



Fellowship Revision Notes

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	Page
Acid-Base	2
Electrolytes	5
Cardiology	10
Dental, ENT, Ophthalmology	25
Dermatology	33
Rheumatology, Immunology	36
Endocrinology	41
Haematology and Oncology	47
Environmental	54
Gastrointestinal	65
Infectious Diseases	70
Management	76
Disaster and Retrieval	82
Neurology/Neurosurgery	88
O & G	97
Orthopaedics	107
Paediatrics	117
Psychiatry	130
Radiology	133
Renal	137
Urology	139
Respiratory	142
Resuscitation	151
Anaesthetics	157
Surgery	169
Toxicology	173
Trauma	197
Spinal	211

'All care, no responsibility'

Feedback and corrections greatly appreciated

*Dr Laura Joyce, Advanced Trainee, Christchurch Hospital
admin@shakem.co.nz*



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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

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)

U:C ratio

U:C > 100 - pre-renal failure



Corrected Na

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

Corrected K+

0.1 decr in pH - 0.5 incr in K

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 > H₂O

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 H₂O >> 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 (H₂O > 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. Bradyarrhythmias, 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: propranolol (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	CHADS2 = 2 means annual stroke risk 4%
CHF (1)	0: low risk - aspirin
HTN >140/90 (1)	1: medium risk - aspirin or warfarin
Age >75 (1)	2: high risk - warfarin
Diabetes (1)	
Stroke/VTE (2)	

CHA2DS2VASC score

CHF (1)	0 = nothing
HTN (1)	1 = aspirin
Age >75 (2)	2 = warfarin/dabigatran
Diabetes (1)	
Stroke (2)	
Vascular disease (1)	
Age 65-74 (1)	
Sex (female) (1)	

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



Probably SVT: >35yrs, IHD, prev MI, CCF, HOCM, FH sudden cardiac death
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 manouevres

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

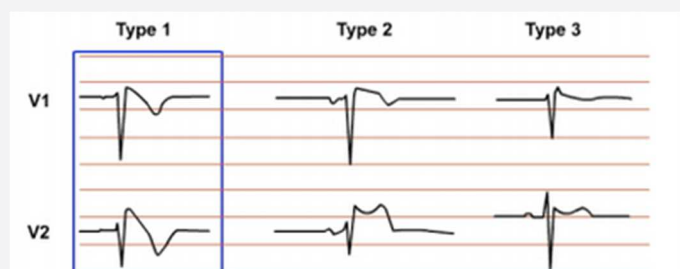
Partial RBBB

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, Beta blockers, Calcium channel blockers, Digoxin

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, clozapine, 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 H₂O 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. labetalol		
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 Incl 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, sildenafil

Neurologic - TIA, migraine, SAH, Shy-Drager, subclavian steal syndrome

Psychiatric

Factors influencing disposition:

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

San Francisco Syncope CHES 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 (Haemophilus, 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 + flucloxacillin 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), Corrigan's pulse (rapid upstroke/downstroke)

De Musset's sign - head nodding 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 < 1cm²; 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

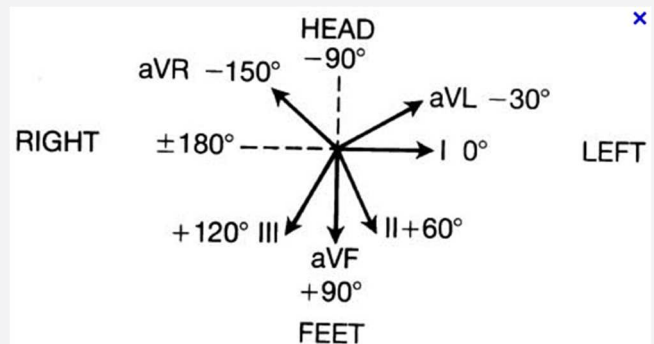
2nd degree HB

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 - flucloxacillin

- ear toilet (wick)

- Keep dry; Daily review until improvement

Malignant OE: invasive form - pseudomonas

- RF = DM, immunosup

- 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 - Horizontal 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; promethazine 10-20mg 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 osteomyelitis, SC abscess

Mng: Abx (cefotaxim 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, retropharyngeal 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+ve rods

Complications: Airway obstruction, sepsis, extension into retropharyngeal space/mediastinum/carotid sheath/mandible

Management

A: sit up; early trachy / fiberoptic 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 nicking

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 adherent flap of cornea

Urgent ophthalmology review, 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 in 50%

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 + flucloz

Orbital: iv flucloz + 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: vasculopathy - 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 - Meningococemia, necrotiz fasciitis, vasculitis, DIC, RMSF, endocarditis

Symptoms

Hypotension - Meningococemia, TSS, RMSF, TEN, SJS

Hand and Foot rashes

Hand Foot and Mouth

Syphilis, gonococcaemia, 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: Pasteurella multocida
Human bites: Eikenella corrodens

