REVISION NOTES FOR THE FACEM EXAM
BY ED BURNS (FEB 2013)

THE KNOWLEDGE

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ABG + ACID-BASE

Equations

Baseline values
$HCO_3 = 24$
$PCO_2 = 40$

Metabolic acidosis
Expected $PCO_2 = (1.5 \times HCO_3) + 8$

Metabolic alkalosis
Expected $PCO_2 = (0.7 \times HCO_3) + 20$

Respiratory acidosis
1 for 10 rule (acute)
4 for 10 rule (chronic)

Respiratory alkalosis
2 for 10 rule (acute)
5 for 10 rule (chronic)

HAGMA

- **Ketones**
  - DKA
  - AKA
  - Starvation
- **Lactate**
  - Type A (shock)
  - Type B (metabolic)
- **Renal failure**
- **Toxins**
  - Toxic alcohols
  - Salicylates
  - Iron
  - Cyanide
  - Valproate
  - Metformin

Lactic Acidosis

Type A

- **Reduced oxygen delivery (shock + hypoxia)**
  - Shock
  - Severe hypoxia
  - Severe anaemia
  - Carbon monoxide poisoning

- **Excessive oxygen demand (increased muscle activity)**
  - Seizure
  - Hyperpyrexia
  - Exercise
  - Shivering

Type B

Mnemonic = "BLACK MIST"

- **B**eta-2 agonists (salbutamol, adrenaline)
- **L**iver failure
- **A**lcohols (ethanol, methanol, EG), **A**nticonvulsant (valproate)
- **C**yanide poisoning
- **K**etoacidosis
- **M**etformin
- **I**nborn errors of metabolism, **I**ron, **I**soniazid
- **S**epsis, **S**alicylates
- **T**hiamine deficiency

Raised osmolar gap

- **Alcohols** – ethanol, methanol, EG
- **Ketones** – DKA, AKA, acetone
- **Sugars** - mannitol
- **Lactate** – severe lactic acidosis
- **Proteins**
- **Lipids**
- Excessively high levels of **ions** (Mg2+, Ca2+, Phos)

NAGMA

In order of likelihood…

Top causes
- **Normal saline**
- **Diarrhoea**
- **RTA**

Also consider
- **Addison's**
- **Acetazolamide**
- **Fistulas**

Or a structured approach…

- **Chloride gain**
  - **Normal saline**

- **Bicarbonate loss**
  - **Gut = diarrhoea, fistulas**
  - **Renal = RTA, Addison's, acetazolamide**

Metabolic alkalosis

Top Causes
- **Vomiting**
- **Diuretics**
- **Increased aldosterone (primary, secondary)**

Aetiology	*Saline Responsiveness*
Chloride loss • GI = vomiting, NG suction • Renal = diuretics (loops, thiazides), post-hypercapnic **Potassium loss** • **S**yndromes = Cushing's, Conn's, Bartter's • **S**econdary ⇧ aldosterone (due to hypovolaemia) • **E**ating disorders • **E**xcessive licorice **Excess base** • Antacids, NaHCO3, citrate (dialysis, blood transfusion)	**Urine Cl < 10 mmol / L** **= Saline Responsive** • Usually volume depleted • Causes: Vomiting (90%), *previous* diuretic therapy, post-hypercapnic **Urine Cl > 10 mmol / L** **= Saline resistant** • Associated with volume expansion + hypokalaemia • Causes: aldosterone excess, K+ deficiency, Bartter's, *current* diuretic therapy

Low anion gap

- Low albumin (= anion gap)
- High levels of unmeasured cations
    - Ca2+
    - Mg2+
    - Li+
- Falsely elevated chloride
    - Bromide (e.g. dextromethorphan bromide overdose)
    - Iodide
- Nitrites
- Myeloma (positively charged proteins)

Respiratory Acidosis

CNS + Neuromuscular	Lung + Chest Wall
Brain • Drugs (opioids, alcohol, sedatives) • Cerebrovascular events, trauma, infection • Metabolic disorders • Preterminal hypotension **Spine** • Trauma, infection, tumour • Demyelination, transverse myelitis **Nerves** • Polio, GBS, bilateral phrenic N injury **NMJ** • OP poisoning, spider or snake venom • Myasthenia • Muscle relaxants **Muscles** • Dystrophies, myopathies, electrolyte abnormalities	**Airway Obstruction** • Upper = Croup, FB, anaphylaxis • Lower = COPD, asthma, aspiration **Lungs** • Fibrosis • Oedema • Pneumonia **Pleura** • Large effusion / haemothorax • Tension PTX **Chest Wall** • Flail segment • Kyphoscoliosis • Severe arthritis **Ventilator + Circuit** • Dead space • Ventilator malfunction • Hypoventilation

Respiratory Alkalosis

Two groups "live the dream" (fully compensated respiratory alkalosis)
= Pregnancy & Altitude

Brain (via respiratory centre stimulation)
- Cerebral oedema
- Hepatic encephalopathy
- Psychogenic = pain, fear, anxiety
- Drugs = salicylates, stimulants, theophylline
- Pregnancy (progesterone)
- Early sepsis (cytokines)
- Exercise

Hypoxaemia (via peripheral chemoreceptors)
- Altitude
- Asphyxiation

Pulmonary (via intrapulmonary receptors)
- PE
- Pneumonia
- Asthma
- Pulmonary oedema

Iatrogenic
- Excessive mechanical ventilation

Causes of Hypoxia

With normal A-a gradient

- **Low FiO2**
  - Altitude,
  - Asphyxia (e.g. gases)
- **Hypoventilation** (includes iatrogenic)

Increased A-a gradient

- **V:Q mismatch**
  - *Reduced alveolar ventilation* = pneumonia, pulmonary oedema
  - *Reduced alveolar perfusion* = PE
- **Shunts (R->L)**
  - Anatomical (e.g. TOF, TGA, truncus arteriosus)
  - Physiological (consolidation, atelectasis)
- **Diffusion block** = Pulmonary fibrosis

ADVANCED LIFE SUPPORT

Cardiac Arrest

Effective Therapies
- Uninterrupted CPR
- Early defibrillation
- Therapeutic hypothermia for VF/VT (weaker evidence of benefit for non-shockable rhythms)

CPR
- Centre of chest
- Depth > 5 cm
- Rate 100-120 bpm
- 50% compression / relaxation ratio
- Minimise interruptions
- Change operator every 2 minutes
- Ratios
  - Adults = 30:2
  - Children = 15:2 (two rescuers), 30:2 (single rescuer)
  - Neonates = 3:1

Monitoring
Waveform capnography for
- Confirming ETT placement
- Monitoring quality of CPR

Airway management
- Cricoid pressure not recommended during intubation
- BVM / LMA preferred unless intubated by airway expert

Adrenaline
- Increased ROSC
- No effect on survival to hospital discharge or neurological outcomes
- No difference between adrenaline and vasopressin
- No additional benefit from high-dose adrenaline; may be harmful

Amiodarone
- Increased survival to hospital *admission* for VF/VT
- No effect on survival to discharge or neurological outcomes

Other Drugs
No evidence of benefit for
- Atropine -> removed from 2010 algorithm
- Bicarbonate
- Calcium
- Lignocaine -> may be harmful

These agents are not recommended (except in specific circumstances)

Post-Arrest Care

- Titrate oxygen to maintain SaO2 94-98%
- Avoid hyperoxaemia
- Early PCI if ACS thought possible (even if ECG non-diagnostic)
- Treat glucose levels > 10, avoid hypoglycaemia
- Induced hypothermia 32-34C for 24 hours (-> improved survival and neurological outcomes in out-of-hospital VT/VF arrest)

ACLS in hypothermia

BLS

- Pulse + breathing check for 60 seconds
- Gentle handling (may precipitate VF = controversial)
- Frozen chest wall may render CPR difficult (reduced compliance)

Defibrillation

- Up to 3 attempts
- Then withhold until temp > 30

Drugs

- Withhold while temp < 30
- Double the interval between doses while temp 30-35

Rewarming

- ECMO / bypass = most effective
- Warmed fluids 42 C
- Warmed, humidified oxygen
- Bair Hugger (impractical)
- Body cavity lavage (inferior to ECMO)

Therapeutic Hypothermia

Mechanisms

- Reduces neuronal damage following cardiac arrest
- Improves survival following out of hospital cardiac arrest
- Increases SVR without reducing ejection fraction
- Reduces myocardial oxygen consumption

Only proven benefits in adult, out-of-hospital VT/VF arrest

- Two prospective trials in 2002
- Improved survival + neurological outcomes with mild hypothermia for 12-24 hours
- Decreased severe disability and death by 15% (absolute)
- NNT = 6
- Earlier cooling associated with better outcome

Criteria

- ROSC < 60 minutes
- Persistent coma (not responding to verbal stimuli)

Other conditions

- Weaker evidence that cooling also beneficial for non-shockable rhythms provided ROSC < 25 mins (= two non-randomised studies)
- Evidence of improved survival + neuro outcomes in neonates suffering from birth asphyxia

ALS 2010 Recommendations

- Treatment of patients with ROSC after VF/VT arrest
- *"Induced hypothermia might also benefit adult patients… [with ROSC] from a non-shockable rhythm"*

Protocol

- Cool to 32-34C for 12-24 hours
- Rapid infusion of ice-cold saline at 30 ml/kg
- Ice packs to axillae, groins, neck
- Cooling blankets
- Sedation + paralysis to offset shivering

ADMINISTRATION

Developing a Guideline / Writing a Proposal

Gather Info

- Define the problem; determine aims
- Any templates? – e.g. other hospital protocols, national guidelines
- Literature review
- Investigation, root-cause analysis

Involve Stakeholders

- Consult widely
- Involve medical, nursing, allied health staff, hospital management

Draft a Plan

- Circulate
- Seek feedback
- Revise + update

Pilot

- Inform / educate relevant people
- Begin pilot
- Identify early issues
- Review + evaluate
- Make corrections

Launch Plan

- Disseminate widely – e.g. via email, newsletters, posters, staff meetings

Audit

- On-going monitoring and review
- Close the QA loop ("Plan-Do-Check-Act" cycle)

Quality Assurance

For *every* admin question:

- Notify ED director
- Feedback / debrief staff
- Educate staff
- Revise existing protocols
- On-going monitoring and audit
- Close QA loop

Complaint Management

Acknowledge complaint

- Prompt reply
- Promise to investigate
- Express regret for any distress caused (do not accept liability)
- Provide contact details

Gather information

- Case notes
- Speak to staff involved with patient
    - Private
    - Non-judgemental
    - Enquire about mental health problems / drug + alcohol / coping
    - Offer support

Plan action

- Determine whether anyone at fault
- Determine what action needs to be taken
    - To resolve medical issues – e.g. patient recall
    - To resolve complaint – e.g. face-to-face meeting, letter
    - Disciplinary action / performance management of staff
- Notify medicolegal department

Response to complainant

- Prepare response
- Formal letter
- Signed by ED director

Audit / QA loop

- Feed back to all involved
- Revise existing protocols
- Educate staff
- Re-audit

Clinical Disaster

- Deal yourself with CD
  - Ensure there is nothing else that can be done

- Deal with rest of department
  - Appoint senior colleague to run ED while you manage the CD

- Gather facts quickly, before seeing family
  - Talk with medical / nursing staff
  - Read notes

- See family / patient with senior nurse +/- social worker
  - Be honest
  - Be prepared to apologize for what appears to be a CD
  - Promise investigation
  - Promise honesty and prompt feedback
  - Promise best ongoing care
  - Give phone number
  - Call back

- Debrief staff
  - Hear what happened
  - Send off distressed staff

- Doctor
  - Private
  - Ensure case notes completed
  - Send home
  - Provide support (doctors kill themselves)
  - Notify insurer if necessary
  - Call back

- Admin
  - Notify relevant parties (e.g. ED director)
  - Call coroner
  - Get info on doctor (? Prior problems)
  - Document

- Revise protocols / QA loop

Patient Management Plans

Patient Identification

- Name
- Address
- DOB
- Known Aliases
- Mug-shot

Medical Problems

Behavioural Problems

Short-Term Strategies for Managing ED Presentations

- Early review by senior doctor
- Streamlined plan addressing medical + behavioural issues
- Avoid unnecessary admissions / investigations
- Zero tolerance for bad behaviour

Longer-Term Strategies for Managing Patient in the Community

- Involvement of GP / social work / psychiatry

Relevant Contacts

- GP
- Caseworker / guardian (if patient incompetent)
- Psychiatrist
- Pain specialist
- Family

Admin

- Author details (name, position, signature)
- Authorised by (e.g. head of department)
- Review date + mechanism

Managing Violence in ED

Staff

- Trained security team in ED
- Verbal de-escalation and self-defence training
- Ensure adequate ED staffing on nights and weekends
- Staff to remove stethoscope, pens prior to seeing patient

Area

- Controlled entry / exit points to ED
- Swipe card access
- Video surveillance – avoid blind spots
- Protective screens for triage + reception staff
- Cubicle setup – no sharp objects, furniture secured to floor
- Highly visible cubicle spaces for potentially violent patients

Equipment

- Duress alarms
- Restraint devices
- Rapid access to sedative agents
- Computer systems – flagging of violent patients

Policies + protocols

- Zero tolerance policy (visible posters)
- Links to police; arrest + prosecution of wilfully violent patients
- Known violent patients searched at triage by security; weapons removed
- Physical + chemical restraint protocol / Code Black
- Rapid triage of behaviourally disturbed patients
- Psychiatric patients seen promptly by psychiatric liaison nurse + senior ED doctor
- On-going audit of violence in ED -> revise protocols, close QA loop

Violent / Disruptive / Psychotic Patient

- Ensure staff safety

- Ensure safety of other patients
    - Clear area around patient
    - Stop new patients coming through
    - Consider stopping ambulances if big disruption
    - Appoint senior colleague to run dept
    - Manage the violent patient yourself

- Manage the violent patient
    - Assemble team (at least 5)
    - Have drugs drawn up (e.g. midazolam 5-10mg, droperidol 5-10mg)
    - Pre-assign limbs / take down word
    - Use family or friends if available
    - Attempt to verbally de-escalate
    - Offer oral sedation
    - If fails -> take down
    - Sedate (IM or IV)
    - Apply four-point physical restraints
    - Assess medically. Exclude organic disease as the cause of behavior (e.g. amphetamines, head injury)
    - Consult as necessary (Psych, Tox)
    - Review the need for ongoing restraint / sedation
    - Remove physical restraints as soon as possible

- Debrief team
- Document

- Review need for quality assurance loop / revision of protocols

Australian Council on Healthcare Standards (ACHS) endorsed clinical indicators for Emergency Medicine

Waiting time + Access block

- Access block = % patients admitted, transferred or died within ED who have a total ED LOS > 8 hours from arrival at triage.
- Waiting time by ATS triage category.
- Total number of DNWs.

Critical Care

- Critical care patients waiting > 4 hours in ED after decision to admit.

Mental Health

- Waiting times for mental health patients.
- Total number of mental health DNWs.

Paeds

- Time to first antibiotic in septic infants.
- Salbutamol given < 30 mins for patients with asthma.
- Analgesics within 30 minutes for paediatric fractures.

Thrombolysis

- Thrombolytics given < 30 mins to patients with STEMI.

Elderly

- Discharge summary completed for patients > 65.
- Documented risk assessment for patients > 65 (i.e. CCT review).

Pain + Analgesia

- Documented pain scores (on arrival, reassessed subsequently).

Audit of all ED deaths

Maximum Waiting Times by ATS Triage Category		
ATS Category	Maximum Waiting Time	Performance Indicator Threshold
1	Immediate	100%
2	10 mins	80%
3	30 mins	75%
4	60 mins	70%
5	120 mins	70%

Strategies to Improve Patient Flow / Reduce Access Block

Key Principles

- More inpatient beds
- Better patient flow processes

ED Solutions

Staff

- More doctors and nurses on the floor
- Rostering to cover busier times of day
- Increased senior doctor cover (24/7)
- "Navigator" role – person with overall responsibility for patient flow
- Allied health team to facilitate discharge for elderly patients
- Dedicated radiology team for ED cases

Area

- More ED beds / cubicles
- Separate admission + discharge streams
- Fast-tracking of minor injuries and psychiatry
- Increased use of observation / short-stay ward with senior doctor supervision

Equipment

- Computerised patient tracking system
- Ensure adequate beds, x-ray machines, CT scanners, etc.

Processes + Protocols

- Early senior doctor review of all ED patients
- 24-hour access to specialty consultations
- 24-hour access to investigations (e.g. pathology, radiology)
- Rapid reporting system for ED patients (notification of abnormal results)
- Emphasis on early disposition planning (= education of junior doctors)
- Admitting rights for ED doctors – inpatient teams not permitted to refuse patients, able to send patients directly to the ward
- Evidence-based protocols for use by junior doctors (standardised care)

Whole Hospital Solutions

Increased number of inpatient beds (need > 3 per 1,000 population)

Streamlined discharge of patients

- Daily consultant ward rounds
- Rapid discharge of suitable patients
- Allied health + pharmacy involvement
- Use of transit lounge for patients awaiting transport

Community Solutions

- Increased ambulatory care (e.g. home IV Abx for cellulitis)
- Increased community step-down / rehab beds

No evidence that access block is reduced by:

- Telephone advice
- Increased GP services
- Ambulance diversion

<u>Did Not Waits</u>

National average ~ 5%

Factors associated with DNWs

- Prolonged waiting time = most common reason
- Lower socio-economic background
- Young adults
- Parents with young children
- Less urgent triage categories (ATS 4 or 5)
- ED overcrowding
- ED attendance after hours

Reasons for leaving

- Prolonged wait = most common reason
- Reason for attendance resolved
- Feel that problem is inappropriate for ED
- Perceived unfairness / rudeness at triage
- Other things to do (e.g. work commitments)

Consequences

- Dissatisfaction / complaints / litigation
- Delayed diagnosis + treatment
- Re-presentations = mainly to primary care or other hospitals
- 5% subsequent admission rate
- Adverse outcomes are rare unless high-risk presentation

Reduction of DNWs

- Shorter ED waiting times
- Accurate triage allocation
- Adequate staffing to attend patients in WR
- Analgesia for patients waiting to be seen
- Regular updates
- Educate waiting patients about triage process

Handover

= The transfer of professional responsibility and accountability for a patient or group of patients between individuals or teams.

Key Issues

- Transfer of clinical information
- Secondary aim of education / staff development
- Risk management issues = potentially dangerous for patients
- Reliability of information reduces with each handover
- Patient confidentiality
- Need to minimise time spent away from direct patient care

Considerations

- Frequency – e.g. every shift change
- Site – flight deck vs bedside
- Who attends
- Paper/board vs electronic
- Documentation

Preparation

- Gather medical staff
- Nurse in charge, other stakeholders (e.g. allied health)
- Delegate senior staff to manage current sick patients
- Free up night staff for handover

Handover process

- Safe handover of all patients seen
- Identify salient issues
- Should have clear management plan
- Teaching + support where appropriate
- Delegation – responsibilities commensurate with level of experience

Following handover

- Ensure medical records complete
- Ensure referrals made – inpatient teams, allied health, etc.
- Enable night staff to leave
- Oversee department and cases
- Address any bed access issues
- Feedback from night staff re any problems overnight

Methods for Optimising Handover

Formats

Electronic or "paper round"

- Using EDIS or patient notes
- Confidential
- Away from patients = better for violent or difficult patients
- More rapid than bedside handover
- Immediate computer access to investigations
- Quality of information is less than with bedside handover

Ward Round

- Allows direct viewing of patients
- Better quality of information
- Patients introduced directly to new doctor = better for patient
- Time consuming – may not be realistic in a busy department
- Less confidential
- Insufficient space for entire ED team to move around (OH+ concerns)

Site

- Within ED = allows monitoring of ED environment (e.g. sick patients)
- Away from ED = less distractions

Frequency

- At each shift change = morning, evening, night

Attendees

- Medical and senior nursing staff
- Others = care coordination, allied health, mental health
- Integrated medical and nursing handover vs separate
    - Timing is an issue (medical staff not keen to start at 07:00!)
    - Type of info and problems handed over are very different
- Different handovers for different streams (admit, discharge, observation)

Handover Tools

- iSoBAR and SBARS models recommended by ACEM
    - I = identify yourself
    - S = situation (clinical problem)
    - O = observations (vital signs)
    - B = background (PMHx)
    - A = agreed plan
    - R = read back (check for mutual understanding of plan)

Records

- Electronic vs paper
- Shift reports

ANAESTHETICS

Airway Assessment

Difficult Laryngoscopy (= LEMON)

- **L** = Look externally (Gestalt)
- **E** = Evaluate 3, 3, 2
- **M** = Mallampati score
- **O** = Obstruction / obesity
- **N** = Neck mobility

Difficult BVM (= MOANS)

- **M** = Mask seal / male sex / Mallampati
- **O** = Obesity / obstruction
- **A** = Age > 55
- **N** = No teeth
- **S** = Stiff lungs / snoring

Difficult LMA (= RODS)

- **R** = Restricted mouth opening
- **O** = Obstruction / obesity
- **D** = Disrupted or distorted airway
- **S** = Stiff lungs

Difficult Cricothyroidotomy (= SMART)

- **S** = Surgery
- **M** = Mass (haematoma / abscess)
- **A** = Access / anatomy (short neck)
- **R** = Radiation
- **T** = Tumour

Drug Doses in the Morbidly Obese Patient

Ideal body weight

Males: IBW = 50 kg + 2.3 kg for each inch over 5 ft

Females: IBW = 45 kg + 2.3 kg for each inch over 5 ft

Lean body weight = IBW x 1.3

Adjusted body weight = IBW + 0.4 x (TBW – IBW)

Intubating Drug Dosing

- **Total body weight**
  - Suxamethonium (1 mg / kg)

- **Ideal body weight**
  - Propofol
  - Midazolam
  - Rocuronium
  - Vecuronium

- **Lean body weight**
  - Fentanyl
  - Thiopentone

Dosing of other Drugs in Obese Patients

TBW	Vancomycin = 30 mg / kg Unfractionated heparin = 80 units / kg then 18 units / kg / hr
LBW	Enoxaparin = 1.5 mg / kg q12h
ABW	Gentamicin

Anaesthetic Drugs in Children

Fentanyl
- 1.5 mcg / kg IN

Midazolam
- IV = 0.15 mg / kg
- IN = 0.6 mg / kg

Ketamine
- IV = 1 – 1.5 mg / kg. Repeat dose = 0.5 mg / kg.
- IM = 4 mg / kg (plus 10 mcg / kg atropine). Repeat dose 2 mg / kg after 15 mins.

Suxamethonium
- 1.5 mg / kg older children
- 2 mg / kg infants
- 3 mg / kg neonates

Describe the Process of Procedural Sedation

Patient Selection

Indications

- Patients needing painful procedures in the ED (e.g. joint relocation, fracture reduction, cardioversion, lumbar puncture)

Contraindications

- Allergy to the sedative agents used
- Haemodynamically unstable
- Appropriately skilled staff not available to perform procedure
- Non-urgent procedure – can be done in theatre
- Significant medical comorbidities
- High ASA grade (III or IV)
- Predicted difficult airway (LEMON) or BVM (MOANS)
- Pregnant or morbidly obese (relative)
- Not fasted (depending on urgency of procedure)

Preparation

Patient

- Explain, reassure
- Obtain informed consent

Staff

- 1 airway doctor (appropriately trained + credentialed)
- 1 procedure doctor
- 1-2 nurses

Area

- Resus bay
- Full monitoring (ECG, SaO2, NIBP, ETCO2)
- Enough room to perform procedure
- Rest of ED not too busy

Equipment

- Oxygen, suction, airway equipment
- Stuff for procedure, e.g. plaster trolley – for fracture reduction

Drugs

- Analgesia = fentanyl 100mcg/10ml
- Sedative = propofol or ketamine 200mg/20ml ± midazolam 10mg/10ml

Procedure

PPE

- Gloves
- Aprons if messy procedure (e.g. plastering)

Pre-med

- Give fentanyl 1 mcg/kg around 3-5 mins before procedure
- Consider midazolam 1-2 mg if anxious

Positioning

- 30 degrees head up for most procedures
- Head down for CVC
- Left lateral for LP

Prep + drape

- Ensure everything is ready to perform procedure
- Warm up ETCO2 monitor and attach to O2 mask
- Sterile prep for LP / chest drain / CVC

Perform

- Pre-oxygenate (denitrogenate) for 3 mins or 8 vital-capacity breaths
- Give initial dose of sedative agent:
    - Propofol 0.5 – 1 mg/kg
    - Ketamine 1 – 1.5 mg/kg
- Use reduced doses in the elderly or those with borderline BP
- Further small doses of sedative every 30-60 seconds until appropriate depth of sedation reached:
    - Propofol 20-30 mg
    - Ketamine 0.5 mg/kg (once only)
- End-points:
    - 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 + treat complications

- Airway obstruction -> jaw thrust, airway adjunct
- Desaturation -> stimulate patient, BVM ventilation if no response
- Hypotension -> give small boluses of metoraminol 0.5-1 mg
- Laryngospasm (with ketamine) -> Get help! BVM ventilation with 100% O2 + CPAP, firm jaw thrust with pressure at Larson's point, deepen sedation ± paralysis, intubate
- Anaphylaxis -> adrenaline

Confirm success of procedure = Post-reduction x-rays
Document = details of procedure, drug doses used

Pros + Cons of Different Anaesthetic Techniques

e.g. for elderly or paediatric fracture reduction

Key Issues

Case
- What are the implications of this condition / injury? (zeitgeist)
- What is the severity?

