; rhabdo

Tibial #
40% due to tibial # (incidence up to 20%; can occur with open #)
Anterior compartment: enclosed by tibia, IO membrane, ant crural septum
Weakness toe extension/foot dorsiflexion

Decr sensation 1st web space (deep peroneal nerve)
Ant tibial artery

Lateral compartment: enclosed by ant crural spetum, fibula, post crural septum
Weak foot plantar flexion and eversion
Decr sensation dorsum foot (sup peroneal nerve)

Deep posterior compartment:
Weakness toe plantar flexion, foot inversion
Decr sensation sole foot (post tibial nerve)
Post tibial artery

Superficial posterior compartment:
Weakness knee and ankle flexion
Decr sensation lat aspect foot/calf (sural nerve)

Assessment of peripheral vascular injury

Hard signs - Immediate operative intervention
- Pulsatile bleeding
- Expanding haematoma
- Absent distal pulses
- Cold, pale limb
- Thrill, bruit

Soft signs - Admit for observation +/- exploration
- Peripheral nerve deficit
- Heavy bleeding at scene
- Reduced but palpable pulse
- Injury in area of major artery

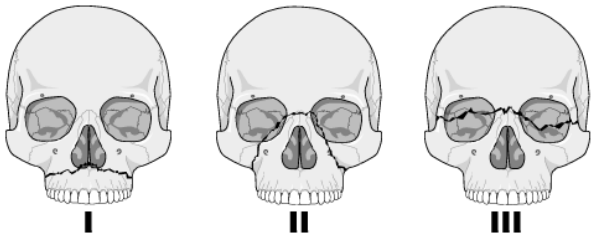
Facial Trauma

I: closed # mandible
II: closed # zygoma
III: open # mandible, Le Forte III, compound # with <20% blood loss
IV: >20% blood loss

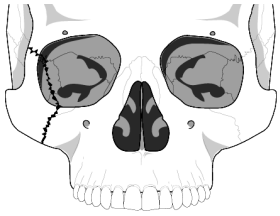
Fractures

Le Fort

I: # through lower ⅓ maxilla, palate, pterygoid plate
Body of maxilla separate from base of skull
II: # through maxilla towards medial infra-orbital rims, into ethmoid sinus, cross bridge nose
Most common midface #; Assoc with epistaxis, CSF fleak
III: # through fronto-zygomatic suture/zygomatic arch, walls of orbits, base of nose
Cranio-facial disruption



Tripod #: separation at zygomatico-frontal/zygomatico-maxillary suture/infraorbital rim
Flat cheek, asymmetrical ocular level, infra-orbital nerve numbness, diplopia, subconjunctival haemorrage, unilateral epistaxis, decr mandibular movment



Mandibular: body; angle; condyle; symphysis

Maxillary, orbital floor blow out #: can trap IR/IO; diplopia , decr upward gaze, enopthalmos, subC emphysema
Rx: Augmentin, decongestants, no nose blowing, OT if diplopia in 1Y position, Sx persist, cosmetic

Lateral canthotomy

Decompress orbit
Indicated if IOP > retinal artery p (vision threatening >2hrs) = visual loss, RAPD, proptosis, hard globe
Incise skin over lateral canthus towards bony orbit - retract lower lid - divide inf lat canthal lig

Head Trauma

5% have associated C spine #
CPP = MAP – ICP
Munroe-Kellie: vol must remain constant
Normal CSFp = 5-15 (10-12; <8 in children <3/12)

Paediatrics
Less mass lesions and contusions - less surgically amenable lesions
Large head - more rotational force - prone to cerebral oedema and axonal shearing
Thin cranial cortex - if skull #, 75% chance ICH
No frontal sinus until 8-10yrs - frontal bone strong
Less incr ICP if open fontanelle or distendable sutures

High risk - Do CT:
- decr LOC/LOC >1min/irritability
- basal/depressed skull fracture
- >5 vomits in 6hrs (vomiting more common >2yrs)
- seizure
- FND
- bulging fontanelle
- any scalp haematoma <2yrs (incr risk of skull #/ICH), mod/large scalp haematoma >1-2yrs

Mod risk - observe 4-6hrs or do CT
Low risk - no imaging: low MOI, asymptomatic, >2hrs since inj, >1yr