Blistering Rashes

Herpes simplex/zoster

Ix: Tzanck 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 flucloxacillin 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 keratinocyte 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: flucloxacillin 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, crepitation, rapid progression, dirty 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, carbamazepine, lamotrigine
Anti-inflammatories: NSAIDs
Antacids: omeprazole

Erythema multiforme

Cause: 50% infections (herpes simplex, mycoplasma), drugs, Ca, idiopathic
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, scleroderma, 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 Spondyloarthropathies
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 syndrome
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 ≥ 5 d

And 4 from 5 of:

Mucous membranes: (pharyngitis, strawberry tongue)

Eyes: conjunctivitis

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

Arrhythmias

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, hirsutism, 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	$osm: (2 \times Na) + Glu + Ur$	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**

BSL >14

pH <7.3

HCO₃ <15

Ketones +++

Osmolality varies

AG >12

H₂O deficit 5-10L (10%, 100ml/kg)

HHOS

BSL >33

pH >7.3

HCO₃ >15

Ketones -/+

Osmolality >320-350

AG <12

H₂O deficit 8-12L (20-25%)

Resus with N saline

0.1iu/kg/hr insulin (max 6u/hr)

Aim BSL 9-14

Use N saline unless Na >150

Replace over 48hrs

Cerebral oedema

Mortality 5-15%

0.05iu/kg/hr insulin (max 3 u/hr)

Aim BSL 14-18

Use 0.45% saline after boluses over

Replace over 48-72hrs

Cerebral oedema uncommon

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

- Diabetes treatment (insulin/sulfonyureas) }
- Alcohol intoxication (decr gluconeogenesis) } most common in ED
- Sepsis (decr gluconeogenesis + incr response to insulin) }
- Liver disease
- Starvation
- Toxic ingestions

Symptoms

CNS: altered GCS, lethargy, confusion, agitation, coma

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 pancytopenia

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, elliptocytosis, 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

MACROCYTIC 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)

PRBC: O neg stat

FFP: give 1:1 with PRBC; aim INR and APTT <1.5x normal

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 (\pm 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 \uparrow 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)
 Coagulopathies (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****A**naemia (haemolytic; Coomb's negative; severely fragmented RBC;)**T**hrombocytopenia**R**enal failure**N**euro 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**

Immunological

Acute haemolytic transfusion reaction

ABO-incompatibility (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

Non-Immunological

TACO

Bacterial contamination

Transfusion related equipment problem - Air embolus, hypothermia

Delayed

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

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 2° 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 & ophthalmic 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, not 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, oliguria

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 <30°C.
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 (40-42°C 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 - \downarrow BP, \uparrow 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 H₂O
Ice pack, Analgesia iv \pm Mg \pm 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 \pm other jellyfish, in tropical waters.
Delayed distressing symptoms from sting & occ fatal
Toxin: Neural Na⁺ channel modulator \rightarrow catecholamine shower
Sting often not felt. Minimal local signs. \sim 30-120min:sense of impending doom, agitation, dysphoria, N/V, diaphoresis, back/limb/abdo pain. \uparrow BP & \uparrow HR.
Severe envenoming \rightarrow 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 \pm 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 - fluoroquinolone, 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 area - 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
<i>Brown</i>	No	Early			Yes	Hypotension, VICC
<i>Tiger</i>	Mild	Early	Late	Late	Yes	Hypotension, VICC, late paralysis
<i>Black</i>	Severe	Anti-coag		Late	Yes	None
<i>Taipan</i>	Mild	Early	Early	Early (mild)	Yes	Hypotension, VICC, paralysis (early), seizures. Most deadly
<i>Death</i>	Mod	No	Early			Desc flaccid paralysis, hypotension
<i>Sea</i>	No	No	Yes	Yes	Yes	

Spider Bites

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



	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, O ₂ , ?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, α 1-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; \geq 11g/l = cirrhosis, CCF, nephrotic syn
- WCC, Amylase (fin 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 cephalosporin

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, CCl₄, idiosyncratic - flucloxacillin, 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
 Thiamine 100mg 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 occurred

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/virulent - SARS, Avian flu, pharyngeal diphtheria, viral haemorrhagic fevers, diss 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

Dysentery: 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 liaison 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 lopinavir 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 - 2-10 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-Neelsen 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 paed

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, Reduced 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 beneficence and non-maleficence

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 ≤ 16 yr 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 (> 14 yr): 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

Compulsory 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 comorbidities

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 utilisation): 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: bronchial 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, visual 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 mediastinum, 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, areflexia
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, H2O 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 1/2 face affected

Paralysis, loss of taste ant 2/3 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

Syndrom 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 intracerebral 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 \geq 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 \geq 65