Cause
- Any contributing causes to consider?
    - Children = NAI
    - Elderly = medical cause for collapse / injury or elder abuse

Complications
- Consider complications of injury, reduction + hospitalisation
- Loss of independence / need for admission in elderly

General Considerations

Patient (± parent)
- Stability + neurovascular status
- Comorbidities
- Fasting status
- Consent
- Preference, acceptability
- Requests for private care

Departmental
- Staffing level + seniority
- Current state of ED
- Availability of specialist (e.g. orthopaedic) assistance
- Local or regional guidelines

Options

- General anaesthetic
- ED procedural sedation (propofol or ketamine)
- Bier's block
- LA injection / regional block / haematoma block

Consider whether each technique is **age-appropriate**:

- Children
    - Minimise pain + suffering
    - Avoid techniques that require co-operation
- Elderly
    - Caution with comorbidities = risk of apnoea, hypotension

Description

= Definition, Administration, Mechanism

- Agent / technique
- Dose + route, description of technique, additional agents required (e.g. atropine with ketamine)
- Mechanism of action + usual effects

Pros

= Role, Advantages, Proven benefits

- Age-appropriate
- Parent / child acceptability
- Antiemetic action
- Protection of airway
- Antidotes available (e.g. flumazenil, naloxone)

Cons

= Contraindications, Limitations, Difficulties, Side-effects, Hidden costs

- Contraindications specific to each agent
- Training or credentialing requirements
- Need for fasting
- Need for IV access
- Side effects specific to each agent
- Impact on ED – staff, number, time and use of resus bay

Other possible pros + cons

- Onset / offset of agent
- Duration of procedure
- LOS in ED and/or hospital
    - Need to wait for theatre
    - Need for transfer
- Ease of manipulation
- Cost

Agents Used for Procedural Sedation

	Propofol	**Ketamine**
Type of Agent	GA	Dissociative
Initial Dose	0.5 – 1 mg/kg	Children 1 – 1.5 mg/kg IV over 60 sec 3 – 4 mg/kg IM Adults 0.5 – 1 mg/kg slow IV
Top-Up Dose	0.25 – 0.5 mg/kg	0.5 mg/kg IV 2 mg/kg IM
Onset of action	Onset < 40 seconds	IV = 30-60 seconds IM = 5 minutes
Duration	~ 5 minutes Rapid redistribution	IV = 10-15 minutes IM = 20-30 minutes
Adjuncts	Fentanyl 1 mcg/kg For analgesia	Atropine 10 mcg/kg To dry up secretions
Role	Adults	Children, elderly
Contraindications	Egg or soy allergy Hypotension	Eye injury / glaucoma Head injury / raised ICP (controversial) Ischaemic heart disease (relative)
Pros	- Very short duration of action – useful for short procedures - Anti-emetic effects - Familiar - Readily available	- Analgesic effects - Preserved airway reflexes - No respiratory depression - Haemodynamically stable - Bronchodilation
Cons	- Pain on injection - Respiratory depression - Apnoea - Desaturation - Transient hypotension - Shivering - Propofol infusion syndrome (only in ICU)	- Vomiting (= common ~10% especially with IM route) - Hypertension + tachycardia - Salivation + bronchorrhoea - Laryngospasm (rare) - Emergence phenomena (uncommon in children) - Raised ICP (conflicting evidence for this) - Raised IOP - Myoclonic jerks

BIOCHEMISTRY

Hyperkalaemia

Decreased excretion = most important

- Renal failure
- ACE-inhibitors
- Aldosterone deficiency (e.g. Addisons)
- Aldosterone blockade = K-sparing diuretics (spironolactone)
- RTA type 4

Increased intake

- Oral / IV potassium
- Deliberate self-poisoning
- GI bleed

Shifts

- Acidosis
- Rhabdomyolysis
- Haemolysis
- Tumour lysis syndrome
- Drugs = digoxin (acute toxicity), beta-blockers, insulin *deficiency*

Factitious

- In vitro haemolysis (vigorous phlebotomy)

Hypokalaemia

- **Increased loss**
  - *Renal* = Diuretics, RTA (type 1 +2), liquorice excess
  - *Gut* = D+V, laxative abuse

- **Reduced intake** = Starvation, eating disorders

- **Aldosterone excess**
  - Primary = Conn's, Cushing's, Bartter's
  - Secondary = volume contraction (⇧ renin -> angiotensin -> aldosterone)

- **Shifts** = Alkalosis, insulin, beta-2 agonists

- **Spurious** = Drip arm

Hypernatraemia

"I-PAD" – imagine a very salty i-pad…

Iatrogenic, incapacitated
- $NaHCO_3$, hypertonic saline
- Formula problems (babies), neglect (elderly)

Pure water loss (H_2O > Na)
- Renal = osmotic diuresis (hyperglycaemia)
- Extra-renal = diarrhoea, blood loss

Aldosterone excess
- Primary = Conn's, Cushing's
- Secondary = due to CCF, cirrhosis, nephrotic syndrome, dehydration

Diabetes Insipidus
- Neurogenic = raised ICP (CNS tumour, trauma, infection)
- Nephrogenic, e.g. polycystic kidney disease, drugs (lithium)

Diabetes Insipidus

Neurogenic = Absolute or relative lack of ADH
- **Idiopathic** (30%)
- Acquired damage to hypothalamus or pituitary
    - Infarction
    - Tumour
    - Head injury
    - SAH
    - Infection
- Familial (rare)

Nephrogenic = Decreased response to ADH
- Renal disease
- Drugs
    - Lithium
- Electrolyte disturbance
    - Hypokalaemia
    - Hypercalcaemia
- Familial

Dipsogenic
- Psychogenic polydipsia
- Primary polydipsia

Gestational
- Placenta produces vasopressinase that breaks down ADH

Hyponatraemia

HYPOTONIC

Hypovolaemic

- **Renal losses *(urine Na > 20)***
  - Diuretics
  - Addison's
  - Salt-wasting nephropathy (e.g. RTA, CRF)
- **Extrarenal losses *(urine Na < 20)***
  - D+V
  - Blood loss
  - Third spacing
  - Excessive sweating

Euvolaemic

- **Water intoxication**
  - Psychogenic
  - Iatrogenic (e.g. TURP syndrome, D5W)
- **Increased ADH**
  - Stress / trauma / surgery
  - Hypothyroidism
  - Medications (e.g. CBZ, SSRIs)
  - SIADH

Hypervolaemic

- **Oedema states**
  - CCF
  - Cirrhosis with ascites
  - Nephrotic syndrome

HYPERTONIC = ↑ glucose

NORMOTONIC= ↑ lipids, protein (pseudohyponatraemia)

SIADH - Definition

- Hypotonic hyponatraemia (< 275 mOsm/kg)
- Inappropriately high urine osmolality (> 100 mOsm/kg)
- Elevated urinary [Na+] > 20 mEq/L
- Clinical euvolaemia
- Normal cardiac, renal, adrenal, thyroid, liver function
- Correctable with water restriction

SIADH – Causes

CNS
- Trauma
- Tumour
- Infection
- CVA / Haemorrhage

Pulmonary
- Pneumonia
- COPD
- Lung abscess
- TB

Cancer
- Lung
- Pancreas
- Thymoma
- Lymphoma
- Ovarian

Hypocalcaemia

Increased excretion
- Alcoholism
- Diuretics
- Salt-wasting nephropathy

Decreased absorption (= Vitamin D deficiency)
- Dietary
- Sunlight
- Chronic renal failure

Endocrine
- Hypoparathyroidism
- *Pseudo*-hypoparathyroidism (= congenital PTH resistance)
- Excess aldosterone (Ca2+ lost in exchange for Na+)

Shifts
- Alkalosis (low *ionised* calcium)
- Rhabdomyolysis
- Pancreatitis (saponification)

Others
- Phosphate (e.g. enemas, hyperphosphataemia)
- Citrate (blood transfusion, dialysis)

Hypercalaemia

Malignancy (50%)
- Paraneoplastic (= most common), e.g. PTHrP in squamous cell lung cancer
- Bony metastases

Hyperparathyroidism (25%)
- Primary + Tertiary
- NOT secondary = associated with *hypo*calcaemia

Vitamin D excess
- Ingestion
- Lymphoma (⇧ release)
- Sarcoidosis (⇧ activation)

Milk-alkali syndrome
- Excess calcium-containing antacids
- Associated with metabolic alkalosis

Thyrotoxicosis

Thiazide diuretics

Hypomagnesaemia

Renal Losses
1. *Alcohol*
2. *Diuretics*
- Diabetes
- Nephrotoxic drugs
- Hypercalcaemia
- Gitelman's and Bartter's

GI Losses (distal GIT secretes the most Mg)
- Diarrhoea
- Malabsorption syndromes
- Crohn's
- Small bowel bypass surgery

Intracellular shift
- Adrenergics

Pancreatitis
- Saponification

Hypermagnesaemia

Decreased excretion
- Renal failure

Increased intake
- Treatment of pre-eclampsia
- Epsom salts
- Dead sea water poisoning!

Release from cells
- Tumour lysis syndrome
- Rhabdomyolysis

Elevated Urea

Dehydration = most important cause

Increased production
- High protein diet
- Upper GI bleed
- Trauma/major surgery
- Starvation with muscle breakdown
- Drugs – corticosteroids, tetracyclines

Decreased clearance
- Renal impairment – acute and chronic
- Urinary tract obstruction

Increased reabsorption (decreased renal perfusion)
- CHF
- Dehydration

Elevated Creatinine

Increased production
- Muscle breakdown
- Testosterone therapy (increased muscle mass)
- Corticosteroids

Decreased excretion
- Pre-renal
- Renal
  - Vascular, glomerular, tubuloinsterstitial disease
  - Hypothyroidism impairs creatinine secretion
- Post-renal

Artefact
- Cephalosporins interfere with assay

BURNS

Major burns - Definition

- > 20% TBSA
- Complicated burns, e.g. electrical, inhalation, trauma

Victoria Burns Unit Referral Criteria

- Special areas = hands, feet, face, perineum, joints
- Electrical burns
- Chemical burns
- Circumferential burns
- Inhalational injury
- > 10% TBSA partial thickness
- > 5% TBSA full thickness
- Associated multi-trauma
- Very young or elderly
- Significant co-morbidities
- Children < 12 months old
- Non-accidental injury
- Social problems, including children at risk
- Pregnancy

First Aid

- Cool running water for 20 minutes (beware hypothermia)
- Clean with normal saline or 0.1% chlorhexidine
- Remove loose dermis or blisters < 2.5 cm
- Cling wrap dressing

Burns Fluids

Indications

Give burns fluids if:
> 15% TBSA (adult)
> 10% TBSA (child)

Modified Parkland Formula

- Hartmann's solution
- 3-4 mL / kg / TBSA% = mL given in first 24 hours
    - ½ in first 8 hours *from the time of burn* (not time of presentation!)
    - ½ over next 16 hours
- Aim for urine output
    - > 0.5 mL / kg / hr (adults)
    - > 1 mL / kg /hr (children < 30 kg)

Maintenance Fluids in Children

- Add maintenance fluids for children < 30 kg
- 0.45% saline + 5% dextrose
- Encourage oral fluids

Weight	Maintenance Fluids
< 10 kg	100 ml / kg / day
10 – 20 kg	1000 ml + 50 ml / kg /day for every kg over 10 kg
20 – 30 kg	1500 ml + 20 ml / kg / day for every kg over 20 kg

http://www.vicburns.org.au/initial-management/primary-survey/circulation-commence-fluid-resuscitation.html

CARDIOLOGY

Chest Pain Risk Stratification

Obvious STEMI -> treat as STEMI
Seek and treat alternative diagnoses (e.g. LRTI, PNX, PE, dissection, Boerhaave's)

	Assessment Features	Management
High Risk	Clinical instability - Pulmonary oedema - Shock / hypotension - Dysrhythmia - Diaphoresis - New onset MR Recent stents / CABG / AMI Ongoing severe cardiac chest pain ST deviation > 1 mm or deep precordial T-wave inversion Raised cardiac enzymes Positive MPS TIMI score > 2 Diabetes with typical Sx	- Cardiology admission - Inpatient angiogram +/- PCI
Intermediate Risk	Typical angina pain Chest pain at rest Crescendo / new onset angina Non-specific ECG changes (ST deviation < 1 mm, T wave changes) TIMI score > 1 Diabetes with atypical Sx	- Medical admission - Inpatient stress test / MPS
Low Risk	Atypical chest pain No previous cardiac history Serial ECGs normal or non-diagnostic Negative cardiac enzymes Symptoms present > 2 weeks Non-Aboriginal	- SSU admission or discharge - Consider use of high-sensitivity delta-troponin to facilitate early discharge - Outpatient stress test
Very Low Risk	As per low risk, plus: Age < 40 No stimulant drug use Normal ECG Normal baseline troponin Clinician Gestalt < 2% *or* Clear alternative diagnosis	- May be suitable for early discharge - Treat as per alternative diagnosis

TIMI Score

1. ST deviation > 1mm
2. Two or more angina episodes in past 24 hours
3. Three or more cardiac risk factors (HTN, DM, smoking, chol, FHx)
4. Raised troponin
5. Known coronary stenosis > 50%
6. Age > 65
7. Aspirin use in past 7 days

TIMI score	Risk	14-day event rate
0	Low	< 2%
1-2	Intermediate	5-10%
3 or above	High	> 10%
6-7	Very high	40%

Contra-indications to thrombolysis

Absolute

- Active bleeding or bleeding diathesis (excludes menses)
- Significant head or facial trauma < 3 months
- Suspected aortic dissection
- Any prior intracranial haemorrhage
- Ischaemic stroke < 3 months
- Known structural CNS lesion (e.g. AVM, tumour)

Relative

- Current use of anticoagulants (higher INR = higher risk of bleeding)
- Non-compressible vascular puncture
- Major surgery < 3 weeks
- Traumatic / prolonged CPR (> 10 mins)
- Internal bleeding (GI / GU) < 4 weeks
- Active PUD
- Severe, uncontrolled hypertension (BP >180/110)
- Ischaemic stroke > 3 months ago, dementia
- Pregnancy

Thrombolysis Doses for STEMI

tPA if age < 75, Aboriginal, hypotensive, > 4 hours since pain:

- Reteplase = 10 units IV over 2 mins then 10 units IV 30 mins later
- Tenecteplase = weight based dosing ~0.5mg/kg (range 30 – 50mg)

Streptokinase if age > 75 + non-Aboriginal, or tPA not available

- 1.5 million units over 60 mins

AF Management Options

1. Nothing

- Spontaneous reversion rate within 48 hours = 65%
- Avoids side effects + complications of cardioversion or anticoagulants
- May be supplemented by electrolyte correction (Mg, K)
- Not acceptable for symptomatic or unstable patients

2. Rhythm control

Role

Rhythm control preferred if:

- Symptomatic
- Young
- Suspected lone AF
- Precipitating condition resolved

Pros

- Improved quality of life in active patients (e.g. able to exercise)

Cons

Less likely to be effective if:

- Age > 65
- Late presentation (> 48h = only 50% reversion rate)
- Recurrent AF
- Valvular heart disease / dilated LA
- Cardiac failure

Other limitations

- No survival benefit over rate control in older / high-risk patients
- Risk of thromboembolism – especially if attempted after 48 hours

2a. Electrical Cardioversion

Description

- Propofol sedation
- AP pad position
- Synchronised DC shock at 100-360j
- Higher energy levels have higher success rate (95% for 200j biphasic)

Pros

- Most effective technique
- High success rate (~ 90%) in uncomplicated patients
- Reduces ED LOS by 3 hours compared to chemical cardioversion

Cons

- Risks of procedural sedation

2b. Chemical Cardioversion

Description

- Flecainide 150mg IV over 30 min (must have structurally normal heart)
- Amiodarone 300mg IV over 30 mins then 900mg/24h

Pros

- Avoids procedural sedation – better in ASA III + IV patients
- Can be used to maintain sinus rhythm (amiodarone)

Cons

Significant side effects:

- Flecainide = cardiovascular collapse, QRS/QT prolongation, TdP
- Amiodarone = thyroid dysfunction, lung fibrosis, skin discolouration

3. Rate control

Agents

- Beta-blockers – e.g. metoprolol IV 5-15mg then switch to PO
- Verapamil / diltiazem
- Digoxin

Role

Patients unlikely to maintain sinus rhythm:

- Age > 65
- Ischaemic heart disease
- Valvular heart disease / dilated LA
- Contraindications to antiarrhythmic drugs

4. Anticoagulation

For cardioversion

Not required prior to cardioversion if:

- AF lasts < 48h
- No intracardiac thrombus on TOE

Indicated for all other cases

- 3 weeks prior to cardioversion
- At least 4 weeks after cardioversion
- In the 24 hours preceding a TOE cardioversion

For stable AF

- Long-term anticoagulation needs determined by CHADS2, CHADSVASC and HAS-BLED score (aspirin vs warfarin/dabigatran)

Cardiac Murmurs

- Left-sided murmurs increase with *expiration* ("Lex")
- Right-sided murmurs increase with *inspiration* ("Rinse")

	Site	Timing	Radiation	Character	Accentuation maneuvers	Other features
Aortic regurgitation	Aortic area	Early diastolic	LLSE	Decrescendo	Expiration, leaning forward	Wide PP Eponymous signs
Aortic stenosis	Aortic area	Systolic	Carotids	Ejection	Expiration	Separate from heart sounds Slow-rising pulse
Mitral stenosis	Apex	Mid to late diastolic	None	Low-pitched Rumbling Use bell of stethoscope	Left lateral position Presystolic accentuation Exercise	Loud S1 Opening snap
Mitral regurgitation	Apex	Pansystolic	Axilla or LLSE	Blowing	Longer and louder with Valsalva	Parasternal impulse (enlarges left atrium)
VSD	LLSE	Pansystolic	None	Localised		Thrill
Tricuspid regurgitation	LLSE	Pansystolic			Inspiration	Big V waves, pulsatile liver
HOCM	Apex LLSE	Late systolic at LLSE Pansystolic at apex			Louder with Valsalva Softer with squatting	S4, double-impulse apex beat, jerky carotid

Eponymous signs of Aortic Regurgitation

- Large volume collapsing pulse:
    - Watson's water hammer pulse
    - Corrigan's pulse (rapid upstroke / downstroke)
- Low diastolic BP, widened pulse pressure
- De Musset's sign = head nodding in time with the heart beat
- Quincke's sign = pulsation of the capillary bed in the nail
- Traube's sign = pistol shot bruit over femoral artery
- Duroziez's sign = systolic + diastolic murmurs over femoral artery

Malignant Hypertension

Hypertension plus evidence of end-organ dysfunction (= HTN emergency)

- Diastolic BP > 130
- MAP > 180

End-Organ Damage

- Dissection
- ACS / APO
- ICH
- Renal dysfunction
- Encephalopathy / Retinopathy

Causes

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

Hypertensive encephalopathy

- Severe hypertension
- Altered GCS (confusion, coma, seizures)
- Blurred vision
- Vomiting
- Retinopathy

Treatment

- Emergency (e.g. aortic dissection) -> reduce rapidly over 5-10 mins with IV agents – esmolol + SNP
- Combination vasodilator and beta-blocker, e.g. metoprolol + GTN
- Benzos for sympathomimetic intoxication or drug withdrawal
- Avoid beta-blocker in cocaine, amphetamines, phaeo

BP targets in various conditions

Malignant hypertension / hypertensive encephalopathy
Reduce by up to 25% over 1-2 hours
Aim for diastolic BP of 110 mmHg

Ischaemic stroke
< 180 / 105 if thrombolysis planned
< 220 / 110 if not for thrombolysis

Haemorrhagic stroke
Treat if BP > 180 / 110
Aim for BP of 160 / 90

Dissection
Aim for SBP 100-120 and HR < 60

DERMATOLOGY

Causes of Erythema Nodosum

- **Idiopathic** (50%)
- **Infections**
  - Streptococci
  - Yersinia
  - Campylobacter
  - TB, EBV, HSV
- **Inflammatory conditions**
  - Sarcoidosis
  - Crohn's + UC
  - Behcet's
- **Haematological malignancy**
  - Leukaemia
  - Lymphoma
- **Drugs**
  - OCP
  - Sulfonamides / penicillin
- **Pregnancy**

Causes of Erythema Multiforme

- **Idiopathic** (50%)
- **Infections**
  - Herpes simplex
  - Mycoplasma
- **Immunisations**
- **Malignancy**
- **Drugs**
  - Penicillins / cephalosporins
  - Sulphonamides
  - Anticonvulsants
  - NSAIDs

Causes of Strawberry Tongue

- Scarlet fever
- Kawasaki disease
- Toxic shock syndrome

Erythroderma

Causes
- Eczema / dermatitis
- Psoriasis
- Drug reaction (NSAIDs, antibiotics, anticonvulsants)
- Cutaneous T-cell lymphoma

Differential Diagnosis
- Viral exanthem
- Severe sunburn / photosensitivity
- TENS / SJS
- Staphylococcal scalded skin syndrome (infants)
- Toxic shock syndrome
- Pityriasis rubra pilaris

Complications
- Dehydration
- Electrolyte abnormality
- Hypothermia
- Hypoalbuminaemia
- High-output cardiac failure
- Infection

Toxic Shock Syndrome

Criterion	Description
1. Fever	> 38.9 C
2. Rash	diffuse macular erythroderma
3. Desquamation	1-2 weeks later
4. Hypotension	Systolic < 90, postural drop > 15, low for age
5. Multisystem involvement (at least 3 systems)	**GI** = D+V **Renal** = ARF, pyuria **Liver** = raised ALT, bili **Blood** = platelets < 100 **Mucous membranes** = hyperaemia, strawberry tongue **Muscles** = rhabdo **CNS** = altered mental state

Blistering Rashes

Viral

- Herpes simplex
- Chickenpox
- Shingles
- Hand, foot and mouth
- Eczema herpeticum

Bacterial

- Bullous impetigo
- Staphlococcal scalded skin
- Necrotising soft tissue infections

Trauma

- Burns (sunburn, chemical burn)
- Bites
- Local trauma

Immunological

- Contact dermatitis
- SJS / TENS / EM
- Pemphigus vulgaris
- Bullous pemphigoid

DISASTER MANAGEMENT

Disaster Notification + Preparation

Key Issues

- Disaster likely to temporarily overwhelm the hospital
- Anticipate type of casualties, e.g. major burns, CBR, paeds, elderly
- Walking wounded likely to arrive before seriously injured patients
- Needs whole hospital response (Code Brown = external disaster) with activation of hospital disaster plan

Confirm Details

- M – Major disaster declared
- E – Exact location
- T – Type of incident
- H – Hazards at the scene
- A – Access to site
- **N – Number and type of casualties + expected arrival times**
- E – Emergency services present, required

Notification

- Call switchboard -> activate Code Brown / Disaster Plan
- Notify hospital director + disaster management team
- Whole hospital placed on standby:
    - All staff to remain on duty
    - Surgeons to remain in theatres, no new surgery to start
    - ED staff meeting
        - Allocate roles and prepare for influx of patients
        - Form trauma teams to receive patients

Preparation of ED for Arrival of Patients

Divert

- Inbound patients -> other hospitals
- Stable patients from triage -> local GPs or other EDs
- Walking wounded -> emergency clinic in outpatients dept
- Visitors + media -> separate areas (e.g. auditorium)

Decant

- ED patients to other clinical areas

Discharge

- Selected ED patients

Deploy

- Surge team to commence advance triage process:
    - Lock down ED
    - Security presence – consider requesting police support
    - Triage in ambulance bay – use separate disaster tags + note sets