Concussion: Transient alteration in cerebral function, usually assoc with LOC, with rapid complete recovery
Axonal shear injury: At grey-white matter interface; CT - small petechial haemorrhages
Cerebral contusion: Diffuse bleeding on/in brain; Most common frontal lobes – rough surface bone
Basal skull fractures : Battle sign, subconjunctival haem without post limit, CSF rhinorrhoea/otorrhoea

Skull fracture clinically significant if:
open
depressed below inner table (needs OT)
overlying dural venous sinus or MMA
post fossa #

Epidural/extradural haematoma
90% assoc with skull # ; middle meningeal A
LOC absent/brief in 50%; 30% have lucid interval; mortality >50%
Hyperdense, biconvex; do not cross suture lines

SDH
Elderly; In children ?NAI
50% have lucid interval
Biconcave; crosses suture lines; acute = hyperdense; 1-3/52 = isodense; 4-6/52 = hypodense
Acute: early evacuation if >10mm thick/>5mm midline shift/symptoms

Canadian CT head rules
Applies to minor HI (GCS 13-15)
High RF:
- GCS <15 at 2hrs
- ?open/basal skull #
- 2+ vomits
- >65yrs

Med RF:
- Retrograde amnesia >30mins
- Dangerous MOI

NICE head rules
Adults: GCS <15 at 2hrs/<13 OE; Children: GCS <14 OE (<15 if <1yr)
?open/depressed/basal skull #
Any vomits adults/3+ vomits kids
Retrograde amnesia >30mins adults/>5mins kids
FND
Post-traumatic seizure
Dangerous MOI/?NAI Bruise/swelling/lac >5cm on head <1yr
Tense fontanelle
Abnormal drowsiness

CHALICE high risk criteria (paeds)
High sens for significant head injury requiring neuro intervention
NEURO:
- Witnessed LOC >5mins/GCS <15 <1yr/GCS <14 >1yr/drowsiness
- 3+ vomiting
- Amnesia >5mins
- FND
- Traumatic seizure, tense fontanelle

INJURY:
- Depressed/basal skull #
- bruising/swelling/lac >5cm <1yr

MECHANISM:
- ?NAI
- MVA >40kmph
- Fall >3m
- High velocity projectile/penetrating inj

PECARN low risk criteria (paeds)
Looking for those who don't need to be scanned
<2yrs:
- Normal mental status/LOC <5secs/normal behaviour
- No palpable skull #
- Non-severe MOI
- No scalp haematoma (except frontal)

>2yrs:
- Normal mental status/no LOC
- No signs of basal skull # Sens 97%; NPV 100%
- No vomiting 60% spec for death/neurosurg/intubation
- Non-severe MOI
- No severe headache

Other investigations
ECG: bizarre T waves in severe
CXR: NCPO; aspiration
Blood: DIC in 25% severe HI; SIADH

Complications
Post-traumatic epilepsy, Meningitis, brain abscess, cranial osteomyelitis, DIC, NCPO, cardiac dysfunction

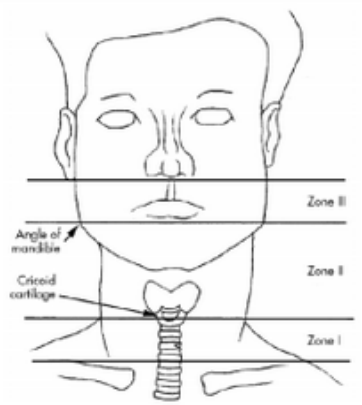
Management
Prevents secondary injury
A:
ETT if:
GCS <9 (within 15mins arrival if not improving)
?surgical lesion
seizure
combative
inadequate ventilation or gas exchange
loss of airway reflexes
need for transport and unstable
1. Blunt incr ICP: fentanyl 0.5-1mcg/kg
2. 0.3mg/kg etomidate
3. Sux 1.5mgkg
C spine precautions
B:
Oxygenation, Normocarbia
C:
CPP (avoid hypo/hypertension; aim MAP 80-90, elevate head of bed)
Maintain euvolaemia
Coagulation
D:
Seizure prophylaxis if: depressed skull #, seizure, penetrating brain inj, GCS <8, acute SDH/extradural/ICH
- Phenytoin 20mg/kg IV