Medium risk features for brain injury detection on CT

6. Amnesia before impact of \geq 30 minutes
7. Dangerous mechanism (ped vs car, ejected, fall \geq 3 feet or 5 stairs)

NEXUS II

Sensitivity 97%, Specificity 47% for clinically important findings

CT indicated if any of following:

1. Age \geq 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 jejuni, 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 CO₂)

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 Babinski, 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 fatigability

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

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, III n 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 (cmH2O)	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

Benzotropine (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 (O₂ 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 \leq 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 fetomaternal transfusion

Calculation of date of delivery

Naegle'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

ERPOC – incr infection risk, cervical trauma, uterine perf, intrauterine adhesions

Medical – misoprostol 600mcg PO

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

Heterotopic 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 progesterone 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

Determine stability – shocked vs not shocked

Shocked = rupture ectopic - Immediate transfer to OT for laparotomy

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

Supportive care

- Analgesia + antiemetic
- Explanation/reassurance; Involve partner/family
- Any concerns re sexual assault/child abuse?
- Offer support/counselling, notify relevant authorities

Specific treatment

- Rhesus D immunoglobulin/anti-D
 - 250 IU in first trimester
 - 625 IU in 2nd-3rd 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 Douglia

Pre-Eclampsia

>20/40

BP > 140/90

Baseline normal BP

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, paediatrics, 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, emergency 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

Staff: Prepare 2 teams for delivery (one for mother, one for baby), allocate roles

Equipment: neonatal resuscitaire, neonatal resus equipment, suction, BVM, delivery pack

Drugs: syntocinon 10U. Analgesia

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

Immediate uterine assessment (fundal height/tone, check no twin) and gentle massage

Syntocinon 10 U IM

Controlled cord traction, delivery of placenta, inspect for complete placenta delivery



Assess for bleeding from lower uterine tract and perineum, and repair if required
Encourage early suckling of infant to promote uterine contraction
Observe for further PV loss over next 1hr

Premature Labour

Labour <37 weeks

Tocolysis

Can only delay delivery by 2-7 days

Purpose:

- allow time 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

IV access x2 large bore, cross match. Saline bolus if shocked, Massive transfusion protocol

Syntocinon (40IU in 1L saline) and deliver at rate of 10 U/hr

Examine and repair perineal tear

Rub uterine fundus; Bimanual uterine compression; manually remove placenta

Notify theatre, anaesthetics, O&G consultant to attend

Consider vaginal packing

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 inj; 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: flucloxacillin 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

Volkman'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 ligaments 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

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

Volkman'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 paed's 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 1/2 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

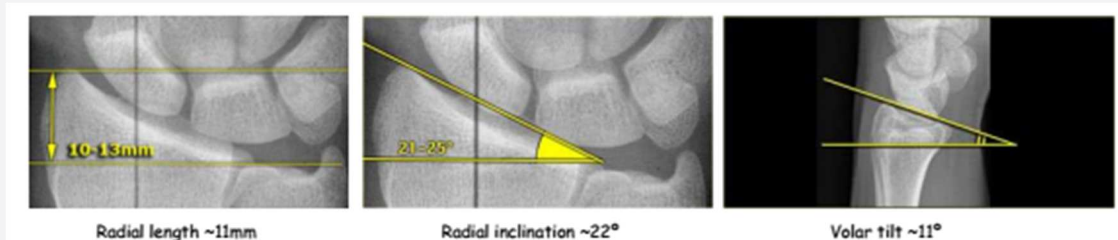
Complications

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.

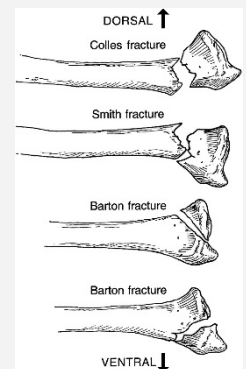


Colles

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 1/3 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 1/3 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



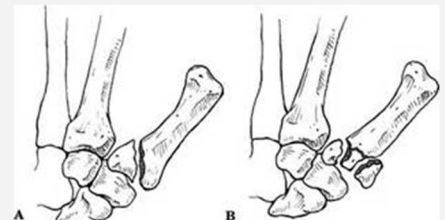
Scaphoid # - 30% prox pole #'s get AVN, nonunion, CRPS

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 flucloxacillin; I&D if collection visible

Felon - Infection of distal finger pulp, very painful; I&D if abscess; flucloxacillin

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 Cl'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)