Post-event = stand-down / debrief / update disaster plan / QA loop

Influenza-Like Illness / Respiratory Contagion

SINGLE PATIENT

Key Issues

- Resuscitate the patient
- Protect staff and other patients from infection risk

Patient

- Isolate
- Keep away from other patients
- Apply mask

Staff

- Wear PPE = gloves, gowns, N95 masks, visors
- Hand-washing + alcohol gel
- Barrier nursing
- No pregnant staff to nurse patient

Area

- Negative pressure room
- Patient not to remain in waiting room

Equipment

- Avoid aerosolizing procedures (NIV, nebulisers)

PANDEMIC

Notifications

- Hospital administration / ED director / infectious diseases
- Department of health -> should activate chain of events to contain contagion

Staff

- Wear PPE at triage
- Chemoprophylaxis, e.g. with Tamiflu (oseltamivir)
- Staff vaccination program
- Symptomatic staff members sent home

Area

- Cohorting of patients to different areas of ED
- Conversion of existing cubicles into isolation bays
- Consider de-activation of air-conditioning system

Equipment

- Purchase additional stocks of PPE / Tamiflu / swabs / PCR kits

Policies + Protocols

- Centralised treatment of affected patients – e.g. 'flu clinics
- Triage-initiated protocol for isolation of patients presenting with influenza-like symptoms
- Testing of patients (e.g. PCR of nasopharyngeal swabs)

Disaster Triage

SIEVE
- At disaster site
- By paramedics
- Prioritises extrication from disaster site

Black = Dead
- No airway
- Non-survivable injuries (e.g. decapitation)

Red = Immediate
- Airway patent with adjunct (e.g. Guedel)
- RR < 10 or > 30
- HR > 120
- CRT > 2 seconds

Yellow = Delayed
- Significant injury, unable to walk
- HR < 120
- CRT < 2 seconds

Green = Minor
- Walking wounded

SORT
- At casualty clearing post
- By nursing or medical staff
- Prioritises treatment + transport to hospital
- Uses revised trauma score

Revised Trauma Score
- GCS
- Systolic BP
- Respiratory rate

Each item scored from 0-4 to give total score out of 12
Low scores = more severe injury

Priority	**RTS**
T1	1-10
T2	11
T4	12
Expectant	1-3
Dead	**0**

ENDOCRINOLOGY

Adrenal Insufficiency

Primary

= Mineralocorticoid + glucocorticoid deficiency

- Low Na+
- High K+ and Ca2+
- NAGMA
- Mild hypoglycaemia
- Shock (reduced vasomotor tone + hypovolaemia)

Causes

- Congenital adrenal hyperplasia
- Bilateral adrenal haemorrhage
    - Haemorrhagic disease of newborn (Vit K deficiency)
    - Severe sepsis (Waterhouse-Friderichsen syndrome)
- Addisons (= autoimmune)
- Drugs, e.g ketoconazole, etomidate
- Infection
    - TB
    - Viral
- Malignancy
    - Primary
    - Secondary = lung, lymphoma
- Infiltrative disease = sarcoidosis, haemachromotosis

Secondary

= Glucocorticoid deficiency ± compensatory *increased* aldosterone (via RAS)

- Hypotension / shock (reduced vasomotor tone)
- Mild hypoglycaemia
- Sodium normal or high
- Potassium normal or low

Causes

- Steroid withdrawal
- Hypopituitarism
- Hypothalamic dysfunction

Congenital Adrenal Hyperplasia

- Girls = virilisation at birth
- Boys:
    - Salt-losing form = Addisonian crisis at age 7-14 days
    - Non-salt-losing = Early virilisation at 2-4 years
- Ix = cortisol (low), ACTH (high), 17-hydroxyprogesterone (high)

ENT

Nasal FB

Positive pressure techniques

- Nose blowing
- Big kiss
- BVM
- Beamsley blaster = wall oxygen at 15L (avoid!)

Pros

- Rapid
- Technically easy to perform
- Relatively non-invasive
- Well tolerated
- High success rates
- Minimal risk of trauma to nasal mucosa

Cons

- Potential risk of barotrauma to lungs and upper airway – especially Beamsley blaster technique (reports of orbital emphysema)
- Nose-blowing requires patient co-operation – difficult in young children
- Big kiss requires parental co-operation – difficult if anxious

Instruments

- Right angle hook / forceps
- Balloon catheter (Foley / Fogarty)
- Suction catheter
- Glue on a stick

Pros

- Better for more firmly wedged FBs
- Suction is good for smooth FBs or those that have disintegrated
- Right angle hook good for spherical FBs

Cons

- More invasive
- More technically difficult
- More distressing to patient
- May require sedation -> risk of aspiration
- May traumatise nasal mucosa (and child!)
- Glue may not stick to object
- Forceps may not grasp smooth object
- Balloon catheter may not be able to pass beyond large object

Suggested Algorithm

- Positive pressure technique (nose blowing for older child, big kiss or BVM for toddlers)
- Instrument technique without sedation (may require physical restraint)
- Removal in OT by ENT if unsuccessful

ENVIRONMENTAL

Drowning

Conn + Modell

Category	GCS	Neuro intact survival (%)
A = alert	≥ 14	100
B = blunted	8-13	100
C = comatose	< 8	>90
C1 = flexion	5	>90
C2 = extension	4	>90
C3 = flaccid	3	<20

Orlowski scale

- Age < 3
- Submersion > 5 mins
- No CPR for > 10 mins
- Coma on arrival
- pH < 7.1

< 3 factors = 90% recovery
> 3 factors = 5% recovery

Poor prognostic signs

- Pupils fixed and dilated
- Orlowski score > 3
- GCS 5 or less (= Conn + Modell C1-3)
- Submersion > 5 mins
- CPR delayed > 10 mins
- Time to first breath > 30 mins
- Coma or cardiac arrest on arrival

Other poor prognostic signs

- Male sex
- Asystole
- Unwitnessed or prolonged submersion
- Fresh water
- Hypothermia in *warm* water drowning (> indicates prolonged downtime)
- Prolonged CPR prior to hospital arrival

Heat Stroke

Features

- Fever > 40C
- Altered mental state
- Multi-organ failure
- High mortality (up to 80%)

Classification

- Classic heat stroke = high ambient temperature + impaired heat loss
- Exertional heat stroke = exercise in hot environment

Differential Diagnosis

- CNS infections = meningitis, encephalitis, abscess
- Sepsis = pneumonia, bacteraemia
- Stimulant drug use
- Serotonin syndrome
- Anticholinergic delirium
- Alcohol or benzo withdrawal
- Thyroid storm
- Neuroleptic malignant syndrome
- Chronic salicylate poisoning
- Malignant hyperpyrexia (only during anaesthesia)

Risk Factors

- Elderly or young
- Immobility / dependency
- Dehydration = diuretics, alcohol
- Reduced compensatory tachycardia = CCB, BB
- Impaired thermoregulation = phenothiazines
- Impaired sweating = anticholinergic agents
- Increased muscle activity = amphetamines, cocaine
- Impaired oxidative phosphorylation = salicylates, lithium

Assessment

Simultaneous assessment and resuscitation
Rapid primary survey (ABCDE) + treat immediate life threats

History – may need collateral

- Exertional vs non-exertional
- Ambient temperature
- Fluid intake
- Appropriate clothing / sun protection
- Symptoms = muscle cramps, N+V, headache, syncope, seizures
- Sweating or anhidrosis

PMHx

- Chronic medical conditions
- Alcoholism
- Thyrotoxicosis
- Dermatological conditions – e.g. severe psoriasis

Drugs

- Anticholinergics
- Antipsychotics
- Serotonergics, e.g. MAOI, SSRI
- Amphetamines / cocaine
- Benzodiazepines
- Diuretics
- Cardiac medications
- Salicylates

Allergies / Immunisations / Social History / Functional Status / Review of Sx

Examination

General appearance

- Vital signs
- Hydration status
- Signs of shock
- Mental state
- Signs of thyrotoxicosis
- Continuous core temperature monitoring – use oesophageal or rectal thermometer

Expected findings

- Tachycardia
- Hypotension
- Tachypnoea

Neuro exam

- Meningism
- Mydriasis with stimulants, anticholinergics
- Clonus or hyperreflexia = suggests serotonin syndrome
- Ataxia and delirium common

Skin

- Presence / absence of sweating
- Heat rash, or petechial rash if DIC
- Track marks with IVDU

Cardiovascular, respiratory, abdominal exam

Investigations

Bedside

Glucose	
ECG	Dysrhythmias
ABG	Lactic acidosis, resp alkalosis
Urine	Myoglobin, urine drug screen, ?UTI

Labs

U+E	Renal failure, electrolyte abnormality (low Na with MDMA)
Coags	Coagulopathy, DIC
LFTS	Raised AST, LDH common in heat stroke
CK	Rhabdomyolysis
FBC	Raised WCC (30-40), thrombocytopenia with DIC

Imaging

CXR	ARDS, aspiration, pneumonia

Management

Resus

Time critical emergency
Needs immediate resus and cooling to prevent MOF and death
Rapidly escalating plan with early intubation and paralysis if temperature not controlled

A Intubate, paralyse + sedate if

- Temp> 40
- Altered GCS
- Aspiration / airway not protected
- Serotonin syndrome

Fluid load prior to intubation (1L normal saline)

Drugs

- Propofol 1-2mg/kg
- Rocuronium 1.2mg/kg
- Metoraminol 0.5-1mg if hypotensive
- Avoid suxamathonium – risk of ↑temp, K+

B Maintain oxygenation – aim for SaO2 94-98%

C Secure IV access x 2
Fluid bolus if shocked = 10-20 ml saline + observe response
Aim for

- HR < 100
- MAP > 60
- Urine output > 1ml/kg/hr

D Check + correct glucose
Treat seizures – midazolam 5-10mg IV

E Commence cooling

- Ice packs to axillae + groins
- Cooled IV fluids at 4 degrees C
- Remove clothes
- Evaporative cooling methods
    - Tepid sponging / spraying
    - Fans directed at patient
- Consider invasive cooling techniques only if remains hyperthermic after intubation + paralysis
- Stop cooling once temp 38-39C to avoid overshoot

Supportive Care

Ongoing sedation ± paralysis
If not paralysed -> treat shivering episodes with diazepam 5-10mg IV
Avoid antipyretics + dantrolene = ineffective
Continue maintenance fluids (1-2 ml/kg/hour)
Correct electrolyte abnormalities

Invasive monitoring

- CVP line
- Arterial line
- Urinary catheter
- Temperature probe in oesophagus or bladder

Inform next of kin / get collateral history

Specific Treatments

Cooling as above
Seek + treat the underlying cause

For rhabdomyolysis
Consider mannitol + isotonic bicarbonate for renal protection (controversial)

For hyperkalaemia

- Salbutamol 5-10mg neb
- Insulin 10 units IV + dextrose 50ml 50%
- Consider need for dialysis

Disposition

Admit to ICU

Rhabdomyolysis

= Muscle breakdown with CK 5 x upper limit of normal (e.g. > 5000)

Causes

- Drugs = alcohol, stimulants, statins
- Infections = influenza, Legionella, viral infections
- Trauma = crush injury, compartment syndrome, high-voltage electricity
- Strenuous exercise
- Hyperthermia
- Seizures
- Pressure areas = coma, immobility
- Muscle disease, e.g. polymyositis

Complications

- Acute renal failure
- Electrolyte abnormalities
    - ↑K+
    - ↑phosphate
    - ↑urate
    - ↓Ca2+
- DIC
- Compartment syndrome

Treatment

Treat the cause – e.g. fasciotomy for compartment syndrome, cease statin

Aggressive IV fluids

- Normal saline at 2.5 ml/kg/hr (~200ml/hr)
- Aim for urine output of 2ml/kg/hr
- Avoid K+ or lactate-containing fluids (e.g. Hartmann's)

Urinary alkalinisation

- Aim = prevent precipitation of myoglobin in renal tubules
- Add 150 ml 8.4% $NaHCO_3$ to 850ml sterile H_2O or 5% dextrose
- Run at 100ml/hr
- Aim for urinary pH > 6.5

Forced diuresis

- Aims = "flush" myoglobin out of the tubules, increased GFR
- Correct volume deficits + establish maintenance IV fluids first
- Mannitol 20% 1g/kg over 30 minutes or as an infusion
- May worsen dehydration and oliguria

Evidence

- No prospective trial data to support the use of bicarbonate or mannitol
- Frusemide diuresis is *contraindicated* -> causes acidification of the urine

GASTROENTEROLOGY

Extra-Intestinal Manifestations of Inflammatory Bowel Disease

Skin	Erythema nodosum Pyoderma gangrenosum
Eyes	Episcleritis, iritis, uveitis
Joints	Seronegative arthritis Ankylosing spondylitis (HLA-B27)
Haematology	Thromboembolism = leading cause of death Anaemia Neutrophilia = during flare Neutropenia = due to steroids, immunosuppressants
Hepatobiliary	Gallstones
Renal	Urinary calculi

HAEMATOLOGY

Pancytopenia

- **Haematological disease**
  - Aplastic anaemia
  - Myelodysplasia / myelofibrosis
  - Leukaemia / lymphoma / myeloma
- **Drugs**
  - Cytotoxic chemotherapy
  - Immunosuppressants, e.g. MTX, 6MP
  - Colchicine, chloramphenicol
- **Infections**
  - Parvovirus B19
  - EBV / HIV / TB
  - Overwhelming sepsis
- **Radiation**
- **Vitamin deficiency**
  - B12 / folate
- **Hypersplenism**

Microcytic anaemia (MCV < 80)

- Iron deficiency
- Chronic blood loss
- Thalassaemia
- Sideroblastic anaemia (e.g. lead poisoning)
- Vitamin C deficiency

Macrocytic anaemia (MCV >100)

- B12 / folate deficiency
- Alcoholism
- Liver disease
- Hypothyroidism
- Myelodysplasia

Normocytic anaemia (MCV 80-100)

- Acute blood loss
- Haemolysis
- Renal failure
- Chronic disease (e.g. malignancy, rheumatological)
- Mixed (iron + B12/folate deficiency)

Causes of DIC

= "HOTMISS"

- **H**ead injury, hepatic failure
- **O**bstetric emergencies: abruption, amniotic fluid embolism, eclampsia
- **T**rauma, including burns
- **M**alignancy: lung, breast, pancreatic, acute promyelocytic leukaemia
- **I**mmune: transfusion reactions
- **S**epsis: gram negative (meningococcal), gram positive (pneumococcal)
- **S**hock and snakebite

Causes of Purpura

Platelet defects

- DIC
- MAHA
- HUS / TTP
- ITP
- HELLP

Coagulopathies

- Congenital – e.g. vWD, haemophilia, haemorrhagic disease of newborn
- Acquired – e.g. liver failure, drugs

Drugs

- Warfarin (also causes skin necrosis)
- Anticoagulants
- Antiplatelets

Vasculitis

- Septic – necrotizing skin infections, septic emboli
- Immune – HSP, leukocytoclastic vasculitis

Features of TTP

= "FAT RN"

- **F** - Fever
- **A** - Anaemia (MAHA)
- **T -** Thrombocytopenia
- **R** - Renal dysfunction
- **N** - Neurological dysfunction

INFECTIOUS DISEASES

Sepsis

SIRS = 2 or more of:

Temperature	> 38 < 35
Heart rate	> 90 > 150 children > 160 infants
Respiratory rate	> 20 or $PaCO_2$ < 32
WCC	> 12 < 4 > 10% bands

SIRS in children

- Age-specific vital signs
- At least one criterion must be temperature or WCC

Sepsis	SIRS + proven / suspected infection
Severe sepsis	Sepsis + end-organ hypoperfusion • BP < 90 adults • BP < 75 children • BP < 65 infants
Septic shock	Hypotension / hypo-perfusion not reversed with fluid resuscitation

Management of Severe Sepsis

Immediate Management

- High flow O_2
- IV access x 2
- Fluid bolus 500 ml (10-20 ml /kg) every 5-10 minutes
- May require 4-6 L fluid (60 ml / kg) during initial resuscitation

Optimise oxygenation

- Early intubation and ventilation
- ARDS-net ventilation strategy
    - Tv 6 – 8 ml /kg
    - RR 18 – 20
    - PEEP ≥ 5 cm H_2O
    - Plateau pressure < 30
    - Aim for SaO_2 88 – 95%

Optimise circulation

- Arterial line, central line insertion
- CVP 8 – 12
- MAP 65 – 90
- ScvO2 > 70%
- Transfuse to maintain HCT > 30 % or Hb > 70-90
- Early use of inotropes to maintain MAP and ScvO2
    - Noradrenaline 2 – 10 mcg / min
    - Dobutamine 2 – 10 mcg / kg / min
- Maintain urine output
    - 0.5 ml / kg / hour (adults)
    - 1 ml / kg / hr (children)
- Monitor lactate

Source Control

- Start broad-spectrum antibiotics < 1 hour
    - Tazocin 4.5 g IV 8h (adults)
    - Cefotaxime 50 mg / kg 6h (children). Add amoxicillin 50 mg / kg 6h for infants < 6 months
- Drain abscesses / collections
- Remove infected lines

Steroids

- No mortality benefit
- Some evidence of faster resolution of septic shock (CORTICUS study)
- Give hydrocortisone 200 – 300 mg /day in 3-4 divided doses if shock unresponsive to fluids and vasopressors

Blood Glucose control

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

Other

- Head up 45 degrees
- Stress ulcer prophylaxis (PPI)
- DVT prophylaxis

Atypical CSF results

Common Exam Picture

- Mildly elevated opening pressure (20-30 cm)
- Moderate CSF pleocytosis (< 1000)
- Low or normal glucose
- High protein
- No organisms seen

Differential Diagnosis

- Meningitis
    - Early bacterial
    - Partially treated bacterial
    - Fungal
    - Toxoplasmosis
    - TB
    - Viral
    - Carcinomatous
    - Inflammatory, e.g. SLE, sarcoid, drugs (NSAIDs, Bactrim)
- CNS abscess

Specific Investigations

CSF

- MC+S
- Acid-fast bacilli
- PCR for viruses, bacteria, TB
- India ink stain, cryptococcal antigen

Blood

- Blood cultures
- HIV test, CD4 count
- ANA, double-stranded DNA (?SLE)
- Serum ACE (?sarcoid)

Urine

- Antigen testing – pneumococcal, meningococcal

Imaging

- CXR ? apical scarring in TB
- CT brain with IV contrast

Encapsulated organisms / post-splenectomy infections

"Some Extremely Nasty Killers Have Slimy Capsular Protection"

- **S**treptococci
- **E** coli
- **N**eisseria
- **K**lebsiella
- **H**aemophilus
- **S**almonella
- **C**ryptococcus
- **P**seudomonas

Fever in returned traveller

- **Malaria** = most common diagnosis
- **Typhoid**
- **Dengue fever**
- Bacterial sepsis, including **meningococcus**
- **Hepatitis** A, B, C, other
- **HIV infection**
- **Sexually transmitted diseases**
- Leptospirosis, schistosomiasis
- Rickettsial infections, haemorrhagic fevers
- Amoebiasis, cholera, brucellosis
- **Illness unrelated to travel** – e.g. URTIs, UTIs etc

Rheumatic Fever

Diagnosis

- 2 major criteria, or 1 major + 2 minor
- Evidence of recent GAS infection

Major criteria
Carditis (ECG changes)
Polyarthritis (aseptic monoarthritis)
Sydenham's chorea = *St Vitus's dance*
Erythema marginatum
Subcutaneous nodules
Minor criteria
Fever > 38 C
ESR > 30 or CRP > 30
Long PR interval

Bloodborne Virus Exposure

Needle on a beach

= extremely low risk

If known positive with the virus, fresh percutaneous blood, transmission risk is:

- HIV 0.3%
- Hep C ~3% (range 1.8 – 10%)
- Hep B ~30%

Rate of HIV in Australian drug users = 1%
Actual risk of transmission of HIV is miniscule = 1 in 150,000

No benefit to testing needle

Mx

- Baseline serum
- Offer HBIG, HB vaccine
- Tetanus prophylaxis
- Advise re symptoms of hepatitis
- Serology at 6 weeks, 3 months, 6 months

Needlestick from known HIV+ patient

= high risk

- Take bloods from patient and doctor
- Urgent immunology consultation (< 2hours)
- Three-drug expanded regime (zidovudine, lamivudine + lopinavir / rotinavir)
- Advice re safe sex until "clear"
- Early follow up 48-72 hours for initial results

Skin splash

= negligible risk

- Reassure

Tetanus Prophylaxis

Time since vaccination	**Type of wound**	**Tetanus toxoid vaccine**	**Tetanus immunoglobulin**
History of 3 or more doses of tetanus toxoid vaccine			
< 5 years	All wounds	No	No
5 – 10 years	Clean minor wound	No	No
	All other wounds	Yes	No
> 10 years	All wounds	Yes	No
Uncertain vaccination history or less than 3 doses of tetanus toxoid			
	Clean minor wounds	Yes	No
	All other wounds	Yes	Yes

Antibiotic Prophylaxis for Wounds

Wounds at high risk of infection

- Delayed presentation > 8 hours
- Puncture wounds unable to be debrided adequately
- Hands, feet or face
- Underlying structures involved (e.g. bone, joint, tendon)
- Immunocompromised patient

NEUROLOGY

Stroke Thrombolysis

12 trials

- 6 showed no benefit
- 4 stopped early because of harm
- 2 methodologically flawed studies are promoted as positive (NINDS, ECASS-III)
- Even the positive trials show a 10-fold increase in intracranial haemorrhage rate.

Summary of Major Stroke Trials

	Number	Protocol	Timing	Findings	Criticisms
NINDS	~600	tPA vs placebo	0 - 3 h	- No difference at 24 h - Better NIHSS at 3 and 12 months - 10-fold increase in ICH - No difference in mortality	- Manufacturer sponsored - Baseline imbalance in stroke severity - No difference in **Δ-** NIHSS - 50% treated <90 min = not generalizable
ECASS III	~800	tPA vs placebo	3 - 4.5 h	- Higher proportion of "favourable" neuro outcome at 3 months (= MRS of 0-1) - 10-fold increase in *symptomatic* ICH - No difference in mortality	- Manufacturer sponsored - Baseline imbalance in stroke severity - Inappropriate endpoints - Benefit disappears when reclassified into MRS 0-2 vs 3-6
IST-3	~3100	tPA vs nothing	0 – 6 h	- No difference in death or disability at 6 months - Timing of tPA had no impact on neurology - Early increase in deaths with tPA use	- Benefits claimed after controversial "secondary exploration" of data - Unblinded study should favour tPA -> so may conceal harm

NINDS

~600 patients treated < 3 hours with tPA or placebo

Findings

- No difference in neurological outcome at 24 hours.
- **Better NIHSS stroke scores at 3 months and 1 year with tPA**
- 10-fold increase in ICH rate with tPA (6% vs 0.6%)
- No difference in mortality

Criticisms of NINDS

- **Manufacturer sponsored**
- Positive findings can be explained by a significant **imbalance in baseline stroke severity** favouring the tPA group.
- Both groups had an identical *change* in stroke scores. **No benefit of tPA if Δ-NIHSS used** instead of absolute NIHSS.
- **50% of patients were treated < 90 minutes** = not generalizable to the general stroke population.

ECASS III

~800 patients treated at 3 – 4.5 hours with tPA or placebo

Positive Findings

- **Slightly higher rate of "favourable neurological outcome" (Modified Rankin Score of 0-1) at 3 months with tPA**
- 10-fold increase in symptomatic ICH rate with tPA (2% vs 0.2%)
- No difference in mortality

Criticisms

- **Manufacturer sponsored**
- **Imbalance of stroke severity** favouring the tPA group
- Patients with **severe stroke excluded** (NIHSS score > 24)
- A similar trial (DIAS-2) published at the same time showed no benefit (?publication bias)
- Inappropriate endpoints chosen
    - Primary endpoint was Modified Rankin score of 0-1 (favourable) versus 2-6 (unfavourable)
    - "Unfavourable" group = too heterogenous (2 = minor disability, 6 = dead!)
    - Restratification into 0-2 and 3-6 -> all treatment benefits disappear.

IST-3

Largest ever stroke trial
~3100 patients treated 0-6 hours with tPA vs nothing (no placebo)

Positive Findings

- No difference in death or dependence at 6 months
- No relationship between timing of administration and drug effect

Criticisms

- Benefits claimed after a "secondary exploration" of the data using a controversial statistical technique.
- Unblinded, open-label trial -> should favour treatment group. Therefore reported findings may actually conceal harm.