Aim BSL <10

Incr ICP >40mmHg, treat urgently
Mannitol 0.5-1g/kg IV over 10mins - temporising measure
Early CT and neurosurg review
OT, ICP monitor

Discharge criteria
4hr observation; normal exam; no vomiting; no ETOH; social circumstances OK; advice
Prognosis
GCS correlates poorly with morbidity outcome
GCS 3 with fixed dilated pupils = mortality >99%
Limitations of ED prognosis: length of coma not known; reversible factors present (eg. Hypoxia, decr BP, electrolytes); sedation on board; early neuro abnormalities are not reliable prognostic factors

Neck Trauma



Zone I
Clavicles to cricoid
Investigate first - CTA, bronchoscopy, oesophagoscopy
Zone II
Cricoid to angle of mandible
OT. If stable and likely vascular injury consider investigations first
Zone III
Above mandible to base of skull
Investigate first - CTA +/- others if indicated

Expect difficult airway
C spine protection (low risk unless GSW)
Breach of platysma = high likelihood significant injury

Hard Signs = surgical exploration
Airway injury: bubbling wound
stridor
Vascular injury: severe or pulsatile bleeding
expanding haematoma
thrill or bruit
neurological deficit

Soft Signs = CT angiogram
Hypotension in the field
Hx of arterial bleeding
Unexplained bradycardia
Non-expanding large haematoma
Apical capping in CXR
Stridor, Hoarseness, Vocal cord paralysis
Subcutaneous emphysema
7th nerve palsy

Indications for urgent airway control
Airway obstruction
Stridor
Expanding neck haematoma
Haemoptysis
Visible defect in trachea
Decr LOC
Ineffective ventilation

Complications
Vascular - arterial (common carotid), venous (ext/int jugular)
Nervous - phrenic, vagus, recurrent laryngeal, brachial plexus
Aerodigestive - trachea, lungs, oesophagus
Glandular - thyroid, parathyroids
C spine/spinal cord
Infection
Thoracic duct injury

Management
Leave FB until OT
Head down if sucking wound
Pressure on bleeding
Early airway control for:
- Airway obstruction
- Stridor
- Expanding neck haematoma
- Haemoptysis
- Visible defect in trachea
- Decr LOC
- Ineffective ventilation

Indications for surgery:
- Hards signs
- Ariway compromise
- Embedded penetrating object
- Other trauma requiring OT
- Unable to determine extent of injury
- ?platysma breached

Laryngotracheal Trauma
Blunt rare, esp children.
Laryngeal cartilage most often involved
?C spine injuries
Hoarse voice, pain, SOB, dysphagia, Aphonia, stridor, subcut emphysema
Ix: Fibre optic laryngoscopy, May not be able to lie flat for CT
Rx: Intubation by most experienced; One size smaller tube, direct vision, gentle; ?awake tracheostomy

Hanging

Venous occlusion - venous infarction
Arterial occlusion and dissection - ischaemia, stroke
Exaggerated baroreceptor reflx - bradycardia, hypotension
Airway occlusion/asphyxia

Complications
Hypoxic-ischaemic encephalopathy
Severe neurological disability in survivors
Airway compromise due to disruption, oedema, haemorrhage
Cervical artery dissection - delayed stroke
Hangmans fracture - rare unless judicial hanging, fall >2m, slipknot under chin
Complications of self-poisoning or other injuries
Death

Assessment
Ligature marks
Injuries from struggling (avulsed fingernails)
Tardieu's spots - conjunctival petechiae
Ecchymotic mask - petechiae of head and neck (SVC distribution)
Subconjunctival haemorrhage
Fractures of larynx/hyoid
Dysphagia/dysphonia/stridor
Agitation, coma, seizures

Management
A - support airway
- intubate if decr GCS, airway unprotected, evidence aspiration
- anticipate difficult airway due to swelling/bleed
- C spine immobilisation if fall > own height

B - maintain oxygenation, aim SaO2 94-98%
C - support circulation
- obtain iv access, maintain MAP >70-80 to maintain CPP (MAP-ICP)

D - check and correct glucose
E - avoid hyperthermia

Supportive
Cerebral protection
- Head up 30 deg
- Avoid neck vein obstruction

Keep sedated
- Propofol + fentanyl

Seizure control
- Don't paralyse - allow to detect seizures
- Treat promptly with benzos
- Consider phenytoin load 20mg/kg over 30mins