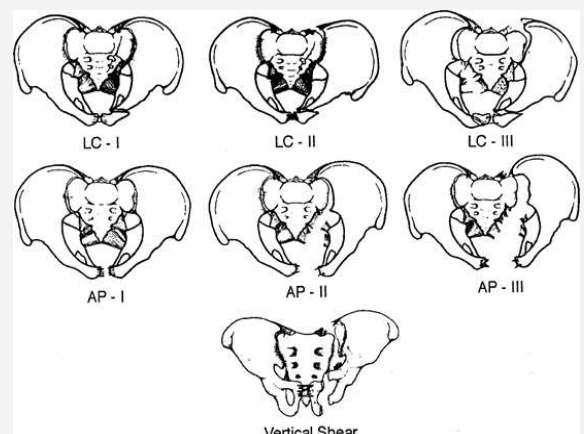
Type I Symphysis diastasis

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

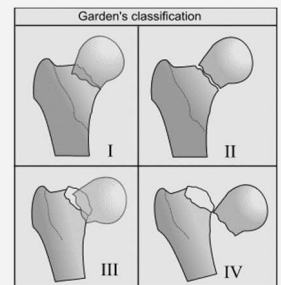
1-2 have up to 20% AVN

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

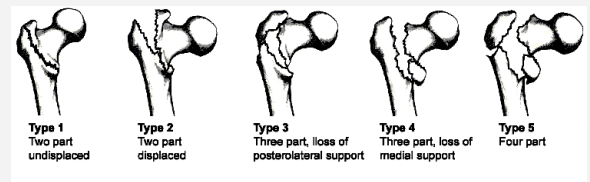
Extracapsular - Evans

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

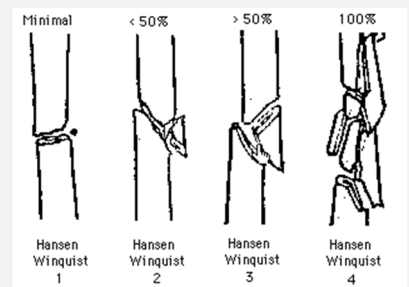
Winqvist classification:

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

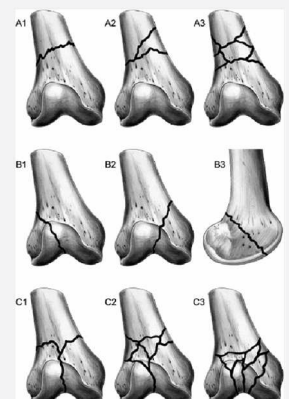
B - intra-articular, unicondylar

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

Second #

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)

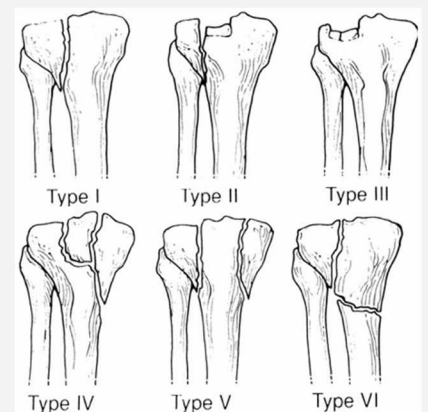
Tibial plateau

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

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

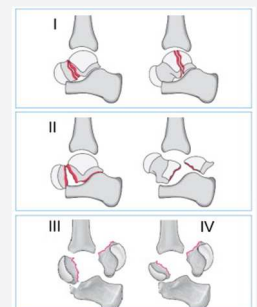
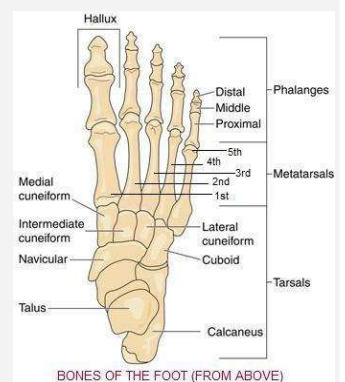
OT if >30% articular surface or >2mm displacement

Pulled elbow

Subluxation of radial head.

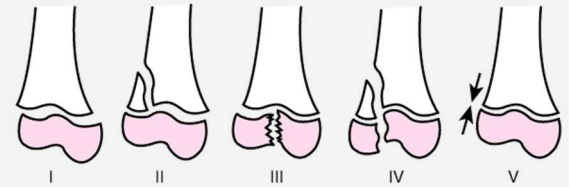
Supination/flexion technique: hold arm with thumb on radial head - supinate and flex arm

Hyperpronation method: hold elbow - hyperpronate forearm with other hand; 95% success rate



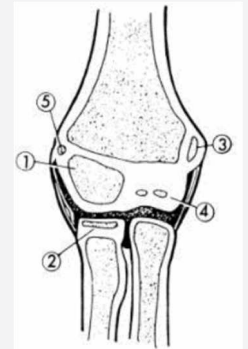
Salter Harris injuries

- 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



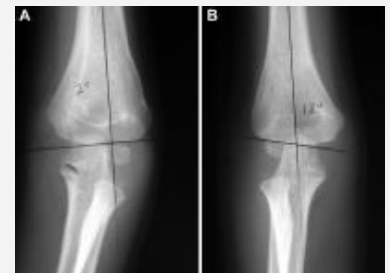
Paediatric elbow

	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 1/3 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 physal 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: $(age + 4) \times 2$

>10yrs: $age \times 3$

ETT

Mm: $(age/4) + 4$ (uncuffed) + 3.5 (cuffed)

Length: $(age/2) + 12$

Observations

BP = $(age \times 2) + 80$

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.