Contra-indications to Lumbar Puncture in Suspected Meningitis

Adults

- Altered mental state
- Focal neurology
- Papilloedema
- Seizures
- Immunocompromise
- History of CNS disease
- Coagulopathy

Children

- Focal neurology
- Papilloedema
- Rapidly deteriorating consciousness / obtundation (GCS <8)
- Perforated ear drum

<u>Normal CSF findings</u>

Opening pressure

- 7 – 18 cm H2 in adults
- < 10 in small children
- < 20 in older children

Do not remove CSF if pressure > 35

Cell counts

- < 4 WBC / mm3 (lymphocytes)
- No neutrophils
- No RBCs
- Up to 20 cells/mm3 in neonates

Protein

- 0.14 – 0.45 g/L
- Higher levels in first few months of life (e.g. up to 0.8 g/L)
- Ig G = 12% of protein

Glucose

- 60-80% of venous glucose (e.g. 2.5 – 3.5 mmol/L)
- < 50% is abnormal

Traumatic tap

- RBC count often > 400-1000

Status Epilepticus in Children

Definition

- Historical = seizure lasting > 30 mins
- Current = any seizure > 5 mins is likely to represent status

Resuscitation

- A = protect airway (jaw thrust, NPA), intubate early if seizure > 20 mins
- B = high-flow O2
- C = obtain IV / IO access
- D = Check / correct hypoglycaemia (2-5 ml/kg of 10% dextrose)

Specific Management

Benzodiazepines

- Midazolam 0.15 mg/kg IV / IO / IM
- Midazolam 0.5 mg/kg buccal (max 15mg)
- Repeat after 5 minutes if still fitting

Phenytoin

- 15-20 mg/kg in normal saline over 20-30 mins.
- Need ECG monitoring
- Risk of hypotension with propylene glycol diluent – stop / slow infusion
- Not compatible with dextrose!!

Phenobarbitone

- 20 mg/kg in normal saline over 15 mins (preferred in neonates, patients already on phenytoin)

Paraldehyde (if no IV access after 5-10 mins)

- 0.4 mL/kg rectally (max 5mL).
- Mix 50:50 with olive oil or saline.

RSI

- If fitting for > 20 mins
- Thiopentone 4 mg/kg or Propofol 2.5 mg/kg
- Atropine 20 mcg/kg
- Suxamethonium 1.5-2 mg/kg
- Avoid long-acting paralytics (conceals further seizures)
- Sedate with midazolam or propofol infusion

Treat the underlying cause

- Antibiotics for meningitis (ceftriaxone 50mg/kg + dex 0.15mg/kg ± vancomycin 30mg/kg ± benpen 60mg/kg ± acyclovir 10mg/kg)
- Pyridoxine IV for refractory seizures in infants or isoniazid poisoning
- Hypertonic saline 2-3 ml/kg of 3% for hyponatraemic seizures
- Bicarbonate 1-2 mmol/kg for sodium-channel blockade (TCAs)
- Further doses of dextrose for hypoglycaemia
- CT head +/- neurosurgical intervention for intracranial haemorrhage

OBSTETRICS + GYNAECOLOGY

First Trimester Bleeding / Suspected Ectopic

Differential

- **Ectopic pregnancy** = most important to rule out
- Miscarriage
    - Threatened
    - Complete / incomplete / inevitable
    - Septic
- Cervical bleeding
    - Polyp / ectropion
    - Carcinoma
- Others
    - Trauma
    - Endocrine (e.g. thyroid disease)
    - Dysfunctional bleeding

Assessment

History

- Menstrual history
- Adnexal pain
- Risk factors for ectopic pregnancy
    - Prior ectopic
    - Prior tubal surgery
    - PID / STIs
    - IUD
- Post-coital bleeding -> suggests cervical disease
- PMHx / meds / allergies / bleeding diathesis / Rh status

Examination

- General appearance
- Vital signs
- Evidence of shock (ruptured ectopic) or sepsis (miscarriage)

Abdominal exam

- Tenderness / peritonism

Speculum exam

- Cervical os – open, closed
- Products of conception or active bleeding
- Cervical polyp / ectropion
- Swabs for STI screen if indicated

Bimanual exam

- Cervical motion tenderness
- Adnexal tenderness

Investigations

Most important test = b-HCG

- Urine = 97% sensitive
    - Home kits only 50% sensitive in first few weeks
    - False negatives with early pregnancy, dilute urine
- Serum = higher sensitivity (close to 100%), more reliable

Bedside

- Glucose
- VBG – rapid Hb check, evidence of shock (lactate)
- Urine – infection (dipstick inaccurate in presence of blood)
- Bedside USS – peritoneal free fluid, pregnancy assessment (see below)

Lab

- Group + save
- Rhesus status
- FBC
- Coags
- U+E
- Cervical swab for MC+S
- First void urine for gonorrhoea/chlamydia PCR

Ultrasound

Discriminatory threshold
= bHCG level above which you would expect to see a gestational sac on USS

- For TV scan = 1500 IU
- For TA scan = 6500 IU

Findings

- Endometrial thickening
- Gestational sac = 5 weeks
- Yolk sac = 6 weeks
- Fetal pole + cardiac activity = 7 weeks
- Features visible on TV scan 1-2 weeks earlier than TA scan

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 sac 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

Determined by stability

Shocked patient = ruptured ectopic
- Immediate transfer to OT for laparotomy

Stable patient
- May be suitable for outpatient treatment if
    - Ectopic excluded
    - O+G follow-up arranged

Resus

A+B = support airway, maintain oxygenation

C = treat hypovolaemic + cervical shock
- Large bore IV access x 2 (14-16G)
- Send bloods for FBC, coags, crossmatch, blood type (Rhesus status)
- Fluid bolus 20 ml/kg normal saline
- Major haemorrhage pack if bleeding (4 units O neg PRBC, 2 units AB FFP)
- Speculum + remove products of conception from cervical os

Supportive Care

- Analgesia + Antiemetic
- Provide sanitary aids
- Explanation / reassurance
- Involve partner / family
- Any concerns re sexual assault or child sex abuse?
    - Offer support / counselling
    - Refer to Sexual Assault Resource Centre (SARC)
    - Notify relevant authorities

Specific Treatment

All patients need Rhesus D immunoglobulin / anti-D / RhoGAM
- 250 IU (= 50 mcg) in first trimester
- 625 IU (= 125 mcg) in 2nd – 3rd TM

Further management + disposition determined by provisional diagnosis:

- **Bleeding / ruptured ectopic** => OT for laparotomy
- **Stable ectopic pregnancy**
    - Admit to O+G service
    - Tx = surgical versus methotrexate
- **Miscarriage**
    - Discharge with O+G follow up if complete
    - Admit for D+C or misoprostol if incomplete / inevitable / missed
- **Septic abortion** -> admit for IV antibiotics
- **Pregnancy of unknown location**
    - O+G follow up in 48 hours for repeat bHCG and USS

Consider STI prophylaxis, e.g.

- Ceftriaxone 500 mg IM / IV (gonorrhoea)
- Azithromycin 1g PO (chlamydia)

Disposition

- As described above
- Early involvement of O+G team in decision-making process
- May need to transfer patient to a hospital with O+G services
- Stabilise patient prior to transfer
- Consider need for medical escort
- Arrange follow up

Assessment of Preeclampsia

Diagnostic Criteria

- Gestation > 20 weeks
- BP > 140 / 90
- Baseline normal BP
- End-organ damage:
  - Proteinuria > 300 mg/day
  - Protein-creatinine ratio >30 mg/mmol
  - Deranged ALT / AST
  - Raised uric acid levels

Risk Factors

- Previous preeclampsia
- Family history of preeclampsia
- First pregnancy (primigravida)
- First pregnancy with new partner
- Multiple pregnancy
- Primary hypertension
- Diabetes / renal disease / connective tissue disease

Severe Preeclampsia

Hypertension	BP > 170 / 110
Renal	Proteinuria > 1000mg/day Spot protein-creatinine ratio > 100 Creatinine > 90 (indicates renal dysfunction in pregnancy)
Hepatic	RUQ pain (= subcapsular liver haematoma) Raised bilirubin /ALT/AST
CNS	Severe headaches Visual scotomata = occipital cortical ischaemia Hyperreflexia + clonus -> portends imminent seizures (eclampsia) = indication for MgSO4
Haematological	Thrombocytopenia, DIC, haemolysis, HELLP syndrome Schistocytes on blood film
Cardiac	Acute pulmonary oedema

Investigations in Preeclampsia

- **Bedside** = glucose, ECG, **CTG**
- **FBC** – thrombocytopenia, rising Hb (volume contraction)
- **U+E** – creat > 90 is abnormal
- **LFTs** – raised bilirubin (haemolysis) and AST (HELLP)
- **Uric acid** – raised in preeclampsia, level > 0.35 is typical
- **Urinalysis + microscopy**
  - Protein 1+ suggests significant proteinuria
  - Spot protein-creatinine ratio > 30 mg/mmol
  - 24-hour urine collection > 300mg/day
- **Imaging** = CXR (ARDS), USS (RUQ pain)

Management of Preeclampsia / Eclampsia

General

- Delivery is the only cure
- Left-lateral position (wedge under right hip)
- Early obstetric consultation ± transfer to tertiary centre

Seizure Control

Indications

- Patient fitting
- Hyperreflexia + clonus (indicating imminent seizure)

Agent

- Give 4-5g $MgSO_4$ IV over 10 minutes
- Follow with infusion at 2g/hour
- Phenytoin can also be used but is less effective

Endpoints

- Resolution of seizures

Monitoring

- Check knee jerks and respiratory rate every 30-60 minutes
- Serial magnesium levels every 6 hours

Stop infusion if

- $MgSO_4$ level rises > 3.5 mmol/L
- Knee jerks disappear
- Respiratory rate falls < 16 / min

BP Control

Indication

- Treat if BP > 170/110

Agent

- Give hydralazine 5mg slow IV
- Repeat every 20 minutes up to 15mg
- Follow with hydralazine infusion 5-10 mg/hour

Endpoint

- Aim to reduce SBP by ≤ 20-30 and DBP by ≤ 10-15 mmHg
- Target BP is < 160/90

Alternative agents (if hydralazine not available)

- Nifedipine IR 10-20mg PO hourly – *NB. Do NOT combine with $MgSO_4$ as risk of precipitous hypotension*

Delivery

Early obstetric consultation to determine:

- Location / appropriateness of transfer
- Timing

Immediate delivery indicated if:

- Eclampsia
- Pre-eclampsia > 37/40 gestation
- Unable to control BP
- Abnormal CTG
- Placental abruption
- Deteriorating liver / renal function
- Progressive thrombocytopenia

Promote Foetal Lung Maturity

- Betamethasone 11.4 mg, 2 doses IM, 24 hours apart

Pulmonary Oedema + Oliguria

- Mannitol 50mL of 20% IV as bolus, followed by an infusion

Supportive Care

- Cautious fluids, e.g. single 500ml saline bolus for hypotension (risk of APO and cerebral oedema)
- Correct coagulopathy – e.g. with FFP
- Continuous CTG monitoring

Disposition

ICU for severe preeclampsia / eclampsia

Postpartum Haemorrhage

Definition

- > 500mL in first 24 hours after vaginal delivery
- > 1000mL after C-section

Causes

- **Tone** = atonic uterus (70%)
- **Trauma** = vaginal lacerations; uterine rupture / inversion (20%)
- **Tissue** = retained placenta (10%)
- **Thrombin** = coagulopathy (1%)

Resus

Get early obstetric help!
All ED treatment = temporising until specialist surgical help arrives

Support A+B
C = Large bore IV access x 2

- Bloods for FBC, U+E, coags, crossmatch, Rhesus status
- Saline bolus 20ml/kg if shocked
- Activate major transfusion protocol
- Correct coagulopathy / thrombocytopenia (e.g. HELLP)

Specific Management

Tone

- Rub uterine fundus
- Oxytocin 10 units IM – usually given during third stage of labour
- Oxytocin infusion:
    - 20 IU in 1L normal saline at 250ml/hr
    - Max rate = 500mL over 10 mins
- Bimanual compression of uterus if ongoing bleeding

Additional oxytocic agents (get specialist advice)

- Ergometrine 250-500 mcg IM (contraindicated in HTN, preeclampsia)
- Carboprost or misoprostol

Tissue

- Manual removal of placenta
- Inspect placenta for retained fragments

Trauma

- Assess for genital tract trauma
- Suture lacerations
- Replace inverted uterus

Thrombin

- Correct coagulopathy

Trauma in Pregnancy

Injuries Unique to Pregnancy

- Foetal distress
- Placental abruption (50% of major trauma)
- Amniotic fluid embolism
- Uterine rupture
- Premature rupture of membranes
- Premature labour
- Foeto-maternal haemorrhage
- Direct foetal injury (= uncommon)

Physiological Changes – Effects on Assessment

System	*Increased*	*Decreased*	Comments
Cardiovascular	↑Blood volume (40%) ↑Cardiac output (40%) ↑Heart rate (15%) Mild tachycardia normal	↓SBP falls by 10mmHg ↓DBP falls by 15mmHg Nadir in 2nd TM ↓SVR falls by 20% Mild hypotension normal	Haemodynamics difficult to assess. Delayed detection of shock. IVC compression when supine.
Respiratory	↑Tidal volume (40%) ↑Minute ventilation Respiratory alkalosis Normal PCO2 = 30	↓FRC due to elevated diaphragm Rapid desaturation during intubation	Difficult intubation due to adipose tissue, large breasts, reflux. RR unchanged.
Gastrointestinal	↑Aspiration risk ↑Alk Phos (ALP) Abdo organs displaced by uterus	↓GI motility ↓LOS tone	AST/ALT/bilirubin unchanged. Peritoneal irritation is blunted.
Renal	↑Kidney size ↑Renal blood flow ↑GFR	↓Urea ↓Creatinine (< 90)	Creatinine > 90 indicates renal failure. Mild hydronephrosis normal.
Haematological	↑Plasma volume ↑Number of RBCs ↑Reticulocyte count ↑WCC (5-12) ↑Clotting factors ↑ESR	↓Haemoglobin concentration (≥ 110) ↓Platelet count	Affects assessment of anaemia, leucocytosis. Increased risk of VTE.
Endocrine	↑Insulin levels -> fasting hypoglycaemia		Mild ↑thyroid gland size.
Gynaecologic	↑Breast and nipple size ↑Uterine size and blood flow	↓Placental blood flow with maternal hypovolaemia	Fetal compromise may occur without signs of maternal compromise.

Specific Findings on Assessment

Fundal Height
- Uterus larger than dates = abruption
- Uterus small than dates = uterine rupture

Uterine tone
- Tense = abruption
- Contractions = premature labour
- Palpable foetal parts = uterine rupture

Investigations
- CTG monitoring
- USS
- Rh status
- Kleihauer if
    - Rh negative
    - >16/40 gestation
    - Major injuries likely to require more than a single dose of anti-D

APGAR score

Activity
- 0 = floppy
- 1 = limb flexion
- 2 = active movement

Pulse
- 0 = pulseless
- 1 = <100
- 2 = >100

Grimace
- 0 = no reflex irritability
- 1 = grimace
- 2 = sneezing, coughing, pulling away

Appearance
- 0 = cyanosed, pale
- 1 = acrocyanosis
- 2 = pink

Respirations
- 0 = absent
- 1 = slow, irregular
- 2 =good, crying

Premature Labour

= labour at 20–37 weeks gestation

Terminology

- Premature rupture of membranes (PROM) = prior to onset of labour
- Preterm premature rupture of membranes (pPROM) = prior to 37/40

Risk Factors for Premature Labour

- Idiopathic
- Multiple pregnancy
- Polyhydramnios
- Preeclampsia
- Antepartum haemorrhage
- Infection (e.g. UTI)
- Uterine / cervical abnormalities (e.g. cervical incompetence)
- Stimulant use

Complications of Prematurity

- Lung disease – lack of surfactant
- Feeding difficulties – immature sucking + swallowing reflex
- Temperature dysregulation
- Apnoea – immature respiratory centre
- Jaundice
- Neurological disabilities

Assessment

History

- Ruptured membranes
- Contractions
- PV bleeding
- Precipitants – e.g. recent UTI
- Antepartum care
- Gestational age

Examination

- Vitals + temperature (? infection)
- Uterine tone + tenderness, contractions (> 1 every 10 mins = labour)
- Amniotic fluid
- Fetal size + presentation

Sterile Speculum Exam

- Cervical dilation + effacement
- Foetal fibronectin test on secretions (= 98% NPV for labour)
- Cervical swabs for MC+S (?GBS)
- NB. Digital examination is relatively contraindicated due to risk of infection

Investigations
- FBC, U+E, coags, G+S, Rh
- Urine MC+S
- USS
- CTG monitoring if >25 weeks gestation

Management

General
- Admit for bedrest
- CTG monitoring if > 25 weeks
- 30-50% resolve spontaneously

Tocolysis

Effective in delaying delivery by 24-48 hours in 80%

Indications
- Gestational age < 34/40
- To buy time to give steroids for foetal lung maturity
- To buy time for transport

Contraindications
- Chorioamnionitis
- Preeclampsia
- Antepartum haemorrhage
- Foetal distress
- Advanced labour
- Foetus > 34 weeks gestation

No evidence of benefit if
- Tocolysis continued for > 48 hours
- Used beyond 34 weeks gestation

Agents
- **Nifedipine** 20mg every 30 mins (up to 3 doses)
  - Maintenance = 20mg TDS for 48-72 hours
- **Salbutamol** infusion 10-30 mcg/min
  - SE = tachycardia, hypokalaemia, tremor
- **GTN** patch 5-10mg. Apply a 2nd patch after 1 hour PRN. Max = 20mg/24h.
- **Indomethacin** 100mg PR
  - SE = premature closure of ductus arteriosus, foetal renal failure

Steroids
- 11.4mg betamethasone IM, 2 doses, 24 hours apart (if < 34/40)

Antibiotics
- GBS prophylaxis = Benzylpenicillin 1.2g IV then 600mg q4h until delivery
- Treat UTI = Augmentin DF q12h for 10 days

ONCOLOGY

Paraneoplastic syndromes

Small cell lung cancer

- SIADH
- Cushing's (= Ectopic ACTH)
- Carcinoid
- Lambert-Eaton

Squamous cell

- Hypercalcaemia (PTHrP)
- Hypoglycaemia (Insulin-like protein)

Others

- Gynaecomastia
- Peripheral neuropathy
- Clubbing (HPOA)
- Scleroderma
- Trousseau's / migratory thrombophlebitis (DIC, VTE)
- Acanthosis nigricans (stomach Ca)

OPHTHALMOLOGY

Pupil Abnormalities

Eponym	Description	Aetiology	Associated symptoms
Argyll-Robertson = prostitutes pupil	- Bilateral small pupils - Accommodate but do not react to light - Brisk + immediate constriction with near vision	- Neurosyphilis	Chancre Rash on palms and soles
Holmes-Adie = tonic pupil	- Unilateral dilated pupil - Accommodates but does not react to light - Slow + prolonged constriction with near vision	- Viral inflammation of parasympathetic ganglion	Diaphoresis Absent deep tendon reflexes
Marcus Gunn = relative afferent pupillary defect	- Absent direct response to light - Positive consensual response to light - Positive swinging flashlight test	- Optic neuritis (MS) - Retinal pathology (CRAO, CRVO)	Visual loss
Horner's Syndrome	- Partial ptosis - Miosis - Facial anhidrosis - Enophthalmos	- Pancoast tumour - Lateral medullary syndrome - Carotid dissection	SVC syndrome (Pemberton sign) Crossed signs in brainstem stroke Lateralising neurology in carotid injury

Horners Syndrome

- Brainstem = stroke, tumour
- Chest = lung cancer
- Carotid artery = trauma, dissection
- Others = shingles
- Kids = neuroblastoma, lymphoma, metastasis

Papilloedema

- Raised ICP
- Malignant hypertension
- Brain tumour
- Normal pressure hydrocephalus

Third Nerve Lesions

Central (midbrain)

- Stroke
- Tumour
- Demyelination

Peripheral

- Compressive = pupil involvement
  - PCOM aneurysm
  - Tumours (nasopharyngeal carcinoma)
  - Basal meningitis / CNS abscess
  - Superior orbital fissure syndrome (Tolosa-Hunt)

- Ischaemic = pupil sparing
  - Arteritis
  - Diabetes
  - Hypertension
  - Migraine

Management of Glaucoma

Specific

- Pilocarpine 4% every 5 mins for first hour
- Acetazolamide 500mg IV

Plus

- Timolol 0.5%
- Brimonidine 0.2%
- Latanoprost 0.005%

One drop of each 2h for first 6h

Surgical = laser iridotomy

Supportive

- Analgesic
- Antiemetic
- Avoid anticholinergic agents

PAEDIATRICS

Paediatric Weight

Neonate = 3.5 kg
1 year = 10 kg

Weight gain = 30g / day ("ounce a day, except on Sunday" = 180g / week)
10% body weight first week
Back to birth-weight by day 10-14

< 1	weight = (age / 2) + 4	[age in months]
1-6	weight = (age + 4) x 2	[age in years]
> 6	weight = (3 x age) + 7	[age in years]

Paediatric Vital Signs

Description	Age	Maximum HR	Maximum RR
Neonate	< 1 months	180	60
Infant	2-12 months	160	50
Toddler	1-2 years	140	40
Pre-school	2-5 years	120	30
Child	6-12	110	20
Adolescent	>12	100	20

Minimum systolic BP
Neonate = 60 mmHg
< 1 year = 70 mmHg
> 1 year = 70 + (age x 2)

Paediatric Airway

Anatomical

- Large head and occiput
- Large tongue
- Superior larynx and anterior cords
- Cricoid narrowing
- Large adenoids and tonsils
- Small cricoid cartilage
- Large stomach, low gastro-oesophageal sphincter tone, relatively small lungs
- Horseshoe-shaped floppy epiglottis
- Loose teeth

Physiological

- Different heart rates and respiratory rates dependent on age
- Less physiological reserve (low FRC)
- More prone to bradycardia, especially with suxamthonium
- Risk of stiff chest with fentanyl

Psychological

- More stressful for them, more stressful for us

Equipment

- ETT size +/- cuff
- Softer suction catheters
- Straight blade for <1yr
- Smaller bag
- Minimise dead space with ventilators/tubing
- Magill's for nasal ETT (preferred for transport/ICU stay)
- Needle cricothyroidotomy is rescue technique in <12yrs (no room for surgical airway)

<u>Bronchiolitis</u>

Assessment

Severity	**Signs**	**Management**
Mild	Alert Feeds > 50% normal Not dehydrated WOB = minimal SaO2 ≥ 94% Age > 6 weeks Not high risk	Discharge Smaller, more frequent feeds GP r/v SOB worsens over 2-3 days. Admit borderline cases if early Px (day 1-2)
Moderate	Lethargic, tired Feeds < 50% normal Dehydrated WOB = marked SaO2 < 94% Age < 6 weeks High risk patient, e.g. ex-prem, cardiac disease	Admit O2, aim SaO2 > 94% Minimise handling NG or IV fluids Close observation
Severe	As above, plus: Escalating O2 requirement Fatigue CO2 retention Apnoeas	Cardiorespiratory monitor Consider CPAP, IPPV PICU

Management

Supportive

No benefit
- Chest physiotherapy
- Mist or steam
- Cough suppressants

Inconclusive benefit
- Saline drops
- Suctioning
- Nebulised hypertonic saline

Specific

Treatment	**Evidence**	**Recommendations**
Salbutamol	No conclusive evidence of benefit	Consider trial if Age > 8 months FHx atopy Recurrent wheeze
Adrenaline	No conclusive evidence of benefit	Avoid
Steroids	No conclusive evidence of benefit	Avoid
Ipratropium	No benefit	Avoid
Ribavirin	Marginal benefit	Limited role in PICU patients
Antibiotics	No evidence in uncomplicated bronchiolitis	Only if secondary infection
CPAP	?	Consider for severe bronchiolitis

Croup

Differential Diagnosis

- Epiglottitis
- Retropharyngeal abscess
- Bacterial tracheitis
- Foreign body
- Congenital: laryngomalacia, subglottic stenosis, vascular ring, cord paresis
- Anaphylaxis / angio-oedema
- Airway injury

Treatment of Anaphylaxis in Children

Adrenaline Bolus

- Dose = 10 mcg / kg IM
- This is 0.01 ml/kg of 1:1000 solution
- Repeat in 5-15 mins