Maintain homeostasis
- PaO2 100-150
- PCO2 35-40
- MAP >70-80
- CVP 0-2
- Gluc 6-10
- Temp 36-37
- Na 140-145
- Euvolaemia

Inform next of kin/gain collateral history

Specific
Investigate to look for complications - CT head, CT angio, Tox screen

Disposition
ICU for ongoing care - risk delayed airway obstruction if not intubated
Need psych assessment
Refer to coroner if dies

Wound Closure

Sutures
- Pros: meticulous closure, greatest tensile strength, lowest dehisc rates
- Cons: require removal, require LA, highest tissue reactivity, cost, slowest application, needle stick risk

Staples
- Pros: rapid, low tissue reactivity, low cost, low risk needle stick
- Cons; less meticulous, not for cosmetic areas, may interfere with CT/MRI

Glue
- Pros: rapid, comfort, antibacterial effects, occlusive dressing, no removal, cheap
- Cons: low tensile strength, dehisc over joints, not useful on hands, can't get wet

Adhesive tape
- Pros: rapid, comfort, lowest infection rate, cheap, no needle stick
- Cons: poor tensile strength, fall off, high rate dehisc, not good on hair, can't get wet

Wounds/Fractures

(3 As, 2 Cs, 1 E)
Arrest visible haemorrhage
Analgesia
ADT/antibiotics
Correct visible deformity and splint
Clean and cover wounds
Elevate and ice

Spinal Summary

Assessment of SCI

Identify injury
- Imaging
- Need for surgery

Identify complications
- Motor level
- Sensory level
- Respiratory/diaphragm involvement (RR, effort, intercostals)
- Neurogenic shock (bradycardia, hypotension, warm/vasodilated peripheries)
- Sacral sparing/incomplete injury
  - Bulbocavernosus reflex, Anal tone, Perianal sensation
- Spinal shock (areflexia, priapism)

Exclude other injuries

Spinal level = lowest normal level
ALWAYS look for hypovolaemic shock in trauma – always scan abdo/pelvis if sensory level.

Complications of SCI

Ineffective ventilation
Neurogenic shock
Aspiration lung injury
Paraplegia/quadriplegia
Pressure areas
Urinary retention
Bowel function

Management

A:
C spine immobilisation
NGT (high risk of aspiration)
Consider ETT
Have atropine available as exaggerated vagal response to instrumentation
RSI best if urgent, fibreoptic if not

B:
Paradoxical breathing
Assess VC
O2 to prevent secondary injury (as in HI)

C:
Assess GCS, UO, CVP
Early insertion IDC
Suspect hypovolaemia until proven otherwise if decr BP - bolus IVF
May require inotrope/chronotrope

D:
Look for Horner's if inj at/above T4
PR; anal and bulbocavernosus reflex
Temp control
IDC early to avoid bladder overdistension

E:
Care for pressure areas

Central cord syndrome
Hyperextension
Arm>leg weakness, Sensory level variable below lesion, Reflexes variable

Anterior cord syndrome
Flexion or direct anterior cord compression
Paralysis below lesion, Bilateral loss of pain and T and coarse touch
May be vague preservation of sensation from dorsal column

Brown-Sequard
More common with penetrating injury/unilateral facet joint injury
No sphincter involvement
Ipsilateral weakness, loss vibration, proprioception and light touch; Contralateral loss of pain and temp

Neurogenic shock
Temporary hypoactivity of SNS, injury above T1-4
Usually resolves in 48hrs
CV: decr HR, decr BP, vasodilation; poikilothermia; absent sweating
GI: paralytic ileus (lasts 3-10/7); sphincter paralysis - aspiration from passive regurg
GU: urinary retention

Spinal shock/concussion
Loss of voluntary movement and sensation, loss of somatic and autonomic reflexes below level of lesion

Autonomic dysreflexia
Level at/above T6
Impaired total body SNS, pelvic PNS
Precipitated by many factors (bladder distension, pressure sores)
CV: decr HR, incr BP (risk of ICH), headache, sweating, chest tightness, erection; flushing above lesion; cold, piloerection below lesion
Trt: elevate head; 10mg SL nifedipine, GTN, treat cause