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

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)



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
Diazepam 0.25mg/kg IV / 0.5mg/kg PR or Midazolam 0.15mg/kg IV / IM
Repeat after 5mins
Phenytoin 20mg/kg over 30mins or Phenobarbitone 20mg/kg over 30mins
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 meningitis)

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 meningitis

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

ABO/Rh incompatibility

Birth trauma/bruising

Congenital 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; Congenital - Rubella; Hepatitis

Haematological - Sick 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 Incompatibility
- 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 1/3; abnormal in supracondylar #, lat condyle

Radio-capitellar line: abnormal in lat condyle, radial neck, Monteggia, elbow dislocation

Baumann angle: angle between physal line lat condyle humerus and line perpendicular to long axis humeral shaft = 8-28 deg;

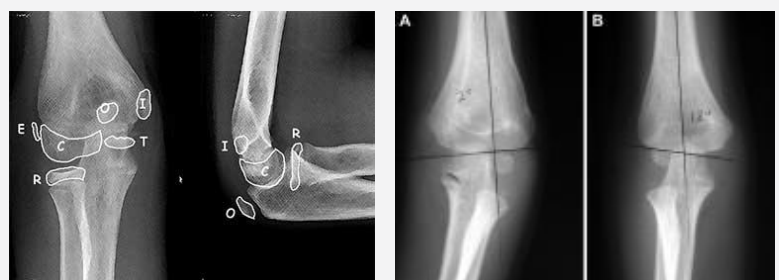
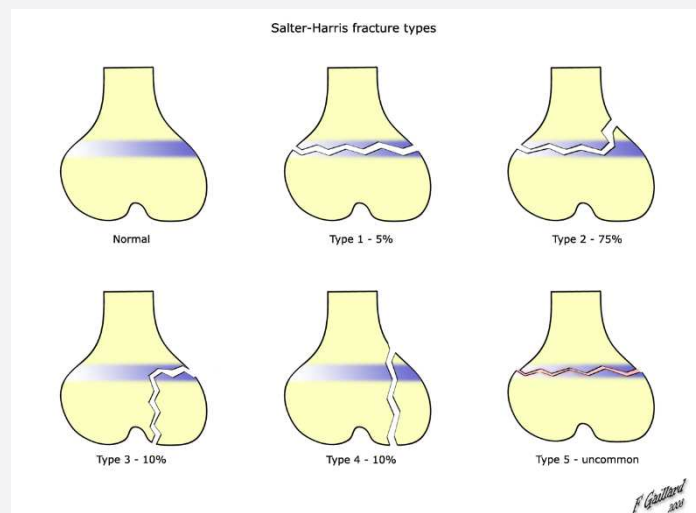
decr angle varus deformity; abnormal in supracondylar #

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 proportional 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: flucloxacillin 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

4/5 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-thrombocytopenic 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 legs

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 herpeticum - 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

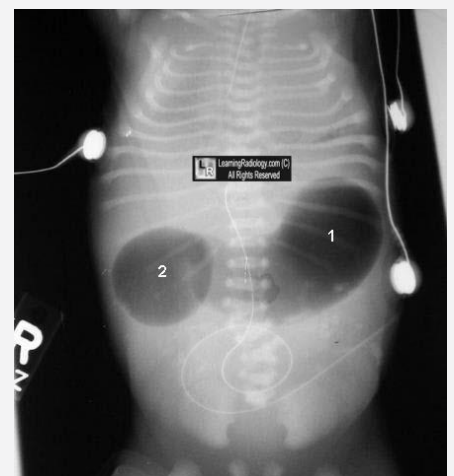
Migration of pain, anorexia, N/V, fever, cough/percussion/hopping pain, RIF tenderness, WCC >10
 >6 = 93% sens, 70% spec; <2 = not appendicitis

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 $\geq 5/9$ 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
- $BMI \leq 17.5$

Bulimia

- Preoccupation with food, weight and shape
- Cycles of binge - purging

SCOFF Questionnaire (>1 positive response \rightarrow 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 carcinomatosa,

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 displacement 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 ($\leq 1\%$) 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