Infusion

- 1 mg / 1000 mL saline
- Start at 0.1 mcg / kg / min
- Titrate to response: range = 0.1 to 1 mg / kg / min

Additional drugs

- Adrenaline or salbutamol 5mg/5ml nebulizer
- Prednisolone 1mg/kg
- Promethazine 1mg/kg (max 25 mg) PO or slow IV

Cardiac Arrest

- 10 mcg / kg for cardiac arrest
- This is 0.1 ml/kg of 1:10,000 solution

Asthma Assessment

Symptoms	**Mild**	**Moderate**	**Severe and *life-threatening***
Altered GCS	No	No	Agitated *Confused, drowsy*
Accessory muscle use / recessions	No	Minimal	Moderate *Severe*
Talks in	Sentences	Phrases	Words *Unable to speak*
Wheeze	Variable	Moderate-Loud	Quiet
Central cyanosis	No	No	Maybe
SaO2	> 94%	94 - 90%	< 90%
Pulse	< 100	100 – 200	> 200
PEFR or FEV1	> 60% predicted	40 – 60%	< 40 % *Unable to perform*
Pulsus paradoxus	No	Maybe	Yes

Life threatening features

- Silent chest
- Cyanosis
- Poor respiratory effort
- Hypotension
- Exhaustion
- Confusion
- Coma

Paediatric Asthma Management

MDI

- Salbutamol = 100 mcg per actuation
- Ipratropium = 20 mcg per actuation

Nebs

- Salbutamol
  - Child < 5 years = 2.5 mg
  - Child > 5 years = 5 mg
- Ipratropium
  - Child < 5 years = 125 mcg
  - Child > 5 years = 250 mcg

Mild	Moderate	Severe	Critical
Salbutamol 6 puffs – age < 6 12 puffs – age > 6 May only be required once	**Salbutamol** 6 puffs – age < 6 12 puffs – age > 6 Every 20 mins for 3 doses Plus **Oral prednisolone** 1 mg/kg for 3/7	**Oxygen** if SaO2 < 92% Inhaled salbutamol and ipratropium: **Salbutamol** 6 puffs – age < 6 12 puffs – age > 6 **Ipratropium** 4 puffs – age < 6 8 puffs – age > 6 Every 20 mins for 3 doses **Oral / IV steroids** Pred 1mg/kg PO Hydrocort 4mg/kg IV 6h	**Oxygen** via facemask at 8L/min **Continuous nebulised salbutamol** (1mg/mL at 25 mL/hour) **Nebulised ipratropium** every 20 mins for 3 doses **IV steroids** Hydrocort 4mg/kg IV 6h **IV magnesium** 40 mg/kg over 20 min Consider: **IV salbutamol** 15 mcg / kg over 10 min 1-5 mcg / kg / min (start 1 mcg / kg / min) **IV aminophylline** 10 mg / kg over 60 mins Then 1.1 mg/kg/hr **IM adrenaline** 10 mcg/kg (max 0.5mg) if peri-arrest Consider need for **intubation**
Home	SSU	Paeds ward	PICU

Fever in Children

Measurement

- Infant (< 12 months) = Axillary
- Child (> 12 months) = Tympanic
- Gold standard = rectal

Occult bacteraemia

- Previously quoted rate = 3-5% of children with fever and no focus
- Newer studies quote a < 1% rate, attributed to effects of HiB and Pneumococcal vaccines
- Emerging pathogens are now E coli and Staph

Not predictive of serious illness

- Degree of fever
- Rapidity of onset
- Response to antipyretics
- Febrile convulsions

Red Light System for Identifying Sick Children with Febrile Illness

	Green = low risk	Amber = intermediate	Red = high risk
Colour	- Normal colour of lips, tongue, skin	- History of pallor	- Pale / mottled / ashen / blue
Activity	- Responds normally to social cues - Content / smiles - Stays awake / awakens quickly -Strong normal cry	- Not responding normally to social cues - Wakes only with prolonged stimulation - Decreased activity - No smile	- No response to social cues - Appears toxic - Does not wake if roused - Does not stay awake - Weak, high-pitched cry, inconsolable
Respiratory	- Nil	- Nasal flaring - RR > 50 (infants) - RR > 40 (childen) - SaO2 < 95% - Crackles	- Grunting - RR > 60 - Moderate-severe retractions
Hydration	- Normal skin + eyes - Moist mucous membranes	- Dry mucous membranes - Poor feeding - CRT > 3 - Reduced urine output	- Reduced skin turgor
Other	- No red / amber signs	- Fever > 5 days - Joint swelling - Non-weight bearing - New lump > 2cm	- Temp > 38C (less than 3 months) - Temp > 39C (3-6 months) - Non-blanching rash - Bulging fontanelle - Meningism / neurology /seizures - Bilious vomiting

Red Flags for Serious Illness in Children

- Lethargy
- Inconsolability
- Poor social interaction
- Abnormal vital signs
- Mottled / cyanosed / dehydrated
- Age < 3 months

Localising signs

- *Respiratory* = retractions / grunting / hypoxia
- *Meningism* = neck stiffness / bulging fontanelle* / prolonged seizures
- *Bacteraemia* = petechiae / purpura
- *Bone + joint* = joint swelling / refusal to weight bear
- *ENT* = otitis, throat infection

* Fontanelles close by 18-24 months (hence only assessable in children < 2)

Age < 1 month (corrected age) or < 3.5 kg + temp > 38C

- **Full sepsis work-up**:
  - FBC
  - Blood cultures
  - Urine MC+S (SPA)
  - LP
  - ± CXR (if resp signs)
- Admit for **empirical Abx**

Age 1-3 months (corrected age) + temp > 38C

- **Full sepsis work-up**:
  - FBC
  - Blood cultures
  - Urine MC+S
  - *Consider* LP
  - ± CXR (if resp signs)
- **Discharge home with review within 12 hours** (ED / GP) if child is:
  - Previously healthy
  - Looks well
  - WCC 5,000 - 15,000
  - Urine microscopy = clear
  - CXR (if taken) = clear
  - CSF (if taken) = negative
- **Admit for observation ± empirical antibiotics** if
  - Child unwell
  - Above criteria not satisfied

Age > 3 months + temp > 38C

Well-appearing child:

- Urine MC+S (SPA if < 12 months, alternatives = in-out catheter, clean-catch)
- Discharge home with antipyretics PRN
- Medical review within 24 hours (sooner if deteriorates)

Toxic child

- Full sepsis work-up:
    - FBC
    - Blood cultures
    - Urine MC+S
    - *Consider* LP
    - ± CXR (if resp signs)
- Admit for observation ± empirical antibiotics

Empirical antibiotics

Infant < 3-6 months

Bacteraemia:

- Amox/ampicillin 50 mg/kg q6h
- Gentamicin 7.5 mg/kg

Meningitis:

- Amox/ampicillin 50 mg/kg q6h
- Cefotaxime 50 mg/kg q6h

Older children > 3-6 months

Bacteraemia:

- Cefotaxime 25 mg / kg q6h (max 1g)

Meningitis:

- Cefotaxime 50 mg / kg q6h (max 2g)

Criteria for discharge

- Infant < 1 month: all need admission
- Infant 1-3 months:
    - Child is well
    - Full septic workup is normal
    - 12-hour follow up arranged
- Child > 3 months
    - Child is well + follow up arranged within 24 hours

Paediatric Pneumonia

Viral = most common pathogen after neonatal period

Age	Pathogens	Antibiotics
< 1 week	E Coli GBS (=Strep agalactiae) Listeria	Amox + Gent Amox + Cefotaxime
1 week to 4 months	Chlamydia trachomatis Bordetella pertussis	Azithro BenPen Severe = cefotaxime (covers staph)
4 months to 5 years	Viral Strep pneumo	Amox
5 to 15 years	Viral Strep pneumo Mycoplasma	Amox Roxi
Tropical	+ cover meliodosis	Meropenem

Antibiotic doses

Antibiotic	Dose	Max Dose	Frequency	Indications
Amox	50 mg / kg	2 g	QDS	Neonatal sepsis
Cefotaxime	50 mg / kg	2 g	TDS	Neonatal sepsis
Ceftriaxone	50 mg / kg	2 g	OD	Meningitis, severe sepsis (avoid if <6/52)
Gentamicin	7.5 mg / kg	-	as per levels	Neonatal sepsis
BenPen	30 mg / kg	1.2 g	QDS	LRTI
Azithro	10 mg /kg	500 mg	OD	LRTI
Roxithro	4 mg / kg	150 mg	BD	LRTI
Vancomycin	30 mg / kg	1.5 g	BD	Staph sepsis
Meropenem	25 mg /kg	1 g	TDS	Melioidosis

Kawasaki Disease

Classic	Incomplete
Fever for 5 days plus 4/5 criteria	Fever for 5 days and 2-3 criteria, plus
Eyes = bilateral non-exudative conjunctivits	**Inflammation** CRP > 3 or ESR > 40
Mucous membranes = red lips, strawberry tongue	Albumin < 30 Anaemia ALT ⇧ Platelets > 450, WCC > 12 Sterile pyuria
Extremities = oedema, desquamation	
Rash = polymorphous red rash	
Nodes = cervical node > 1.5cm	

Bakers Dozen B's of Bashed Baby Badness

1. Bullshit story: Mechanism not consistent with injury, late presentation, no explanation, changing story, vague story, mechanism, not consistent with developmental level 'something just ain't right…' etc.

2. Background: Parental = drugs, domestic violence, single parent, foster care, socioeconomic factors, etc. Child factors = developmental delay, behavioural problems, premature, chronic disease, etc.

3. Behaviour – of child and parent, interaction, scared, aggressive, sexualisation

4. Brain – shaken baby changes

5. Back of eyes – retinal haemorrhages

6. Burns – immersion scalds, cigarette lighter burns etc.

7. Bites

8. Bruises

9. Bones (see below)

10. Broken frenulum

11. Bottom and genitals

12. Blunt abdominal trauma

BONES: remember mnemonic **Suspect Harm** from **Mother** or **Father** (3 fractures each, 12 types in total)

- **S = Sternum**, **scapula**, **spine** or vertebrae
- **H = Humerus** (other than supracondylar), **hand** (non-ambulating), **head** (skull fractures – multiple, non-parietal, complex, with associated brain injury)
- **M** = **Multiple** fractures, **metaphyseal** corner fractures, **metaphyseal** bucket handle fractures
- **F = Foot** (non-ambulating), **femur** (non-ambulating), **fractured ribs**

Head Injury in Children

Aims of Assessment

- Detect significant intracranial injury
- Minimise ionising radiation (risk of CNS malignancy)

Minor head Injury

Ax

- Alert, normal conscious state
- No LOC
- Vomiting ≤ 1 episode
- Mild scalp bruising or laceration
- Otherwise normal examination

Mx

- Discharge with head injury advice

Moderate head injury

Ax

- Brief LOC
- Mild drowsiness, responds to voice = V on AVPU
- Two or more episodes of vomiting
- Persistent headache
- One single, brief convulsion (< 2 mins)
- Scalp haematoma
- Otherwise normal examination

Mx

- Close ED observation for at least 4 hours
- Full neuro obs every 30 minutes (GCS, pupils, limb strength, vital signs)
- If fails to improve by 2 hours, deteriorating, ongoing vomiting, any concerns -> immediate CT head
- If rapidly improves and back to baseline by 4 hours -> discharge with head injury advice

Severe Head Injury

Ax

- Prolonged LOC
- Decreased GCS, poorly responsive = “P” or “U” on AVPU
- Focal neurology
- Signs of raised ICP (blown pupil, Cushing reflex)
- Signs of base of skull #
- Penetrating head injury
- Prolonged seizure (> 2 mins or status)

Mx

- Prevent secondary brain injury = control airway, BP, SaO2
- C-spine protection
- Early neurosurgical / ICU consultation
- Reduce ICP = 30 degrees head up, PCO2 35-40, mannitol 0.5 - 1 g / kg
- Control seizures (midazolam 0.15 mg/kg, phenytoin load 15-20 mg/kg)
- Urgent CT brain

PECARN Criteria
= no need for CT if all low-risk criteria satisfied

Children aged 2-18

- Normal mental state (= not drowsy, confused, agitated)
- No loss of consciousness
- No vomiting
- No severe headache
- No severe mechanism (e.g. MVA, fall > 1.5 m)
- **No signs of base of skull #**

Children aged < 2

- Normal mental status
- Behaving normally according to parent
- LOC < 5 seconds
- No severe mechanism (e.g. MVA, fall > 1 m)
- **No palpable skull fracture**
- **No scalp haematoma except frontal**

Exclusions

- GCS < 14
- Trivial mechanism
- Penetrating trauma
- Brain tumour / VP shunt / neuro disorder
- Bleeding diathesis

<u>Discharge Advice for Head Injury</u>

- Close parental observation for 24 hours
- Return to hospital if
    - Unconscious or difficult to rouse
    - Confused
    - Seizure
    - Persistent headache
    - Repeated vomiting
    - Bleeding or watery discharge from ears / nose
- Avoid contact sports for at least 1 week
- Give **head injury advice leaflet**

Apparent Life-Threatening Event

= An event that is frightening to the observer, with some combination of:

- Apnoea
- Colour change (blue, purple, pale)
- Change in muscle tone (floppy or stiff)
- Choking or gagging

Significance

- Benign or physiological cause in > 95%
- No association with SIDS

Differential Diagnosis

Pathological

- Respiratory infection = most common
  - Coryza
  - Bronchiolitis
  - Pertussis
- Sepsis = meningitis, septicaemia
- Cardiac = congenital heart disease, long QT syndrome
- Neuro = seizure, tumour, head injury
- Abdominal = testicular torsion, strangulated hernia, intussuception
- Metabolic problems = hypoglycaemia, inborn errors
- Child abuse / NAI = shaken baby, suffocation
- Drugs / toxins = accidental / non-accidental

Benign

- Exaggerated (immature) cough reflex in response to physiological reflux
- Periodic breathing of newborn (apnoea < 20 seconds)

Assessment

History

Event

- During sleep or while awake?
- Colour + Tone
- Seizure-like activity?

Preceding events

- Recent feed / vomit?
- Sleeping position (prone, supine, side)
- Sleeping environment (cot, bed, sofa)

Recent illness

- Cough, coryza, URTI, LRTI
- PMHx, e.g. ex-prem, heart/lung disease, immunisations (e.g. pertussis)
- Social situation, e.g. maternal drug + alcohol abuse, meds at home

Examination

1. General appearance
2. Hydration status
3. Vital signs
4. Parent-child interaction

- Neuro exam, including fontanelle
- Cardio-respiratory exam
    - ? URTI/LRTI
    - ? signs of heart failure
- Look for evidence of trauma / NAI (including fundoscopy)

Risk Assessment

Higher risk of underlying cause if:

- Neonate (< 28 days)
- Prematurity / low birth weight / twin / multiple birth
- Prior medical illness
- Looks unwell / toxic
- Recurrent events before presentation
- Prolonged symptoms
- FHx sudden death / SIDS
- Long QTc on ECG

Investigations

Bedside

- Glucose
- ECG for long QT

Lab

- Septic screen
- Electrolytes
- NPA for viruses + pertussis

Also consider

- Investigation for suspected NAI (skeletal survey, CT brain)
- Metabolic screen = lactate, ammonia, carnitine
- EEG
- CT brain
- Holter
- Urine toxicology screen

Management

- Admit for observation
- Treat underlying cause
- Parental education + reassurance

Febrile Seizures

Affect 3-5% of children

Simple Febrile Seizure

- Aged 6 months – 6 years
- Febrile > 38.5 C
- Brief (< few min)
- Generalised
- 1 seizure per illness
- Rapid recovery with short post-ictal phase (< 30 min)
- No focal neurology
- No signs of CNS infection

Higher risk of recurrence if

- Prolonged > 10 mins
- Focal
- Multiple
- Altered conscious state afterwards
- Child < 12 months
- Brief duration between fever onset and seizure
- FHx febrile convulsions

Prognosis

- 25-30% recurrence rate
- Up to 50% recurrence rate if first seizure at < 12 months

Future Risk of Epilepsy

- 1% risk of subsequent afebrile seizures (= same as general population)
- Increased risk with:
    - Complex febrile seizures
    - Developmental delay
    - FHx epilepsy / neurological abnormality

Management of DKA in Children

Key Issues

Case:

- Potentially life-threatening
- Needs urgent resuscitation, correction of glucose + electrolytes

Consider underlying cause:

- Non-compliance / new diagnosis
- Sepsis

Prevent, seek + treat complications:

- Shock
- Hypokalaemia
- Cerebral oedema (avoid aggressive fluid resus)

Resus

- A = protect airway
  - intubate if comatose
  - maintain hyperventilation if intubated (risk of acidaemic cardiac arrest at normal resp rates)
- B = provide O2 to maintain SaO2 >94%
- C = IV or IO access
  - Fluid bolus *only* if shocked (lethargy, mottled skin, slow cap refill)
  - Give 10-20 ml/kg normal saline slowly (e.g. over 1 hour)
  - Do not exceed 30 ml/kg of bolus fluids.

Specific Treatment

Fluids

- Estimate deficit + maintenance:
  - Deficit = % dehydrated x 10 x weight in kg (e.g. 5% = 50 ml / kg)
  - Maintenance = use 100/50/20 rule (per day) or 4/2/1 (per hour)
- Correct over 48 hours using normal saline

Insulin

- Start at 0.05 – 0.1 units / kg / hour
- Aim for fall in glucose < 5 mmol/L/hr
- Once BSL < 17, change fluids to 0.45% saline + 5% dextrose

Potassium

- Add KCL 40 mmol per litre of maintenance fluid
- Titrate KCL replacement, aiming for [K+] of 4-5 mmol/L
- Do not add K+ to bolus fluids

Treat the *underlying cause*, e.g. antibiotics for sepsis

Supportive Care

Treatment

- Analgesia
- Antipyretics

Monitoring

- Hourly glucose and urine output
- U+E / VBG every 2-3 hours

Social

- Nurse in calm environment
- Involve family
- Explain + reassure

Disposition

- Admit to HDU
- Early involvement of endocrinology + ICU teams
- Monitor for complications

If cerebral oedema develops (altered GCS, headache, irritability)

- Stop fluids
- Give mannitol 0.5 – 1g/kg IV
- Consider need for intubation + ventilation, CT brain

Finally (= DEF)

- **D**ocument = write notes
- **E**ducation = diabetes education for patient + family
- **F**ollow-up = arrange follow-up with endocrinologist, GP

Assessment of the Vomiting Baby

Case

Vomiting 6-week old boy (FACEM SAQ 2006.1.3)
Potential for severe illness - need to differentiate between pathological and physiological causes

Causes

Pathological:

- Sepsis = UTI, pneumonia
- GI = pyloric stenosis, volvulus, intussusception, incarcerated hernia
- CNS = head injury, meningitis, tumour
- Metabolic = hypoglycaemia, hypo/hypernatraemia, inborn errors
- Endocrine = adrenal insufficiency (e.g. CAH)
- Trauma = NAI, shaken baby
- Toxins = accidental / deliberate poisoning

Benign = physiological reflux

Complications

- Dehydration
- Electrolyte abnormality
- Shock
- Aspiration
- Hypoglycaemia

Aims of Assessment

- Identify cause
- Prevent, seek + treat complications
- Determine Tx and disposition

History

- Antenatal + birth history
    - Birthweight
    - Prematurity
    - Perinatal / congenital problems
- Feeding
    - Feeding pattern
    - Weight gain
- Bowel + bladder function
    - Frequency of wet nappies
    - Stool pattern
- Developmental history
- Prior medical problems / medications / allergies / immunisations
- Family + social history

Examination

Key areas:

- General appearance
- Vital signs
- Hydration status
- Parent – child interaction

Focused examination:

- GI – abdo distension, mass, hernia, visible peristalsis, bowel sounds
- GU – testicles (?torsion), virilisation (CAH)
- CNS – bulging fontanelle, meningism, retinal haemorrhages
- Resp – grunting, retractions, hypoxia, coryza, crepitations
- Trauma – head-to-toe exam looking for evidence of NAI

Developmental examination

Investigation

Guided by differential diagnosis, Hx + Ex

Bedside

• Glucose	? hypoglycaemia
• VBG / cap gas	? metabolic alkalosis (PS) ?NAGMA (CAH) ?HAGMA (shock)
• Urine dip, MC+S	? UTI

Labs

• FBC, CRP/ESR, cultures	?evidence of infection
• U+E	?electrolyte abnormality ? renal failure
• LFT	
• Ammonia, lactate	?inborn errors ?shock
• Urine toxicology screen	

Consider screening for CAH

- Cortisol (low)
- ACTH (high)
- 17-hydroxyprogesterone

Imaging

- USS - ? PS, intussusception
- AXR - ? bowel obstruction
- CXR - ? LRTI
- CT head - ? bleed / tumour / NAI

Paediatric Gastroenteritis

FACEM SAQ 2005.2.8 Describe a detailed protocol for the emergency department management of paediatric gastroenteritis (100%).

Background

- Infectious gastroenteritis is a common ED problem.
- It is usually self-limiting.
- Most cases can be managed effectively with oral fluids.
- Enteral rehydration is preferable to IV fluids.
- Shocked children need immediate resuscitation with IV normal saline and early involvement of senior doctors.

Inclusion Criteria

Children < 16 presenting with:

- Diarrhoea
- Vomiting (non-bilious)
- Crampy abdominal pain

NB. Not all three features need to be present, but consider the diagnosis carefully if there is only isolated abdominal pain or vomiting.

Exclusion Criteria

The following patients need early review by a senior doctor and are excluded from this protocol:

- **Vomiting without diarrhea** – consider sepsis, UTI, CNS disease
- **Severe abdominal pain** – consider appendicitis, testicular torsion
- **Bilious vomiting** – consider bowel obstruction (e.g. intussusception)
- **Blood in stool** – consider HUS
- **Persistent diarrhea** for > 10 days – consider bacterial / parasitic infection or inflammatory bowel disease
- **High risk groups**
    - Infants < 6 months of age, ex-premature infants
    - Toxic or ill-appearing
    - Children with significant co-morbidities, e.g. diabetes, renal transplant, immunosuppression, previous bowel surgery, heart or lung disease

Assessment

Mild (<4%)	Moderate (4-6%)	Severe (≥ 7%)
Increased thirst No clinical signs of dehydration	CRT > 2 seconds Respiratory rate ⇑ Skin turgor ⇓	CRT > 3 seconds Mottled skin Signs of shock • Irritability • Reduced conscious level • Tachycardia • Hypotension Skin turgor ⇓⇓ Kussmaul respirations
Less predictive signs = dry mucous membranes, lethargy, sunken eyes		

Current weight is the most accurate way to estimate fluid deficit – provided a recent (< 2 weeks) weight is available for comparison.

Management

Mild

- Trial of oral fluids in ED
    - ORS via syringe (10-20 ml/kg over 1 hour)
    - Hydralyte icy pole
- Well-looking children with minimal symptoms can be discharged home after parental education *without* a trial of fluids
- Consider ondansetron wafer 0.1–0.2 mg/kg
- If improving:
    - Discharge home to continue ORS
    - Provide parental advice leaflet
    - Arrange follow-up
- If deteriorates -> treat as moderate

Moderate

- Admit to short-stay unit
- Rapid rehydration protocol
- 25-50 ml/kg ORS via NG tube over 4 hours
- If ongoing vomiting -> ondansetron wafer 0.1-0.2 mg/kg, slow NG fluid rate
- If fails NG therapy -> treat as severe

Severe

- Consult senior doctor (ED /ICU)
- IV or IO access
- Send bloods for U+E, VBG
- Normal saline bolus 20 ml/kg
- Treat hypoglycaemia with 2-5 ml/kg of 10% dextrose
- Ongoing fluids given as 0.9% saline + 5% dextrose using the 4/2/1 rule
- Admit to paeds ward or PICU depending on severity of symptom

Discharge instructions

- Continue breast-feeding
- Resume normal diet as soon as rehydrated
- AVOID soft drinks, sports drinks, fruit juice, Lucozade
- AVOID anti-diarrhoeals and metoclopramide (ileus, opiate intoxication, dystonia)
- Return to hospital if develops progressive dehydration, not managing oral fluids

Neonatal Jaundice

Physiological

- Increased breakdown of foetal haemoglobin
- Low capacity of foetal hepatocytes to conjugate bilirubin

Pathological if

- Appears within 24 hours
- Conjugated bilirubin

Onset < 2 days

- Early haemolysis due to ABO or Rh incompatibility
- Cephalohaematoma
- TORCHES infections (= Toxo, Rubella, CMV, Herpes, Syphilis)

Onset day 2-3

- Usually physiological
- Lasts < 1 week

Onset day 3-7

- Usually bacterial sepsis
- Crigler-Najjar or Gilbert syndromes
- TORCHES infections

Onset > 1 week

- Sepsis
- Breast-milk jaundice
- Biliary atresia
- Haemolytic anaemias (sickle cell, spherocytosis, G6PD)
- Hypothyroidism
- Metabolic disorders
- Pyloric stenosis

PSYCHIATRY

Medical Clearance of Psychiatric Patient

Key Issues

"Medical clearance" is a misnomer: it is not possible to predict whether a patient will develop medical illness during their psychiatric admission

Main aims are to:

- Rule out organic disease as the cause of the behavioural disturbance
- Ensure that patient has no unresolved medical issues and is medically stable for transfer to a psychiatric facility

This does *not* mean that the patient has no ongoing medical problems.