Spinal Immobilisation

Cochrane review failed to find any benefit to C-spine immobilisation despite being standard of care
Harmful effects:
- Pain and discomfort (100%)
- Neck collar – mask head/neck injuries, raised ICP
- Supine position – aspiration, impaired respiration, pressure sores, concealed injuries to back
- Incr resource utilization – log rolls, additional nursing
- Psychological – loss of dignity (bed pan/IDC), unable to see what happening to them

NEXUS

Sens 99%, Spec 13%. Reduces imaging by 13%
No XR if:
1. Absence of midline cervical tenderness
2. Normal alertness & consciousness
3. No intoxication
4. No focal neurological deficit
5. No painful distracting injury

Assess rotation 45deg - only XR if can't do

Canadian C spine rule

Sens 100%, spec 43% for clinically important injuries. Reduces imaging by 15%
Not applicable in: elderly, >2yrs
If low risk criteria fulfilled, assess rotation 45deg - only XR if can't do
Absence of High-Risk factors - failure = XR
- Age >65
- Dangerous mechanism (fall >3 feet, axial load, highspeed/roll-over/ejection, MRV, bike)
- Presence of paraesthesia in extremities

Presence of Low-Risk factors - absence = XR
- Rear-end MVA
- Able to sit up
- Ambulatory at any time
- Delayed onset neck pain
- No midline tenderness

C spine CT: Sens >95% for #/dislocation; may miss ligamentous inj at C1-2
C spine MRI: Sens 100% for cord inj, 55% for #, 80% for dislocations

L/T spine XR: Sens 75%
Widened mediastinum; displacement L paraspinal line; pleural cap; interpedicular distances should gradually increase L1-5; lack of concavity post vertebral body cortex (?burst #)

C spine
C2 most common # (25%); C5-6/6-7 most common dislocation
T/L spine
T/L junction most at risk
20% with # have 2nd #; 50% have other injury

C1

Jefferson #: vertical compression inj; blowout # ant and post arch; lateral masses C1 driven laterally
Unstable. 1/3 assoc with C2 #; ½ assoc with other C spine #

C2

Hangman's #: extension +/- distraction inj; bilateral # pedicles of axis - ant movement of C2 on 3>2mm
Unstable
Causes Horner's syndrome (ipsilateral constricted pupil due to damage of sympathetic trunk)
 # dens: flexion inj
I = tip, above transverse lig
II = junction of body and dens; unstable; needs OT if displaced >6mm
III = through body of dens; unstable but good prognosis
C2-3 pseudosubluxation: 40% <8yrs – spinolaminar line preserved, causes incr pre-dental space

C7

Clay shoveller's #: flexion inj; displaced fractured spinous process; stable

Other #s

Ant teardrop #
Flexion inj; often retropulsion of fragments; unstable

Ant wedge/compression #
C spine: Flexion inj; stable
T/L spine: major; flexion/axial load; most common T12-L2; stable usually; unstable if ant margin decr >50%
Chance # (posterior involvement)
Flexion/distraction inj, unstable; 65% have intestinal/mesenteric inj

Burst #
C spine: vertical compression inj; # fragments may injure cord; stable unless severe (>15-20deg)
T/L spine: major; vertical compression inj; # fragments may injure cord; unstable

Transverse process #
Assoc with renal/ureteric/splenic/hepatic/pancreatic inj, adrenal haematoma, diaphragmatic hernia, pelvic #
L3 most common (30%)

Unilateral facet joint dislocation
Rotational injury; subluxation <1/2 vertebral body width; unstable if assoc facet #

Bilateral facet joint dislocation
Flexion inj; subluxation >1/2 vertebral body width; unstable; require reduction/fusion

XR C Spine

Lateral

1. **Adequacy**
   Alignment
   Up to 1mm anterior subluxation acceptable in adults (3mm in children)
   Predental space <3mm adult, <5mm children
   Bones
   Disc spaces
   Soft tissue swelling
   Penning's criteria: C1 <10mm/C2 <7mm/C6 <22mm (or <width vertebral body)

Unstable

Jefferson	Jeffersons #
Bit	Bilateral facet dislocation
Of	Odontoid type II, III
A	Any # with dislocation/subluxation
Hangmans	Hangmans #
Tit	Teardrop #