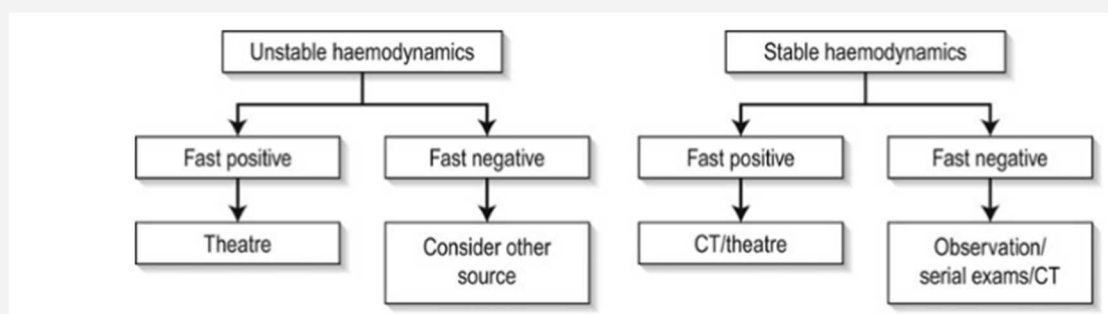
FAST

- 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 paed

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 or >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: cephalosporin/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 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

- Disequilibrium 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 + roxithromycin 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 0.6mg/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 metoramamol 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 H₂O
Keep plateau pressure <20cm H₂O
Expect high pressures (aim for <40cm H₂O)
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
If 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-phlebotic 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

Bordetella pertussis (G -ive); parapertussis as common in 2-6yrs, but less common outside these

1-2/52 catarrhal phase: URTI sx, coryza, fever, conjunctivitis

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 pneumoniae (most common, rusty sputum)

Gram positive, encapsulated diplococcus

Xray: lobar, but can be multilobar

Tx: IV vs oral abx (macrolides, fluoroquinolones, cephalosporin + macrolide)

Haemophilus influenzae

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 pneumophila

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 - amoxicillin 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 – 14x by receiving O2

- needle aspiration

Minimally invasive, early discharge

Higher failure rate, need for other procedure

- small bore catheter

Ongoing drainage, less pain/scar

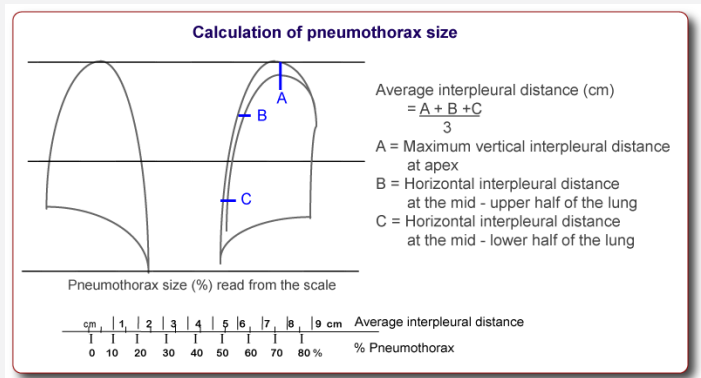
Prone to kinking/occlusion, high complication rate

- 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, chondroma
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

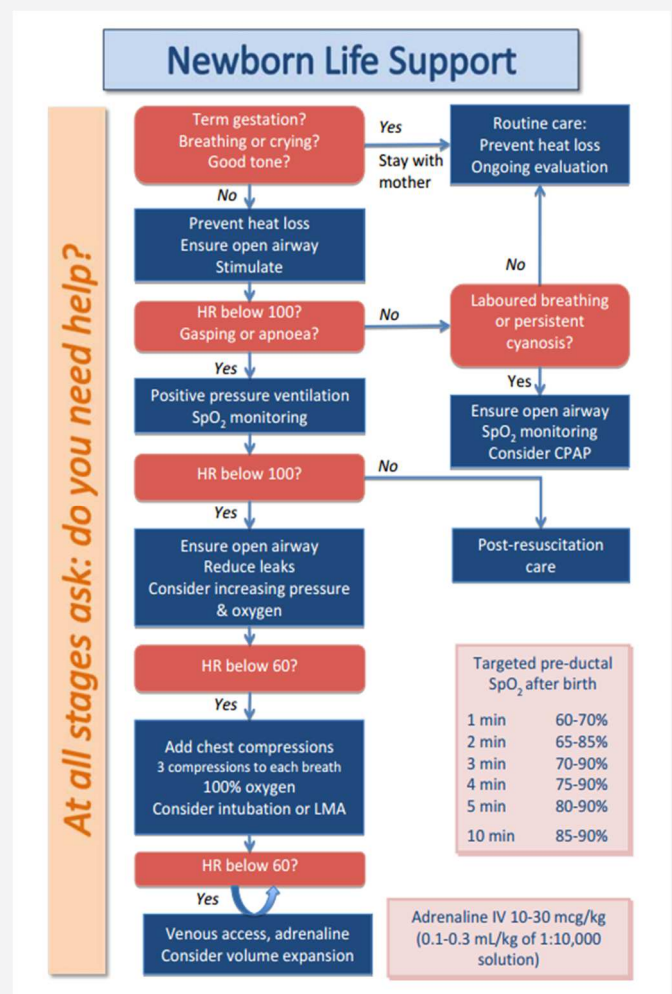
Most arrests are due to hypoxia, hypotension, acidosis, underlying illness
 Most common dysrhythmias severe bradycardia, asystole

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 1/3 AP diameter; lower 1/2 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

Stimulate, dry, warm

Assess colour/tone/breathing/HR (C/T/B/HR)

Open airway, suction mouth and nose

- do Apgar after this

Blue/floppy/not breathing/decr HR:

- open airway, suction if meconium

- 5 inflation breaths (2-3sec, 30cm H20)

After 30sec reassess C/T/B/HR.