Differential Diagnosis of Behavioural Disturbance

- **V**ascular = stroke, bleed
- **I**nfection = meningo-encephalitis, UTI
- **N**eoplastic = cerebral metastasis
- **T**rauma = head injury
- **M**etabolic = Na+, glucose, Ca+
- **E**ndocrine = thyroid, adrenal
- **D**egenerative = dementia, Huntington's, Parkinson's
- **A**utoimmune = cerebral vasculitis
- **T**oxins = stimulants, alcohol, drug withdrawal
- **I**diopathic = temporal lobe epilepsy

Clues to an Organic Cause

- Age > 40 at first presentation
- Abnormal vital signs (e.g. hypoxia, fever)
- Visual hallucinations
- Delirium
    - Acute onset
    - Fluctuating mental state
    - Attention deficits
    - Altered sleep-wake cycle
    - Cognitive deficits
- Lack of concern for own nudity

Likely Psychiatric Cause

- Known chronic psychiatric diagnosis (e.g. schizophrenia, bipolar)
- Typical presentation for patient (verified by family, usual psych team)
- Recent history of non compliance with psych medications

SADPERSONS Scale

Sex	Male	1
Age	<19 or >45	1
Depression or hopelessness	Depressive symptoms	2
Previous attempts or psychiatric treatment	Inpatient or outpatient care	1
Excessive alcohol or drugs	Known alcoholic, signs of liver disease	1
Rational thinking loss	Psychosis, organic brain syndrome	2
Separated, divorced, widowed	Recent or anniversary	1
Organized or serious attempt	Careful planning, lethal mechanism	2
No social support	No family, friends, job, religion	1
Stated future intent	Determined to repeat, ambivalent	2

("DROS" = items scoring 2)

Score

< 6	Low risk
6-8	Intermediate
>8	High

Rapid Tranquilization

Adult

- Lorazepam 2mg IV/IM
- Midazolam 5mg IV/IM
- Droperidol 5mg IV/IM
- Haloperidol 5mg IV/IM
- Olanzapine 10mg IM
- Ketamine 4mg/kg IM or 1-2mg/kg IV

Elderly

- Haloperidol 0.5-2.5mg IV
- Risperidone 0.5mg PO
- Olanzapine 2.5mg PO

Can mix olanzapine or risperidone with food/drink

Society of Adolescent Medicine Criteria for Hospitalisation of Eating Disorder Patients

Admit if one or more criteria present:

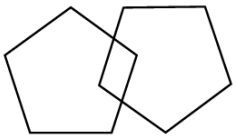
- Severe malnutrition (weight < 75% of average for age, sex, height)
- Dehydration + electrolyte abnormalities (↓K+, Mg2+, phos)
- Physiological instability
    - HR < 50
    - BP < 80/50 or postural drop
    - Hypothermia < 35.6 C
- Arrested growth or development
- Failure of outpatient treatment / acute food refusal
- Uncontrollable bingeing and purging
- Acute medical complication of malnutrition (syncope, seizures, cardiac failure, dysrhythmias, pancreatitis)
- Acute psychiatric emergencies (suicidal ideation, psychosis)
- Co-morbid diagnosis interfering with treatment (e.g. severe depression, OCD, severe family dysfunction)

Abbreviated Mental Test Score

1. Age
2. Time (to nearest hour)
3. Address for recall at the end of test e.g. 42 West Street
4. Year
5. Name of hospital
6. Recognition of two people (e.g. doctor, nurse)
7. Date of birth
8. Year of start of WWI
9. Name of Monarch
10. Count backwards from 20 to 1

Screening Tool: The Mini-Mental State Examination (MMSE)

Patient _____ Examiner _____ Date _____

Maximum	*Score*	
5		**Orientation** • What is the (year) (season) (date) (day) (month)?
5		• Where are we (state) (country) (town) (hospital) (floor)?
3		**Registration** • Name 3 objects: 1 second to say each. Then ask the patient all 3 after you have said them. Give 1 point for each correct answer. Then repeat until he/she learns all 3. Count trials and record. Trials _____
5		**Attention and Calculation** • Serial 7's. 1 point for each correct answer. Stop after 5 answers. Alternatively spell "world" backward.
3		**Recall** • Ask for the 3 objects repeated above. Give 1 point for each correct answer.
2		**Language** • Name a pencil and watch.
1		• Repeat the following "No ifs, ands or buts."
3		• Follow a 3-stage command: "Take a paper in your hand, fold it in half and put it on the floor."
1		• Read and obey the following CLOSE YOUR EYES.
1		• Write a sentence.
1		• Copy the design shown. 

_____ **Total Score**

ASSESS level of consciousness along a continuum _____

Alert Drowsy Stupor Coma

"Mini-Mental State." A Practical Method for Grading the Cognitive State of Patients for the Clinician. *Journal of Psychiatric Research*, 12(3): 189-198, 1975.
Used with permission.

more information on reverse

RADIOLOGY

Cavitating lesions on CXR

- **Lung abscess**
  - Aspiration = anaerobes (due to EtOH, OD, CVA)
  - Necrotizing pneumonia = Staph, Klebsiella, E Coli, Pseudomonas
  - Septic emboli, e.g. Staph endocarditis in IVDU
  - Fungal infection, e.g. Aspergillosis complicating prior TB
  - Pneuomocystis in HIV
- **TB**
- **Neoplasm**
  - Primary
  - Secondary, e.g. from colorectal or renal tumours
  - Lymphoma
- **Inflammatory conditions**
  - Wegener's
  - Sarcoidosis
- **Infected bullae**
- **Pulmonary infarction**
- **Congenital lesions**

Differential Diagnosis
- Hiatus hernia
- Diaphragmatic rupture

CXR findings of traumatic aortic injury

Mediastinal haematoma
- Widened mediastinum > 8 cm
- Blurred aortic knob
- Obliteration of AP window
- Depressed left mainstem bronchus
- Tracheal or NG tube deviated to right (beyond T4 spinous process)
- Left apical cap
- Widened right paratracheal stripe
- Displacement of left / right paravertebral stripe

Signs of severe chest trauma
- 1^{st} / 2^{nd} rib #
- Pulmonary contusions
- Haemo- or pneumothorax

Tumours that metastasize to brain

2 “B” s

- Breast
- Bronchus

2 “C” s

- Colon
- Kidney

2 “oma” s

- Lymphoma
- Melanoma

Tumours that metastasize to bone

- Breast
- Bronchus
- Bowel

- Prostate
- Thyroid
- Kidney

[Six B’s = breast, bronchus, bowel, “brostate”, “byroid”, “bidney” -> bone]

Tumours to lung

= “BCG”

- **B**s = Breast, bowel
- **C**hildhood = sarcoma, neuroblastoma, Wilms
- **G**enito-urinary = prostate, bladder

RESPIRATORY

Airway Management in Critical Asthma

Preparation

- Most experienced intubator available
- Largest diameter ETT (minimise resistance to airflow)
- Anticipate cardiovascular collapse on intubation
    - Pre-load with normal saline 10-20 ml / kg
    - Avoid hyperventilation
    - Prepare push-dose vasopressor (e.g. metoraminol 0.5 – 1mg bolus)

Drugs

- Ketamine 2 mg / kg
- Suxamethonium 1.5 mg / kg

Post-intubation

- Manually ventilate to assess compliance
- Use *volume-controlled* ventilation
    - RR 6 – 10 breaths / min
    - TV 6 – 8 mL / kg
    - Long expiratory time
    - I:E ratio 1:4 – 1:5
    - Minimal PEEP < 5 cm H2O
    - Keep plateau pressure < 20 cm H2O
    - Expect high peak pressures (aim for < 40 cm H2O)
- Adjust settings to avoid breath stacking / dynamic hyperinflation
- Employ *permissive hypercapnia* – aim for:
    - SaO2 > 90%
    - pH > 7.1
- Keep heavily sedated and paralysed

<u>Crashing Asthmatic Post Intubation</u>

- Take the patient off the ventilator
- Manually ventilate with 100% O2
- Pass a flexible suction catheter and suction the ETT
- Assess for reversible causes ("DOPES")
    - **D**isplacement of ETT = oesophageal or RMB intubation
    - **O**bstruction of ETT = kinking, secretions
    - **P**neumothorax
    - **E**quipment failure
    - **S**tacked breaths = dynamic hyperinflation
- If pneumothorax suspected
    - Palpate for tracheal deviation
    - Bedside USS for lung sliding
    - Decompress with needle / finger thoracostomy then insert ICC
- Portable CXR once stabilised

Evidence for NIV

Best evidence is in COPD, where NIV (CPAP or BiPAP) has been shown to:

- Reduce ICU admissions
- Reduce mortality
- Reduce length of hospital stay

Contra-indications to NIV

- Immediate need for tracheal intubation
- Cardiorespiratory arrest
- Haemodynamic instability
- Impaired consciousness with inability to protect the airway
- Fixed upper airway obstruction
- Copious secretions or vomiting
- Pneumothorax
- Facial injuries
- Recent upper gastrointestinal surgery
- Non-cooperative patient or patient intolerant of the mask.

SURGERY

Ranson's Criteria for Pancreatitis

On presentation	At 48 hours
Age > 55 **W**CC > 16 **G**lucose > 10 **A**ST > 250 **L**DH > 350	**C**alcium < 2.0 **H**ypoxia < 60 **H**aematocrit drop > 10% **U**rea increase >1.8 **B**ase deficit > 4 **S**equestered fluids > 6L
AW-GAL = "awful for gallstone pancreatitis" –> is more predictive of outcomes in alcoholic pancreatitis	CHHUBS = imagine an obese person with pancreatitis

Modified Glasgow Criteria

- **P**O2 < 60
- **A**ge > 55
- **N**eutrophilia WCC > 15
- **C**alcium < 2.0
- **R**enal dysfunction
- **E**nzymes (raised AST, LDH)
- **A**lbumin < 32
- **S**ugar > 10

Other Predictors in Pancreatitis

- APACHE II score > 8
- CRP > 150
- Pancreatic necrosis > 30% (Balthazar criteria)
- Multi-organ failure

Alvarado score (MANTRELS)

- **Migratory** pain 1
- **Anorexia** 1
- **Nausea** + vomiting 1
- ***Tenderness*** in RLQ 2
- **Rebound** 1
- **Elevated** temperature 1
- ***Leukocytosis*** 2
- **Shift** of WBC to left 1

Score	Likelihood of appendicitis
< 5	Unlikely
5-6	Possible
7-8	Likely
9-10	Highly likely

TOXICOLOGY

General Approach to Poisoning

Resuscitation
- ABCDE
- Correct glucose
- Treat seizures
- Control temperature

Risk Assessment
- Agent
- Dose
- Time of ingestion
- Clinical features
- Patient factors – e.g. weight, comorbidities

Supportive Care + Monitoring
- Fluids
- Pressure area care
- Ventilatory support

Investigations
- Screening
    - Glucose
    - ECG
    - Paracetamol level
- Specific
    - Drug levels
    - Markers of toxicity – e.g. U+E, CK, lactate, VBG

Decontamination
- Charcoal – does not bind alcohols, acids/alkalis, metals, hydrocarbons
- Whole bowel irrigation – ties up staff, aspiration risk
- Ipecac and gastric lavage = no longer recommended
- Endoscopy + surgery = specific indications only

Enhanced Elimination
- MDAC – for CBZ, phenobarbitone. risk of charcoal bezoar, aspiration.
- Haemodialysis – for toxic alcohols, metals, salicylates, metformin
- Urinary alkalinisation – for salicylates. Keep urine pH >7.5.

Antidotes
- Agent, dose, route
- Indication
- Clinical end-points

Disposition
- Depends on level of care required – medical ward vs HDU/ ICU

Single Dose Activated Charcoal

Key Issue

- Does not improve outcome when applied to *unselected* patients with poisoning

Dose

- 50g or 1g/kg PO or NG

Indications

- Agent binds to charcoal
- Benefits outweigh risks (e.g. aspiration)
- Good outcome not expected with supportive care alone
- Can be given soon after ingestion (< 1 hour or < 4 hours if XR)

Contra-indications

- Unstable patient requiring resuscitation
- Non-toxic ingestion or good outcome expected with supportive care
- Unprotected airway
- Risk assessment indicates rapid onset of seizures or coma (can be given NG after airway secure)
- Agent not bound to charcoal, e.g.
    - Alcohols
    - Acids + alkalis
    - Hydrocarbons
    - Metals

Complications

- Vomiting + mess
- Aspiration
- Corneal abrasions
- Distraction of staff from resus and supportive care

Whole Bowel Irrigation

Indications

- Life-threatening overdose with:
    - Verapamil or diltiazem XR
    - Metals: iron (>60mg/kg), potassium (>2.5mmol/kg), arsenic, lead
- Body packers

Contra-indications

- Uncooperative patient
- Cannot place NG tube
- Uncontrolled vomiting
- Bowel obstruction or ileus
- Intubated + ventilated (relative)
- Good outcome expected with supportive care ± antidotes

Multi-Dose Activated Charcoal

Mechanisms
- Interruption of enterohepatic circulation
- GI dialysis

Requires
- Small molecule + Small Vd
- Low protein binding
- Lipid soluble

Administration
- Initial dose of charcoal = 50g (1g/kg) PO/NG
- Further doses = 25g charcoal PO/NG every 2 hours (0.5g/kg)
- Check bowel sounds before each dose
- Discontinue after 6 hours in most cases

Indications
- CBZ
- Phenobarbitone
- Theophylline
- Quinine
- Dapsone

Complications
- Vomiting, aspiration, mess
- Bowel obstruction
- Distraction of staff from resuscitation + supportive care

Haemodialysis in Poisoning

Requires
- Small molecule + Small Vd
- Rapid redistribution from tissues
- Slow endogenous elimination

Indications
- Toxic alcohols
- Metals, e.g. potassium, lithium
- Theophylline
- Salicylates
- Metformin lactic acidosis
- Barbiturate coma
- Massive CBZ or valproate ingestion

Urinary Alkalinisation

- Bicarb 1-2 mmol/kg then isotonic bicarbonate at 100-150 ml/hr
- Aim for urinary pH >7.5
- Detect + correct hypokalaemia
- Uses = salicylates, phenobarbitone

Calcium Channel Blocker Poisoning

Risk Assessment

- 10 tablets potentially fatal
- Causes refractory cardiovascular collapse
- Onset of symptoms delayed for 6-12 hours with XR preparations
- Two pills can kill a toddler

Signs of toxicity

- Cardiovascular = bradycardia, hypotension, 1st degree AV block
- Metabolic = hyperglycaemia, lactic acidosis (due to shock)

Resus

Resus bay with full monitoring
Early involvement of Toxicology service

Support **A**+**B** = intubate if coma (unlikely), high-flow O2

C – Rapidly escalating plan required to manage hypotension

- Obtain central venous access and arterial line early
- Initial treatment of hypotension:
  - Normal saline bolus 10-20 ml/kg + assess response
  - Calcium gluconate 60 ml of 10% or calcium chloride 20 ml of 10% (transient effects, can be repeated 2-3 times)
- Treatment of bradycardia
  - Atropine 600 mcg boluses for bradycardia, up to 3mg
  - Temporary pacing (external or internal) for bradycardia due to AV block – may be difficult to obtain mechanical capture
- Inotropes
  - Titrated infusion of adrenaline / noradrenaline
  - High-dose insulin
    - Bolus = 1 U/kg IV with 50ml 50% dextrose
    - Infusion = 0.5 – 2 U/kg/hr with dextrose infusion to maintain euglycaemia
- NaHCO3 50-100 ml can be given for hypotension associated with acidaemia
- Consider cardiopulmonary bypass / EMCO or IABP in refractory shock

If cardiac arrest => start CPR, give intralipid 100ml of 20%, immediate referral to cardiothoracics / ICU to initiate cardiopulmonary bypass

D = monitor glucose
E = temperature control

Supportive Care + Monitoring

- Antiemetic
- Maintenance fluids
- Invasive lines
    - CVC
    - Arterial line
    - Urinary catheter
    - NG tube
    - Consider Swan-Ganz catheter or pacing wire (inserted in ICU)
- Inform next of kin / gain collateral history
- Initiate psychiatric care
    - Keep in ED under duty of care
    - Provide guard / companion
    - Psych review and disposition once medically stable
- Consider NAI / neglect (children)

Investigations

- ECG – Early signs of toxicity = sinus bradycardia with 1st degree AV block or slow junctional rhythm
- Blood glucose – usually elevated (despite high-dose insulin)
- Paracetamol level – screening test
- ABG – lactate = prognostic marker

Decontamination

- Charcoal 50g PO/NG (1g/kg in children – give in ice-cream)
    - If presents < 4 hours for XR presentation
    - Give to all intubated patients via NG
    - Caution if reduced GCS – may need to intubate first then give via NG (confirm position on CXR first)
- Whole Bowel Irrigation
    - 2L/hour of PEG-ELS (Golitely) via NG tube
    - Reduces total dose absorbed
    - Risk of aspiration, distracts staff from resuscitation

Enhanced Elimination

- Not clinically useful

Antidotes

- Calcium, Atropine, High-dose insulin – as described above

Disposition

- Admit to ICU with close involvement of Toxicology service
- Thorough psychiatric assessment to determine subsequent disposition

Iron Poisoning

Resuscitation

- Support A + B
- C = Restore circulating volume
    - IV access
    - Fluid boluses 10-20 ml/kg normal saline, assess response
    - On-going fluid resuscitation to match GI fluid losses
- D = Correct hypoglycaemia

Risk Assessment

- Agent – type of iron preparation
- Dose – inspect bottle for missing tablets
- Time of ingestion
- Clinical features
- Patient factors (e.g. weight)

Dose	Effect
> 20 mg / kg	GI corrosive symptoms: - Abdo pain - N+V, diarrhoea - Haematemesis + melaena - Hypovolaemia due to fluid losses
> 60 mg / kg	Multi-organ failure (direct cellular toxicity) - Shock - Lactic acidosis (HAGMA) - Liver failure - Coagulopathy
> 120 mg / kg	Potentially lethal

One ferrous sulphate tablet is approximately equal to 80-100 mg elemental iron.

Therefore 2 tablets in a 10 kg toddler = 20mg/kg approx (i.e. not lethal)

Stages of Iron Poisoning

Stage	Clinical Features
Gastrointestinal (< 6 hours)	Abdo pain, N+V, diarrhoea, GI bleed, hypovolaemic shock
Latent (6-12 hours)	Apparent improvement. Iron is accumulating intra-cellularly.
Multi-organ failure (12-48 hours)	Shock, lactic acidosis, renal failure
Liver failure (2 – 5 days)	Jaundice, coma, coagulopathy, hypoglycaemia, raised ALT
Delayed (weeks)	Cirrhosis, corrosive strictures

Supportive Care

- On-going assessment of volume status and fluid resuscitation
- Monitor HR, BP, urine output
- Aim for urine output > 1 ml/kg/hr
- Correct electrolyte abnormalities

Investigations

Bedside

- Glucose – initial hyperglycaemia; subsequent hypoglycaemia
- VBG – HAGMA, lactic acidosis

Lab

- FBC – ⇧ WCC (>15 predicts toxic serum level), ⇧ platelet counts
- U+E – renal impairment
- LFTs – hepatotoxicity
- Coags – coagulopathy
- Iron levels – take at 4-6 hours. Severe toxicity with level > 90 μmol/L

Imaging

- AXR – 50% sensitive for iron tablets; may allow estimation of number of tablets ingested

Decontamination

- Iron does not bind to charcoal
- WBI with PEG-ELS indicated for ingestions > 60m/kg
    - Problems = labour intensive, risk of aspiration
- Consider surgical or endoscopic removal for massive ingestions
- Gastric lavage / forced emesis no longer recommended

Enhanced Elimination

- Not useful

Antidotes

- Desferrioxamine chelation if systemic toxicity or iron level >90μmol/L
- Dose = 90 mg /kg given as infusion at 15 mg/kg/hr
- Urine changes to *vin rose* colour (ferrioxamine)
- Side effects = hypotension
- End points = clinical improvement, normalisation of iron levels and urine colour (controversial)

Disposition

- Admit to HDU or medical ward
- Close involvement of toxicology service

Lithium Poisoning

ACUTE

Resus

- Support A+B – not usually required unless co-ingestants
- C = circulatory support (replace GI losses)
    - 10-20 ml/kg boluses of normal saline, assess response
- Check / correct glucose

Risk Assessment

- Up to 25g usually benign
- Main effects = GI corrosive symptoms (abdo pain, N+V, diarrhoea)
- Risk of CNS toxicity low unless dehydration, low Na+, renal failure

Supportive Care

- Normal saline 100-250 ml/hr to maintain urine output > 1 ml/kg/hr
- Psychiatric treatment / keep under duty of care / companion

Investigations

- Screening tests in DSP
    - Glucose
    - ECG
    - Paracetamol level
- Specific tests
    - U+E - renal failure
    - Lithium level
    - > 5 mmol/L = expected in acute overdose
    - < 2.5 mmol/L = requires no further treatment
    - Ongoing monitoring of U+E, Na, Li levels

Decontamination

- Not required
- Does not bind to charcoal

Enhanced Elimination

- Removed by haemodialysis – only required if patient is oliguric and not responding to fluids or late presentation with established neurotoxicity

Antidotes

- None available

Disposition

- Admit to ward under medical / toxicology team until medical treatment completed. Fit for medical discharge once Li+ < 2.5 mmol/L and falling.
- Close involvement of psychiatry team.
- Needs psych Ax to determine need for further psych Tx or admission

CHRONIC

Resus

- Support ABC – resus unlikely to be required unless co-ingestants or severe neurotoxicity
- Check / correct glucose
- Treat seizures with IV benzos, e.g. midazolam 0.15 mg/kg

Risk Assessment

Toxicity indicated by:

- Raised lithium level > 2.5 mmol/L
- Neurological symptoms

Symptoms

- Gastrointestinal = uncommon with chronic poisoning
- Neurological
    - Grade 1 = tremor, hyper-reflexia, ataxia
    - Grade 2 = stupor, rigidity, hypotension
    - Grade 3 = coma, seizures, myoclonus
- Others
    - Hypothyroidism
    - Nephrogenic diabetes insipidus
    - Serotonin syndrome

Supportive Care

- Correct water and sodium deficits
- Normal saline infusion 100-250 ml/hr, aim for urine output > 1ml/kg/hr
- Stop medications that increase lithium levels:
    - NSAIDs
    - ACE-I
    - Thiazides
    - SSRIs
- Psychiatric care as needed

Investigations

Screening

- Blood sugar
- ECG
- Paracetamol level

Specific

- U+E
- Lithium level – confirms diagnosis, does not correlate well with severity
- Thyroid function tests – hypothyroidism with chronic toxicity

Decontamination

- Not useful

Enhanced Elimination

- Haemodialysis is indicated for
    - Neurological symptoms
    - Serum level > 2.5 mmol/L
- Need prolonged dialysis due to continuous redistribution from tissues

Antidotes

- None available

Disposition

- Admit to HDU / ICU for on-going care
- Close involvement of toxicology and psychiatry services

<u>Potentially Lethal Digoxin Ingestion</u>

- K+ > 5 mmol/L
- Dose > 10 mg
- Serum level > 15 nmol/L

<u>Prolonged QT</u>

4 "hypos"

- **⇓ K+**
- **⇓ Mg2+**
- **⇓ Ca2+**
- **Hypothermia**

3 others

- **Myocardial ischaemia**
- **Raised ICP**
- **Congenital LQTS**

Drugs ("Anti"s)

- **Antipsychotics** = amisulpride, haloperidol
- **Antidepressants** = citalopram, TCAs
- **Antibiotics** = macrolides
- **Antimalarials** = chloroquine
- **Antihistamines** = loratadine
- **Antiarrhythmics** = sotalol (III), amiodarone (I-IV), Ia + Ic

Sodium Channel Blockade

ECG Features

- Broad QRS (with RS interval < 100ms)
- Positive R' wave in aVR
    - > 3mm tall
    - R/S ratio > 0.7

Causes

- TCAs
- Local anaesthetics
- Antiarrhythmics
    - Type Ia = procainamide, quinidine
    - Type Ic = flecainide
- Propranolol
- Dextropropoxyphene
- Antimalarials
- Carbamazepine

Causes of Anticholinergic Delirium

- Atropine
- Benztropine
- Hyoscine
- Antihistamines – e.g. promethazine
- Carbamazepine
- Phenothiazines
- TCAs
- Plants = *Datura* / Jimson weed / Angels trumpet

Causes of Serotonin Syndrome

- Analgesics: Dextromethorphan, fentanyl, pethidine, tramadol
- Amphetamines
- SSRIs: citalopram, escitalopram, fluoxetine, fluvoxamine, paroxetine
- SNRIs: Buproprion, venlafaxine
- TCAs
- Tryptophan
- Lithium
- MAOIs: Moclobemide, phenelzine
- Herbal: St John's Wort

Lethal Ingestions in a 10-kg Toddler

Two Pills Can Kill

- Amphetamines – including MDMA
- Anti-malarials – e.g. chloroquine
- Beta-blockers – propranolol
- Calcium-channel blockers – verapamil + diltiazem
- Dextropropoxyphene
- Opiates
- Sulfonylureas
- Theophylline
- Tricyclic antidepressants

A Sip Can Kill

- Organophosphates + carbamates
- Paraquat
- Hydrocarbons – e.g. eucalyptus oil, kerosene, solvents
- Camphor, naphthalene

Paracetamol Poisoning

Toxic Dose

- Adults = 150mg/kg or > 10g
- Children = 200mg/kg

Toxic Thresholds Based on Levels

Time	mg/L	micromol/L
4 hours	150	1000
8 hours	75	500
12 hours	38	250
16 hours	19	125

Criteria for Liver Transplant

= *"He Crash"*

- **H**ypoglycaemia
- **E**ncephalopathy
- **C**oagulopathy: INR > 3.0 at 48 hours or > 4.5 at any time
- **R**enal failure: Oliguria or creatinine > 200 umol/L
- **A**cidaemia: pH < 7.3 despite resuscitation
- **S**evere thrombocytopenia
- **H**ypotension: BP < 80 mmHg

Serotonin Syndrome vs Neuroleptic Malignant Syndrome

Both conditions present with:

- Altered mental status
- Fever
- Muscle rigidity + elevated CK

Untreated, both conditions may progress to:

- Severe hyperthermia
- Rhabdomyolysis
- Renal failure + metabolic acidosis
- DIC / multi-organ failure / death

Key Differences

	Serotonin syndrome	**NMS**
Mechanism	Excess serotonin	Dopamine blockade / depletion
Causative Agents	Typically a combination of two or more serotonergic agents: MAOI, TCA, SSRI, MDMA, lithium, St John's Wort, tramadol, fentanyl	Typical + atypical antipsychotic agents, including: • Clozapine, olanzapine, risperidone, ziprasidone haloperidol
Typical Scenarios	Depressed patient being changed from MAOI to SSRI. Recreational MDMA user.	Schizophrenic - starting new antipsychotic - dose change - addition of second agent
Dose related?	Yes	No (idiosyncratic)
Onset	Hours	Several days
Mental state	Agitation, anxiety, seizures	Confusion, coma, mutism, staring, catatonia
Neuromuscular effects	Rigidity (lower limbs > upper limbs), clonus hyperreflexia, trismus, ocular clonus, akathisia	"Lead pipe" rigidity (whole body affected), bradyreflexia, dysphagia, dysphonia. Clonus uncommon
Autonomic effects	Hypertension, tachycardia, sweating, mydriasis	Autonomic instability: labile BPs, sweating, tachycardia
Rhabdomyolysis	Occurs in severe cases, less common than NMS	More common: CK > 1000 is a diagnostic criterion
Other laboratory abnormalities	Low Na+ with MDMA	Raised WCC (up to 30,000)
Treatment	Benzodiazepines +++ Stop offending agents Active cooling Fluids Cyproheptadine Olanazapine Intubation and paralysis if severely hyperthermic	Mainly supportive Stop offending agents Active cooling Fluids Bromocriptine, amantadine or dantrolene may be tried (controversial) Intubation and paralysis if severely hyperthermic
Disposition	ICU unless mild Sx	ICU unless mild Sx
Duration of symptoms	Days	Days to weeks

TRAUMA

Emergency Department Thoracotomy

Interventions

- Relief of tamponade
- Control of bleeding from heart or major vessels
- Cross clamping of descending aorta (control of sub-diaphragmatic bleeding)
- Cross clamping of hilum (control of air embolism)
- Internal cardiac massage

Indications

Penetrating trauma

- Cardiac arrest within 15 mins + signs of life pre-hospital or in ED
- Unresponsive hypotension (BP < 70)

Blunt trauma

- Cardiac arrest within 10 mins + signs of life pre-hospital or in ED
- Unresponsive hypotension (BP < 70)
- Rapid exsanguination from chest tube (>1500ml)
- Temporising measure for severe sub-diaphragmatic bleeding (cross-clamping of aorta)

Signs of Life

- Palpable pulse
- Spontaneous movements
- GCS 4 or above
- Brainstem reflexes (pupils, corneal, gag)
- Organised electrical activity on ECG
- Cardiac contractions on bedside echo

Contraindications

- Asystole on arrival
- No signs of life (prehospital or in ED)
- Cardiac arrest > 15 mins
- Non-survivable head injury
- No access to definitive surgical intervention

Outcomes

- Reported success rates vary widely (<5% to 70-80%)
- Penetrating trauma has the highest survival rates, esp. isolated stab wound to the heart (30-70% in some studies)
- Blunt trauma has a dismal outcome (survival 1-2%)

Major Haemorrhage

e.g. pelvic trauma

Immediate Management

- Request major haemorrhage pack
    - 4 units O negative PRBC
    - 2 units AB FFP
- Set up Level 1 fluid warmer
- Secure 2 x large bore IV access (14-16G)
- Send blood for FBC, U+E, coags, crossmatch, VBG
- Request *group-specific* blood products (XM when available)

Transfusion Therapy

- Early use of red cells, FFP and platelets in a < 2 : 1 : 1 ratio
- Correct coagulopathy, e.g.
    - Prothrombinex 25-50 units / kg + Vitamin K 10mg IV if warfarinised
    - Platelets 1 adult dose if regular aspirin / clopidogrel
- Give tranexamic acid 1 g IV over 10 mins, then 1 g over 8 hours (mortality benefit in CRASH-2 trial)
- Avoid hypothermia -> Bair Hugger, warmed fluids
- Correct acidosis (keep pH > 7.2)
- Consider Recombinant Factor VIIa 100 mcg / kg for uncontrolled haemorrhage and salvageable patient (discuss with haematology + trauma surgery)

Permissive Hypotension

- Avoid over-resuscitation (⇧ risk of bleeding)
- Aim for systolic BP 80-100 + adequate end-organ perfusion:
    - Normal level of consciousness
    - Urine output > 0.5 ml /kg /hr

On-going transfusion requirements determined by frequent blood testing:

- PRBC 2 units if Hb < 80
- FFP 4 units if INR > 1.5 or APTT > 50s
- Platelets 1 adult dose if platelet count < 80
- Cryoprecipitate 8 units if fibrinogen < 1.0
- Calcium chloride 10 mls 10% if ionised Ca2+ < 1.1

Surgical Intervention

- OT for laparotomy + pelvic packing if FAST +
- Angiography + embolization if FAST –
- May go via CT if patient stabilises

Prevention of Secondary Brain Injury

Resus

Trauma team activation
Seek and treat other injuries / immediate life threats.
Avoid hypoxia / hypotension => increased mortality
C-spine protection

A

- Early intubation if GCS < 8, agitated, respiratory compromise (rapid neuro exam prior to paralysis)
- Pre-treat with fentanyl 1-2 mcg / kg (blunts ICP rise with intubation)
- Induction agent
    - Thiopentone 2 - 5 mg / kg or propofol 1-3 mg / kg if normotensive
    - Ketamine 1 – 2 mg / kg if hypotensive (controversial – but latest evidence indicates this is safe)
- Suxamethonium 1.5 mcg / kg
- Keep sedated – propofol infusion 50-200 mg / hr
- Leave unparalysed - permits detection of seizures

B

- Controlled O2 therapy; aim for SaO2 94-98%

C

- Fluid bolus for hypotension = 10-20 ml/kg normal saline. Avoid albumin as worse outcomes (SAFE study).
- Commence vasopressors if persistent hypotension.

Supportive

- Head up 30 degrees (reverse Trendelenburg)
- Avoid
    - Venous congestion (remove collar, no jugular lines)
    - Excessive ETT suctioning
- Maintain
    - PaO2 100 - 150 (avoid hypoxia / hyperoxia)
    - PCO2 35 - 40
    - MAP > 70-80
    - CVP 0 - 2
    - Glucose 6-10
    - Temp 36-37 C
    - [Na+] 140-145
    - Euvolaemia
- Monitoring
    - Arterial line, regular ABGs
    - Urine output

Specific

- Urgent neurosurgical consultation
    - Drainage of haematoma
    - Insertion of ICP monitor
- Commence hyperosmolar therapy if evidence of raised ICP (in discussion with neurosurgeon)
    - Mannitol 0.5 – 1 g / kg IV, or
    - 3% saline 150 mL IV bolus
- If signs of impeding herniation (blown pupil, Cushing reflex)
    - Hyperventilate to PCO2 30 – 35 (temporising measure)
- Seizure prophylaxis – phenytoin 15-20 mg / kg over 20

Penetrating Neck Injury

Zones of Neck

Zone 1 = clavicles to cricoid
- Major thoracic vessels
- Vertebral + carotids arteries
- Superior mediastinum
- Lungs
- Oesophagus + trachea
- Thoracic duct

Zone 2 = cricoid to angle of jaw
- Vessels = carotid, vertebral, jugular
- Nerves = spinal cord, recurrent laryngeal, sympathetic chain
- Airway = larynx, vocal cords
- Digestive = oesophagus
- Glands = thyroid
- Bones = cervical spine

Zone 3 = above angle of jaw
- Distal carotid + vertebral arteries
- Pharynx
- Spinal cord

Assessment of Penetrating Neck Injury

Hard Signs	**Soft Signs**
Pulsatile bleeding Expanding haematoma Thrill / bruit Diminished carotid pulse Hypotension Haemoptysis Haematemesis Haemothorax Air / bubbling in wound Tracheal deviation Lateralising neurology (i.e. stroke)	History of arterial bleeding Hypotension in the field Non-expanding haematoma Apical cap Unexplained bradycardia Subcutaneous emphysema Stridor Hoarseness Vocal cord paralysis CN VII injury
Surgical exploration	CT angiogram

Breach of Platysma

- High likelihood of significant injury
- Needs further assessment

Penetrating Abdominal Trauma

Indications for laparotomy

- Peritonitis
- Evisceration
- Pneumoperitoneum
- GI bleeding
- Weapon in situ
- Haemodynamic instability
- Anterior fascia breached
- Trans-diaphragmatic injury with haemo-/pneumothorax
- Trans-abdominal gunshot wound
- Injury on CT requiring repair

Lap Belt Syndrome

= hyperflexion-distraction mechanism with lap belt acting as fulcrum

Main Injuries:

- Abdominal seat-belt sign
- Chance fracture (= horizontal # T11-L2, unstable)
- Small bowel injury
    - Jejunal tear / perforation
    - Duodenal haematoma
- Mesenteric injury
    - Avulsion
    - Secondary ischaemia / bowel infarction
- Pancreatic injury
- Intra-peritoneal bladder rupture (with full bladder)
- Diaphragmatic rupture (may be delayed)
- Dissection of abdominal aorta / IVC

Additional injuries due to deceleration mechanism:

- Head injury
- Facial #
- C-spine #

Handlebar Injury

= blunt force applied by handles to upper abdomen

- Splenic rupture
- Liver contusion / haematoma
- Duodenal haematoma (may cause gastric outlet obstruction)
- Pancreatic injury
- Diaphragmatic rupture

Methods of Wound Closure

Technique	Pros	Cons
Sutures	Meticulous closure Greatest tensile strength Lowest dehiscence rate	Requires removal (if non-absorbable sutures) Requires LA Highest tissue reactivity Highest cost Slowest application Needle-stick risk
Staples	Rapid closure Low tissue reactivity Low cost Low risk of needle stick	Less meticulous closure Not appropriate for cosmetically sensitive areas (e.g. face) May interfere with CT/MRI
Glue	Rapid closure Patient comfort Antibacterial effects Occlusive dressing No need for removal Cheap	Low tensile strength (less than 5-0 sutures) Dehiscence over high-tension areas (joints) Not useful on hands Cannot get wet
Adhesive tapes	Rapid closure Patient comfort Lowest infection rates Cheap No risk of needle-stick	Poor tensile strength Frequently fall off Highest rate of dehiscence Often require toxic adjuncts, e.g. tincture of benzoin Useless on scalp or hairy skin Cannot get wet

Uses of Bedside Ultrasound

eFAST

- Intra-abdominal free fluid
- Pericardial tamponade
- Lung sliding / effusions (pneumo-/haemothorax)

Other uses

- Vascular access – central + peripheral
- Nerve blocks
- Volume status / fluid responsiveness (IVC collapsibility)
- Assessment of ocular trauma
- Diagnosis of fractures (e.g. sternal)
- Localisation of pleural effusions for drainage
- Localisation of the airway (with distorted anatomy)
- Confirmation of asystole during CPR

Imaging in Abdominal Trauma

	Pros	**Cons**
FAST	- Sensitive + specific for free fluid - Rapid (< 4 min) - Non-invasive - Repeatable - Portable – patient does not need to leave resus bay - No nephrotoxic contrast - No radiation - Can evaluate for free pericardial and pleural fluid - Can evaluate for pneumothorax - No risks in pregnancy, coagulopathy, previous abdo surgery	- Cannot detect the aetiology of free fluid - Operator-dependent - Difficult if obese, subcutaneous air, excess bowel gas - Cannot differentiate bleeding from ascites - Cannot evaluate retroperitoneum
CT	- Can precisely locate intra-abdominal lesions - Can evaluate retroperitoneum - Can identify injuries suitable for conservative management - Non-invasive	- Expense - Requires transport out of ED - IV contrast -> nephropathy, allergy - Radiation exposure
DPL	Very sensitive for FF Readily available (no specific equipment) Relatively quick to perform Low complication rate Early detection of bowel perforation No radiation / IV contrast	- Invasive - Iatrogenic injury - Non-specific - Cannot detect injuries suitable for non-operative Mx - Misapplication for evaluation of retroperitoneal injuries

Steve Dunjey's approach to limb injury

2As, 3Cs, E+T

- **A**rrest visible haemorrhage
- **A**nalgesia
- **C**orrect visible deformity and splint
- **C**lean wounds and cover
- **C**omplications? – crush / compartment / neurovascular
- **E**levate and ice
- **T**et tox / antibiox

Complications of Bone and Joint Injury

e.g. fracture, dislocation, crush injury.

Bone

- Delayed union
- Malunion
- Non-union
- Deformity
- AVN (lunate = Kienboch's disease)

Joint

- Instability
- Stiffness
- Arthritis
- Recurrent dislocations

Soft tissue

- Compartment syndrome
- Skin loss / necrosis
- Rhabdomyolysis

Vascular

- Haemorrhage
- Distal ischaemia
- Volkmann's ischaemic contracture

Nerve

- Neuropraxia
- Paralysis

Iatrogenic

- Complications of:
    - Anaesthesia
    - Manipulation / reduction
    - Hospitalisation
    - Medications

Social

- Loss of independence / earnings
- Emotional distress

Delayed

- Infection
- Complex regional pain syndrome
- Loss of function

Pros / Cons of Spinal Immobilization

Cochrane review failed to find any benefit of C-spine immobilization, despite being considered "standard of care".

Harmful effects

- Pain + discomfort = universal (100%)
- Neck collar
  - Masking of life-threating head / neck injuries
  - Raised ICP
- Supine position
  - Aspiration risk
  - Impaired respiration
  - Pressure sores
  - Concealment of injuries to back
- Increased resource utilization (log rolls, additional nursing care)
- Psychological
  - Loss of dignity (need to use bed pan / catheter for toileting)
  - Unable to see what is happening to them

Spinal Cord Syndromes

Syndrome	Aetiology	Symptoms	Prognosis
Anterior cord	Direct anterior cord compression. **Flexion** of C-spine. Thrombosis of anterior spinal artery.	Complete paralysis below lesion. Loss of pain and temperature. Preserved dorsal columns.	Poor
Central cord	**Hyperextension.** Disrupted blood flow to spinal cord. Cervical stenosis.	Quadraparesis. Reduced pain + temperature sensation. Upper limbs > lower limbs.	Good
Brown-Sequard	Transverse hemisection of cord. Unilateral cord compression.	Ipsilateral spastic paresis + loss of proprioreception / vibration Contralateral loss of pain + temperature	Good
Cauda equina	Peripheral nerve injury (e.g. disc protrusion)	Variable motor and sensory loss in lower limbs. Sciatica. Bowel / bladder dysfunction. Saddle anaesthesia.	Good

High-Dose Steroids in Blunt Spinal Cord Injury

Overview

- Controversial topic!
- Currently there is insufficient evidence to recommend high-dose methylprednisolone in blunt spinal cord injury
- Steroids are contraindicated in *penetrating* spinal trauma due to proven worse outcomes

Reported Benefits

- NASCIS series of clinical trials reported:
    - Improvement in motor + sensory function
    - … in patients with complete + incomplete cord injuries
    - … following blunt trauma
- Positive outcomes were dependent on
    - Dose of steroids (i.e. high-dose methylprednisolone)
    - Time of administration (only effective if commenced < 8 hours)
    - Early transfer to a specialist spinal unit

Criticisms

- Methodology of positive studies has been seriously questioned
- Meta-analysis of NASCIS data by independent authors has yielded conflicting results
- American Association of Neurological Surgeons 2002 recommendations:
    - "Insufficient evidence to support the use of methylprednisolone as standard of care"
    - "Evidence suggesting harmful side effects is more consistent than any evidence of benefit"

Dose

- Loading dose = 30mg/kg over 15 mins
- Infusion commenced 45 mins after loading dose, run over 23 hours

Potential Complications

- Increased incidence of infection (pneumonia, sepsis, wound infections)
- Increased thromboembolism, GI bleeds, delayed wound healing
- Increased length of hospital stay
- Increased cost of treatment

Hanging

Mechanism

- Venous occlusion causing widespread venous infarction
- Arterial occlusion + 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
- Hangman's fractures (< 1%) = Rare unless judicial hanging, fall > 2m, slipknot placed under chin
- Complications of deliberate self-poisoning or other self-inflicted injuries
- Death

Assessment

- Ligature marks
- Injuries from struggling (e.g. avulsed fingernails)
- Tardieu's spots = conjunctival petechiae
- Ecchymotic mask = petechiae of head + neck (SVC distribution)
- Subconjunctival haemorrhage
- Fractures of larynx / hyoid
- Dysphagia / dysphonia / stridor
- Agitation or coma due to venous cerebral infarction
- Seizures

Management

A = Support airway

- Intubate if ⇓ GCS, airway unprotected, evidence of aspiration
- Anticipate difficult airway due to airway distortion, haemorrhage
- Get expert help! – e.g. anaesthetics, ENT

B = Maintain oxygenation, aim for SaO2 94-98%

C = Support circulation

- Obtain IV access
- Maintain MAP > 70-80 to maintain CPP (= MAP – ICP)

D = Check + correct glucose

E = Avoid hyperthermia

C-spine immobilisation is unnecessary unless fall > own height

Supportive

Cerebral protection
- Head up 30 degrees
- Avoid obstruction to venous return (remove C-spine collar, no neck lines)

Keep sedated
- Propofol + fentanyl infusion

Seizure control
- Leave unparalysed to allow detection of seizure activity
- Treat seizures promptly with benzos e.g. IV midazolam 5-10mg
- Consider phenytoin load 15-20mg/kg over 30 mins (prophylactic treatment = controversial)

Maintain Homeostasis
- PaO2 100-150 (avoid hypoxia / hyperoxia)
- PCO2 35-40
- MAP >70-80
- CVP 0-2
- Glucose 6-10
- Temp 36-37C
- [Na+] 140-145
- Euvolaemia

Inform next of kin / gain collateral history

Specific

- Management is essentially supportive
- Investigate to look for evidence of complications:
  - CT head = cerebral oedema, haemorrhages
  - CT angiogram of neck = dissection of neck vessels
  - Toxicology screen

Disposition

- ICU for ongoing care
- If not intubated -> observe closely due to risk of delayed airway obstruction
- Will need psychiatric admission if survives
- Refer to coroner if dies

Prognosis

- 75% of those that arrive in hospital survive neurologically intact
- Recovery may occur even with GCS 3

Blast Injury

1° = barotrauma (TMs, lungs, bowel)
2° = shrapnel
3° = blast wind, impact, structural collapse
4° = burns, inhalation injury, asphyxiation, toxic gases

Compartment Syndrome

Indications for fasciotomy

- Compartment pressure > 30 mmHg
- Delta P (DBP – CP) < 30 mmHg

Compartment pressures

- < 10 mmHg = normal
- < 20 mmHg = safe, well-tolerated
- 20-30 mmHg = compromised
- > 30 mmHg = critical

Causes of compartment syndrome

- Fractures = tibial, forearm
- Vascular = bleed into a compartment, ischaemia-reperfusion injury
- Soft tissue injury = crush injury, burns
- Iatrogenic = vascular puncture, constrictive casts

Assessment of Peripheral Vascular Injury

Hard signs	**Soft signs**
Pulsatile bleeding Expanding haematoma Absent distal pulses Cold, pale limb Thrill / bruit	Peripheral nerve deficit Heavy bleeding at scene Reduced but palpable pulse Injury in proximity to a major artery
Immediate operative intervention	Admit for observation +/- exploration

UROGENITAL

Renal Stones

Diameter (mm)	Passage Rate
4	90%
5	80%
5-8	15%
> 8	5%

Imaging in Renal Colic

Test	Sensitivity	Specificity	Comments
CT KUB	95%	99%	Pros = speed, no contrast, detects other diagnoses (e.g. AAA) Cons = radiation, does not assess renal function
IVP	60-90%	90-100%	Pros = evaluates renal function Cons = contrast (allergy, nephrotoxic, metformin lactic acidosis)
USS	60-85%	80-100%	Pros = safe in pregnancy, no radiation, no contrast, no side effects Cons = misses small stones (< 5mm), insensitive in middle 1/3 of ureter
KUB	30-60%	70-75%	Pros = may be used to follow stones Cons = poor sensitivity + specificity

Criteria for Urology Admission

- Infected, obstructed kidney
- Obstructed solitary kidney / renal transplant
- Large proximal stone (> 6mm)
- High-grade obstruction
- Renal failure
- Persistent or multiple episodes of pain requiring opiate analgesia
- Bilateral stones

Priapism

High flow = non-ischaemic = low risk
- AV fistula (cavernous artery -> cavernous body)
- Trauma

Low flow = ischaemic = urological emergency (esp if > 4 hrs)
Venous sludging; vasodilation
- Drugs
  - Intracavernosal papaverine, PGE1
  - Viagra
  - Antipsychotics
  - Prazocin, hydralazine
  - Cocaine, cannabis
- Hypercoagulability
  - Sickle cell
  - Leukaemias
  - Hyperviscosity syndromes
  - Vasculitis
- Spinal cord injury

Ischaemic cavernosal gas = pH < 7.2, PCO_2 > 60, PO_2 < 30

Treatment
- Analgesia and sedation
- Pseudoephedrine 120mg PO
- Early urology consultation
- Terbutaline 500 mcg subcut
- Aspiration and instillation of dilute adrenaline / phenylephrine
- If sickle cell -> IV fluids, O_2, exchange transfusion
- Surgical shunt procedure (cavernosum -> spongiosum)

Causes of Macroscopic Haematuria

- Trauma
  - Catheter problems
  - Post-procedure
  - Sexual misadventure
- Tumour
  - TCC of bladder = most common
  - Prostate
  - Kidney
- Infection
  - Haemorrhagic cystitis
- Stones
- Polycystic kidney disease
- Glomerulonephritis (more often microscopic)

CLINICAL DECISION RULES + SCORING SYSTEMS

PERC rule

"3, 3, 2, 2"

3 *numbers*:
- Age < 50
- Pulse < 100
- SaO2 > 94%

3 *risk factors*:
- No prior PE / DVT
- No recent trauma / surgery
- No exogenous oestrogen

2 *clinical features*:
- No haemoptysis
- No unilateral leg swelling

Less than **2%** chance of PE if all 8 criteria satisfied *and* low risk of PE.