- If HR <100: further 30sec vent

- If HR <60: start CPR 3:1, 120/min

1/3 depth of chest. lower 1/2 sternum

100% O2, consider intubation

Venous access

- umbilical vein: insert 10-12cm; IO

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

iNborn 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%, avoid 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, pharyngeal fat

Difficult BVM

Higher pressures

Intubation

Pre-oxygenation critical (desaturate quicker) – pre-oxygenate ?NIV
Position: elevation of shoulders (fat/breasts away from neck)
Short handled laryngoscope
Consider: Awake intubation, Nasal, Fiberoptic
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 commissure 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 emptying, GORD



Incr circulating volume, anaemia, 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 airway
May leak with high pressures
Some anatomies don't fit
May contribute to laryngospasms (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 H₂O
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
β_1 - inotrope/chronotrope	- incr SBP and CO
β_2 - inotrope/chronotrope, vasoD in muscles	- decr PVR, decr DBP
D1 - vasoD inc renal and splanchnic bed	- decr peripheral resistance

Adrenaline

α +++; β_1 ++++ = β_2 +++

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 ; β_1

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 β_2 at low dose; β_1 ++++ at mod dose; α at high doses

Indication: Anaphylaxis, hypotension, cardiogenic shock w mild hypotension, trauma, sepsis, CHB

2 – 50mcg/kg/min

Dobutamine

β_1 ++++ >> β_2 ++; 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

β_1 ++++ = β_2 ++++; 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 fasciculations stop; intubation
ETCO₂, oesophageal detector device, misting
direct inspection of tube passing through 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

HELP! Get difficult airway trolley

STOP and BVM with 100% O₂

Make change: position of head, adequate relaxation, BURP

Stylet / bougie

LMA

Fibreoptic if breathing spontaneously

Or BVM and allow to wake up

Surgical

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

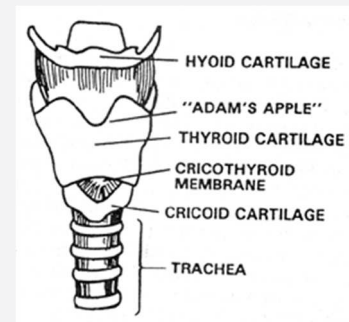
Open cricothyroidotomy

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 4th twitch : 1st 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, SaO ₂ , NIBP, ETCO ₂) Enough room to perform procedure; Rest of ED not too busy
Equipment	O ₂ , 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
Cls	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
1WOB if asynchrony
Nosocomial infections
Bronchospasm
Mucosal drying and ciliary 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, emphysematous 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 (bacteroides, 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**

- Age >55
- WBC >16
- Glucose >10
- AST >250
- LDH >350

At 48 hours

- Ca <2
- HCT fall >10%
- Hypoxia <60
- Urea rise >5
- Base deficit >4
- Sequestration 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

PO₂ <60

Age >55

Neutrophils >15

Calcium <2

Renal dysfunction

Enzymes (raised AST, LDH)

Albumin <32

Sugar >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:

Ongoing cardiac monitoring not required

Adequate sedation achieved

Clinical deterioration not anticipated.

Criteria for admission to ICU:

Airway control

Ventilation

Prolonged or invasive haemodynamic monitoring or support

Haemodialysis

In paed

2 tabs can kill: amphetamines, CCB, chloroquine, opioids, propranolol, 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, propranolol, 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; Propranolol

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, cyproheptadine, 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 N₂O/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

Benzotropine, 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 paed - 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, ophthalmoplegia

Severe (>50mg/kg): seizures, GCS 3-5; areflexia, 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, methHb, 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, ophthalmoplegia, 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: benzotropine 1-2mg IV (1mg PO BD-QDS)



Aspirin

<100mg/kg – minimal Sx	<1.5 mmol/L = therapeutic
>300mg/kg – severe	>2 mmol/L = toxic
>500mg/kg – potentially lethal	>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 propranolol dangerous - In paed: Any dose propranolol or sotalol bad

Na channel blockade - propranolol (prolonged QRS, VF, VT, seizures)

K channel blockade - sotalol (prolonged QTc, VT, VF)