Wells Criteria for PE

Top risk factors = 3 points each:
- Clinical signs and symptoms of DVT
- PE #1 diagnosis or equally likely

Medium risk factors = 1.5 points each
- Heart rate > 100
- Immobilization > 3 days or surgery < 4 weeks
- Previous DVT or PE

Lesser risk factors = 1 point each
- Haemoptysis
- Malignancy, treated < 6 months (or palliative)

Highly sensitive DD	**Moderately sensitive DD**
< 2 = low risk 2-6 = moderate risk > 6 = high risk	≤ 4 = PE unlikely > 4 = PE likely

Wells Score for DVT

4 Risk Factors (+1 each)

- Active cancer (Tx < 6 months or palliative)
- Paralysis, paresis, plaster immobilisation of legs
- Recently bedridden for 3 days, surgery within 3 months (regional or GA)
- Previously documented DVT

5 Clinical Features (+1 each)

- Localised tenderness along distribution of deep venous system
- Calf swelling > 3 cm than other leg (measured 10cm below tibial tuberosity)
- Pitting oedema confined to symptomatic leg
- Entire leg swollen
- Collateral superficial veins (non-varicose)

1 Modifier (- 2 points)

- Alternative diagnosis at least as likely as DVT

Score
< 2 = DVT unlikely -> can rule out with D-dimer
2 or more = DVT likely -> go straight to USS

Canadian CT head rule

High risk (for neurosurgical intervention)

- GCS < 15 at 2 hours after injury
- Suspected open or depressed skull #
- Any sign of base of skull #
- Persistent vomiting > 2 episodes
- Age > 65

Medium risk (for brain injury on CT)

- Amnesia > 30 mins prior to impact
- Dangerous mechanism**

Rule does not apply if

- GCS < 13
- Age < 16
- Warfarin
- Obvious open skull #

**Dangerous mechanism

- Fall > 3 feet / 5 steps
- Ejection from vehicle
- Pedestrian vs car

Canadian C-spine rule

No high-risk criteria

- Age > 65
- Dangerous mechanism*
- Paraesthesias in extremities

Presence of **at least one low-risk criterion**

- Simple rear-end shunt
- Ambulatory at any time
- Sitting position in ED
- Delayed onset of neck pain
- Absence of midline neck tenderness

Able to **rotate neck 45 degrees** each side

*Dangerous mechanism

- Fall > 3 feet / 5 steps
- Axial load
- MVA high speed (> 100kph), rollover, ejection
- Motorised recreational vehicles
- Bicycle collision

NB. Must be GCS 15 to apply rule.

NEXUS

- No posterior midline tenderness
- Normal level of alertness
- Not intoxicated
- No focal neurology
- No painful distracting injury

Comparison of NEXUS and Canadian

NEXUS

- 99% sensitive
- 12.9% specific
- Reduction in imaging = 12.6%

Canadian

- 100% sensitive
- 42.5% specific
- Reduction in imaging = 15.5%

Revised Trauma Score

- GCS
- Systolic BP
- Respiratory rate

Points	GCS	SBP	RR
4	> 12	> 90	10 - 30
3	9-12	75 – 90	> 30
2	6 - 8	50 – 75	6 - 9
1	4 – 5	< 50	1 - 5
0	3	0	0

Maximal score = 12
Lower scores indicate more severe injury

Use of RTS in disaster triage (SORT)

Priority	RTS
T1	1-10
T2	11
T3	12
Expectant	1-3
Dead	0

- No abnormal variables = delayed (P3)
- One abnormal variable = urgent (P2)
- Two abnormal variables = immediate (P1)

Paediatric Trauma Score

- Weight
- Airway
- Systolic BP
- CNS injury
- Open wounds
- Skeletal trauma

San Francisco Syncope Rule

- **C**ongestive heart failure
- **H**aematocrit < 30 %
- **E**CG abnormal
- **S**hortness of breath
- **S**ystolic BP < 90

Absence of all 5 CHESS criteria has a 99% NPV for a serious outcome (e.g death, MI, arrhythmia, PE, haemorrhage) -> allows safe discharge.

CHADS2 Score

Estimates risk of stroke with AF and used to select appropriate treatment regimen

CHF	1
Hypertension >140/90	1
Age ≥75	1
Diabetes	1
Stroke/TIA/thromboembolism	2

CHADS2 score of 2 equates to an annual stroke risk of 4%

CHADS2 Score	Risk	Anticoagulation
0	Low	Aspirin
1	Medium	Aspirin or warfarin
≥2	High	Warfarin

Consider using CHADS-VASc and HAS-BLED instead.

CHA_2DS_2-VASc Score

C	Congestive Heart Failure	1
H	Hypertension	1
A	Age ≥ 75	2
D	Diabetes mellitus	1
S	Stroke / TIA	2
V	Vascular disease (PVD)	1
A	Age 65-74	1
S	Sex (female)	1

Used in a similar way to CHADS
0 = nothing
1 = aspirin
2 = warfarin / dabigatran

HAS-BLED Score

H	**Hypertension**	1
A	**Abnormal renal + liver** function (= 1 point each)	1 or 2
S	**Stroke**	1
B	**Bleeding** (clinically significant)	1
L	**Labile INRs** (outside range >60% of time)	1
E	**Elderly** (>65)	1
D	**Drugs** or **alcohol** (= 1 point each)	1 or 2

Criticism = big crossover with CHA_2DS_2-VASc (e.g. hypertension, stroke, age)

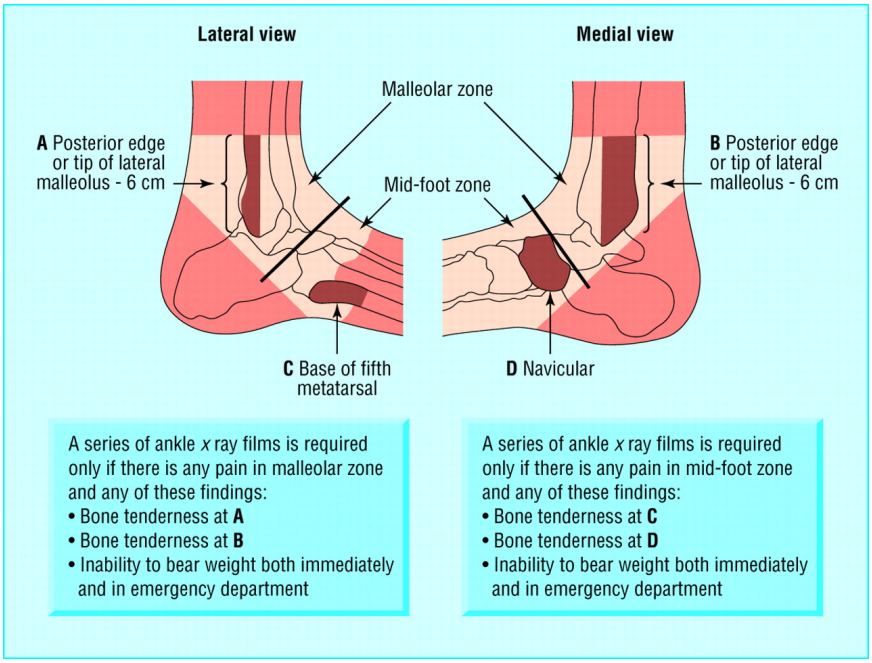
ABCD2 Score

Predicts 2 day risk of stroke following TIA

Age	≥60	1
BP at acute presentation	≥140/90	1
Clinical features	Unilateral weakness Speech deficit only	2 1
Duration	≥60 minutes 10-59 minutes	2 1
Diabetes	present	1

Score	Risk
0-3	1%
4-5	4%
6-7	8%

Ottawa Ankle Rules



Ottawa Knee Rules

X-ray the knee if:

- Age > 55
- Isolated patellar tenderness
- Tenderness at head of fibula
- Unable to flex knee to 90 degrees
- Unable to weight bear (4 steps) immediately + in ED

EXAM TECHNIQUE / TEMPLATES

Assessment Questions

Key Issues

Case
- Interpretation of clinical stem, including nature + severity of presentation
- Outline relevant issues, including medical, social + departmental

Cause
- Differential diagnosis list, or
- Likely mechanism of injury

Complications
- List potential complications

Goals of assessment

- Establish diagnosis + differential diagnosis
- Identify cause
- Seek + treat complications
- Determine treatment + disposition

History

- MIST or AMPLE in trauma
- SOCRATES for pain
- HPC/PMHx/medications/allergies/social history
- Collateral history in trauma / psych / elderly

Paediatric History
- Antenatal + birth (including birth weight)
- Feeding + weight gain
- Bowels + bladder
- Immunisations
- Developmental history
- Social + family history

Elderly history
- Functional history
- Current accommodation + level of care

Examination

Unstable Patient
- Rapid primary survey (ABCDE) to determine stability
- Simultaneous resuscitation
- Full secondary survey

Stable patient
- General appearance
- Vital signs
- *Hydration + nutritional status*
- *Signs of abuse or neglect*
- *Parent-child interaction*

Focused Examination
e.g. looking for evidence of NAI
- Bruises
- Bites
- Burns
- Fractures
- Retinal haemorrhages

Systematic Examination
- Cardiac, Respiratory, Neuro, Abdo, ENT, Skin, Mental state exam, etc.

Investigations

Principles – e.g. guided by Hx+Ex, minimise radiation exposure in children

Bedside
- Glucose
- ECG
- VBG
- Urine
- Ultrasound

Labs
- Blood tests + cultures
- Urine / sputum / stool MC+S

Imaging
- X-ray
- USS
- CT + MRI

Other
- Invasive = LP / joint aspirate / pleural or ascitic tap / laparoscopy
- Non-invasive = cardiac monitoring, neuro obs, serial abdo exams

Management Questions

Key Issues

Case

- Interpretation of clinical stem, including nature + severity of presentation
- Outline relevant issues, including medical, social + departmental

Cause

- Differential diagnosis list, or
- Likely mechanism of injury

Complications

- List potential complications

Goals of Management

- *First aid – e.g. for burns*
- Resuscitation
- Supportive care – e.g. analgesia
- Definitive care – e.g. surgery
- Safe disposition

First Aid

- Cool running water for 20 minutes (burns)
- Apply PIB (snakebite)

Resuscitation

- Triage priority – e.g. ATS 1
- Location – e.g. monitored bay
- Personnel – e.g. trauma team approach

A = "support airway" – outline relevant interventions, criteria for intubation

B = "maintain oxygenation" – e.g. O2 via facemask, maintain SaO2 94-98%

C = "secure IV access" – includes IO access in children

- Fluid bolus if given – e.g. 10-20ml boluses of normal saline if signs of shock, assess response + repeat if required
- Blood products – e.g. major haemorrhage pack, send crossmatch
- Vasoactive agents / inotropes / cardiac arrest drugs

D = "check + correct glucose" – e.g. 2-5 ml/kg 10% dextrose

E = exposure / temperature control – prevent hypothermia, e.g. Bair Hugger

Supportive Care

Simple Measures
- Splint fractures
- Clean + cover wounds
- Elevate limbs
- Head up 30 degrees (in brain injury)

Medications ("As")
- Analgesia – including nerve blocks
- Antiemetic
- Antipyretic
- ADT

Monitoring
- Non-invasive = ECG, SaO2, NIBP
- Invasive = urine output, arterial line, CVP
- Electrolytes, glucose, PCO2

Social
- Involve family / parents – explain, reassure, answer questions
- End of life decisions – consider limitations of care, advanced directives
- Consider NAI / elder abuse and reporting obligations – e.g. DCP
- Provide companion or guard

Specific Treatment

Medical – e.g. antibiotics
Give details, including dose, route, frequency, end-points, cautions

Surgical – e.g. fracture reduction
Consider the options, such as indications for reduction in ED vs OT

Disposition

- Location – e.g. "admit to ICU"
- May give different disposition options and conditions for each
- Referrals made – e.g. "close involvement of toxicology service"

"DEF" of disposition
- Documentation
- Education
- Follow-up

Other considerations

- List anything that you have forgotten to include!

Describe a Procedure

Key Issues

- Purpose of the procedure – relate back to stem

Patient selection

Indications

- Diagnostic / therapeutic

Contra-indications

- Compliance
- Fasting status
- Allergies / co-morbidities / medications
- Infection at the puncture site
- Coagulopathy

Preparation

Patient

- Explanation and reassurance
- Informed consent

Staff

- Medical (procedure / anaesthetic)
- Nursing

Area

- Procedure room / monitored area

Equipment

- Specific equipment required
- Includes monitoring + airway equipment

Drugs

- Immediate access to resus drugs / antidotes
- IV access, e.g. for Bier's block

Procedure

- **PPE**
- **Positioning**
- **Pre-med**
    - Procedural sedation
    - Nerve block
- **Prep + drape**
    - Sterile technique
    - Includes pre-procedure neurovascular check
- **Perform**
    - Detailed account of the procedure itself

Post-procedure

- Assess for complications
- Document
- Disposition + follow-up

Write A Protocol

Title
e.g. "Propofol Use in the ED – Clinical Protocol"

Background + Rationale
- Background to the condition / technique (common, high-risk)
- What is the protocol for? (to ensure standardised / safe practice)

Target Audience
- *Who* is the protocol for? (residents, registrars, nurse practitioners)
- Are there any specific training or credentialing requirements?

Patient Selection

Inclusion Criteria
- Enters pathway if…
- Appropriate age
- Uncomplicated or typical case
- Meets standard diagnostic criteria (list)

Exclusion Criteria
- Not for pathway if…
- Wrong age
- Wrong or uncertain diagnosis
- Clearly unstable

Consider alternative diagnoses
- Differential list here
- Individual Ax features below

Assessment

History
- Red flags on history -> exit protocol (senior doctor review)
- Decision points (if X -> do Y)

Examination
- Red flags on examination -> exit protocol (senior doctor review)
- Decision points

Investigations
- Decision points

Diagnoses
- Based on totality of assessment above, e.g.
- "Ectopic pregnancy" = +BHG and negative USS
- "Pregnancy of unknown location" = bHCG below threshold + negative USS

Management

Prioritised as per a management question…

Resus
- ABCDE
- Specific resus drugs, doses, routes

Specific
- Drugs + doses
- Indications
- Caveats
- Endpoints

Supportive
- Any additional therapies

Disposition

May need a table format if 2-3 possible diagnoses with different management options (e.g. gastroenteritis with management guided by severity)

Admin

- Author sign off = name, date
- Authorised by (ED Director)
- Review date

How Would You Write A Protocol?
- Determine specific needs of your institution
- Any templates available? College / other institution
- Consult widely for input, involve all relevant stakeholders
- Write draft
- Release for feedback
- Pilot the protocol
- Reassess
- Make changes
- Release final protocol

Discuss Questions

1- **Key Issues** = free flowing list covering consultant-level issues - what is the zeitgeist??

2- **Description** (= "DAM")
- **Definition** (e.g. "aspiration" = removal of air via 16G cannula)
- **Administration / dosing** (e.g. propofol doses, typical BiPAP settings)
- **Mechanism** of action (e.g. CPAP works by recruiting alveoli…)

3 - **Pros** (= "RAP")
- **Role / indications**
- **Advantages** = ease of use, availability, repeatability, sensitivity, etc.
- **Proven benefits** = evidence-based

4 - Cons (= "CL-DSH")
- **Contra-indications -** not permitted in xyz
- **Limitations**, i.e. "not useful for..." or "no proven benefit in..."
- **Difficulties** with use = not readily available, expensive, requires credentialing
- **Side-effects + complications**
- **Hidden costs** (whole of ED approach) = ties up staff, requires transfer out of ED, requires hospital admission

This approach works well for questions where there are 4 – 5 similar items to discuss, e.g. alternative approaches to pneumothorax drainage or PE Ix.

More difficult "discuss" questions:

Question Style	**Possible Solution**
All the options are required in *every* patient – e.g. components of a septic screen for neonates.	Group the options together at the start, explain why they are all mandatory, then list **cons** of each
Very broad scope of question, e.g. "management options" in elderly patient with dislocation – includes analgesia, sedation, reduction, disposition	Demonstrate understanding of the various challenges with a killer **"key issues"** page For each area of management, give 1-2 options and brief pros + cons of each. Focus on **limitations**

Discuss Questions (alternative approach)

- **Intro** – Why is this question in the FACEM exam?
- **Issues / considerations** - What factors are important in choosing between the different options?
    - **Patient factors**
        - Stability
        - Fasting status
        - Comorbidities
        - Patient preference
    - **Procedural factors**
        - Invasiveness
        - Risks
        - Cosmetic implications (e.g. chest drain)
    - **Departmental factors**
        - Availability – of staff + equipment
        - State of ED – too busy for PSA?
        - Training / credentialing – for the planned procedure
- **Any important areas NOT for discussion?**
    - Immediate management of *unstable patient* – e.g. decompression of tension pneumothorax (beware: the stem may categorically state that the patient is stable)
    - Simple treatments that ALL patients would receive – e.g. O2, analgesia, correction of electrolytes (one-liner)
- **DISCUSS each option in turn**
    - Least invasive -> most invasive
    - Most useful -> least useful
    - Start with "do nothing" or " observation"
    - Prioritise the 1-2 techniques *you would actually use*
    - Devote less time / space to less useful techniques – e.g. "axillary nerve block – not appropriate for this patient"
- **For each option**:
    - **Description** – e.g. what does "observation" mean?
    - **Role** – is this method best for a particular subgroup / scenario?
    - **Pros / advantages**
    - **Cons / limitations / exclusions / complications**
- **State your preferred method of managing THIS PATIENT**
    - May give options if insufficient clinical information available, e.g.
        - DC cardioversion if stable, ASA 1-2, ED quiet
        - Amiodaraone infusion if comorbidities, ASA 3-4, ED busy

Ideas for pros + cons

1. Is it any good?
2. Can we do it in my ED?
3. Is it safe?
4. Will the patient tolerate it?
5. What are the hidden costs?
6. Is it appropriate for THIS patient?

Remember

Cons =

- Limitations
- Risks + complications
- Side-effects
- Contra-indications
- Additional considerations (hidden costs)

Considerations	**Pros**	**Cons**
Is it any good?	**Effective** High success rate High sensitivity, etc.	Specific **limitations**
Can we do it in my ED?	**Quick, easy** **Widely available** Does not require specific training / credentialing Can be performed - In ED - At the bedside	Complex Not readily available **Requires specific training / expertise** Requires patient transfer - Out of ED - To another hospital
Is it safe?	Safe	Specific **risks** or **complications** - Radiation / contrast - Pneumothorax - Requires procedural sedation
Will the patient tolerate it?		Consider the patient's age and mental status State specific **side-effects**
What are the hidden costs?		Time-consuming Requires hospital admission / ongoing treatment or monitoring Ties up staff and resources
Is it appropriate for THIS patient?	Relate it to the stem	**Contra-indications** for specific subgroups

If the question is too complex / difficult to properly discuss pros + cons

- Concentrate on **opening statements** / **key issues** page
- Consider issues involved in choosing between different treatments
- Comment on **limitations** of techniques / strategies mentioned

Child Run over by Parent

FACEM SAQ 2005.2.4
A 17 month old boy is brought to your emergency department by ambulance. He has been previously identified to be a child at risk. He has been run over by a motor-bike in the driveway of his home. He has multiple tyre marks over his lower limbs. He is alert and appropriately responding for his age. Following clinical examination, you determine that his injuries are restricted to his lower limbs. Describe your management of this boy (100%).

Case

- Motorcycle vs pedestrian
- Lower limb crush injuries

Cause

- Likely NAI
- Multiple tyre marks = suggests that child has been deliberately run over

Complications

- Lower limb / pelvic fractures
- Neurovascular injury (femoral nerve, artery, vein, sciatic nerve)
- Crush / compartment syndrome -> rhabdomyolysis, high K+
- Blood loss
- Severe pain

Priorities

- Resuscitate
- Treat pain
- Definitive management of specific injuries
- Child protection -> will need admission to facilitate investigation

Resus

- Monitored bed, trauma team approach
- A+B = stable
- C = IV access
    - EMLA or AnGel if time permits
    - IO if unsuccessful
    - Send bloods for FBC, U+E, coags, VBG, G+H
    - Fluids: 10-20 ml/kg normal saline if shocked
- D = check + correct glucose

Supportive

Treatment

- **Arrest visible haemorrhage**
    - Consider transfusion if ongoing bleeding
- **Analgesia**
    - IN fentanyl 1.5 mcg / kg
    - Femoral nerve block (0.4mL / kg of 0.5% Ropivacaine)
- **Correct visible deformity + splint**
- **Clean + cover wounds**
- **Elevate + ice** injured limbs
- **Tetanus toxoid + antibiotics** if open wounds, e.g. cefazolin 25mg/kg IV
    - Tetanus immunoglobulin if child not immunised

Monitoring

- Haemodynamic status
- Compartment pressures
- Urine output

Social

- Involve / inform family

Specific Management

- Urgent orthopaedic consultation
- OT for ORIF / MUA of fractures, washout of any wounds
- ED reduction under PSA for immediately limb-threatening injuries
    - Ketamine 1-1.5 mg/kg ± atropine 10mcg/kg IV

- Treat **complications**
    - Fasciotomy for compartment syndrome
    - Fluid resus for rhabdomyolysis

Disposition

- Admit regardless of injuries:
    - To orthopaedic / trauma unit if fractures
    - To paediatric ward if medically well
- Urgent child protection investigation to determine child safety
- ? other children at risk

Other

- Document = write good notes (may be used in court)

Lists of Causes / Complications

Surgical Sieve	*e.g. applied to the causes of confusion*
Vascular	Stroke, SAH, ICH, venous sinus thrombosis
Infection / **I**nflammation	Meningo-encephalitis, CNS abscess
Neoplastic	Primary (glioma), secondary (mets)
Trauma	Head injury – DAI, contusion, bleed
Metabolic	Glucose, Na+, Ca2+ ⇑⇓, inborn errors, liver failure
Endocrine	Hyper/hypothyroidism
Degenerative	Dementia
Allergic / **A**utoimmune	Cerebral vasculitis (SLE)
Toxins + withdrawal	Amphetamines, opiates; EtOH/benzo withdrawal
Idiopathic / **I**atrogenic	Epilepsy (post-ictal) Drugs: antipsychotics, TCAs, antihistamines, lithium

RANDOM FACTS

Adrenaline in anaphylaxis (revisited)

IM dose

- Give as 1:1000 solution
- Adults = 0.3-0.5 ml (300-500 mcg)
- Children = 0.01 ml/kg (10 mcg/kg)

IV bolus for moribund patient

- Give as 1:100,000 solution (1mg in 100ml saline = 10mcg/ml)
- Adults = 100-200 mcg slow IV (10-20 ml)
- Children = 2-3 mcg/kg slow IV

IV infusion

- Make up 1:100,000 solution (1mg in 100ml saline = 10mcg/ml)
- Adults = start at 10-20 mcg per minute (= 60-120 ml/hr)
- Children = start at 0.1mcg/kg/min, titrate up, max dose < 1mcg/kg/min
- Max dose is < 1mcg/kg/min

Key Elements of Disaster Response

- **C**ommand + control
- **S**afety
- **C**omms
- **A**ssessment
- **T**riage
- **T**reatment
- **T**ransport

Oxygen Cylinders

Size of cylinder	Capacity (L)	Lifespan at 10 L/min
BL	224	~ 22 min
C	490	~ 49 min
D	1500	2 ½ hours
E	4200	7 hours

FLACC Scale = Behavioural Pain Scale for Children

Criteria	**Score 0**	**Score 1**	**Score 2**
Face	No particular expression	Occasional grimace or frown Withdrawn, disinterested	Quivering chin, clenched jaw Frequent, constant
Legs	Normal position, relaxed	Uneasy, restless, tense	Kicking, legs drawn up
Activity	Lying quietly, normal position, moves around	Squirming, shifting around, tense	Arched, rigid or jerking
Cry	No cry (awake or asleep)	Moans or whimpers, occasional complaint	Crying steadily, screams or sobs, frequent complaints
Consolability	Content, relaxed	Reassured by physical contact, distractible	Difficult to console