Alpha blockade - labetalol (worsened hypotension)

Highly lipid soluble - propranolol - 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 (propranolol), long QTc (sotalol), VT, TdP, RBBB

Bloods: monitor electrolytes and glucose

Management

Propranolol: 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: propranolol OD with CV compromise
Glucagon: 5-10mg IV bolus - 2-5mg/hr in 5% dex
Intralipid: life-threatening OD propranolol

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 paed: 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

T_{1/2} 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:

Coma/decr LOC/neuro sx**Ongoing sx after 100% O2 for 4hrs****Myocardial ischaemia, Mum (pregnant)****Acidosis****Cyanide**

Potentially life-threatening - immediate intervention

Histotoxic 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 conjunction 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 forCons: CI in CO poisoning as will decr O₂ carrying capacity

Dose: INH via crushing under nose - MetHb levels 5%

Na nitrite: forms MetHbCons: 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%

	SaO ₂	pO ₂	Cyanosis		
Cyanide	High		High	No	Yet profound cellular hypoxia
Met-Hb	Lower		Normal	Yes	Unresponsive to O ₂
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, hyperreflexia, 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, dapson, 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 retention, 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)

TCA's

>5mg/kg = toxic

>10mg/kg = potentially major

>30mg/kg = severe, coma

In paed's >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 GABA_A 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 breaching peritoneum (2/3 breach)

Peritonism

Evisceration

Free 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

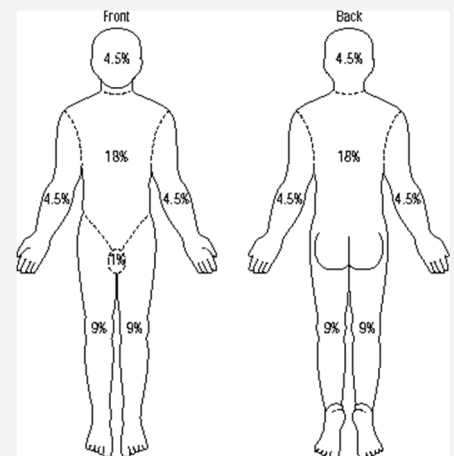
Complicated by #/trauma

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 worsen 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

HFI 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 MgSO4
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/cm² 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 5th 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 (bupivacaine 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 1/3

Associated with tracheal, T3-4 injuries

5% mortality, 25% infectious complications (mediastinitis)



CXR - pleural effusion on L
Gastrograffin 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 obstruction 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 septum, 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



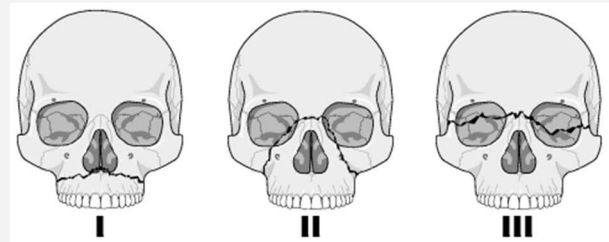
Facial Trauma

- I:** closed # mandible
- II:** closed # zygoma
- III:** open # mandible, Le Forte III, compound # with <20% blood loss
- IV:** >20% blood loss

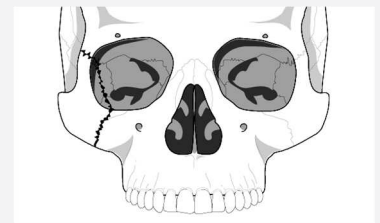
Fractures

Le Fort

- I:** # through lower 1/3 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 haemorrhage, unilateral epistaxis, decr mandibular movment



Mandibular: body; angle; condyle; symphysis

Maxillary, orbital floor blow out #: can trap IR/IO; diplopia, decr upward gaze, enophthalmos, 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 1.5mg/kg

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

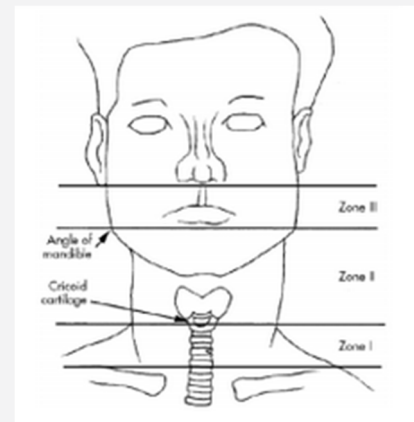
Above mandible to base of skull

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
- Airway 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 reflex - 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, fiberoptic 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 #; 1/2 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

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

<i>Jefferson</i>	Jeffersons #
<i>Bit</i>	Bilateral facet dislocation
<i>Of</i>	Odontoid type II, III
<i>A</i>	Any # with dislocation/subluxation
<i>Hangmans</i>	Hangmans #
<i>Tit</i>	Teardrop #