

**Bedside Clinical Guidelines Partnership**

in association with

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# **Paediatric Guidelines**

# **2016–18**

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# PREFACE • 1/2

This book has been compiled as an aide-memoire for all staff concerned with the management of general medical paediatric patients, especially those who present as emergencies.

## ***Guidelines on the management of common medical conditions***

No guideline will apply to every patient, even where the diagnosis is clear-cut; there will always be exceptions. These guidelines are not intended as a substitute for logical thought and must be tempered by clinical judgement in the individual patient.

***The guidelines are advisory, NOT mandatory***

## ***Prescribing regimens and nomograms***

The administration of certain drugs, especially those given intravenously, requires great care if hazardous errors are to be avoided. These guidelines do not include all guidance on the indications, contraindications, dosage and administration for all drugs. Please refer to the British National Formulary for Children (BNFc).

## ***Antibiotics***

Recommendations are based on national guidance reflecting a balance between common antibiotic sensitivities and the narrowest appropriate spectrum to avoid resistance but local policies may reflect frequently encountered sensitivity patterns in individual local patient groups.

## ***Practical procedures***

DO NOT attempt to carry out any of these Practical procedures unless you have been trained to do so and have demonstrated your competence.

## ***National guidelines***

Where there are different recommendations the following order of prioritisation is followed:  
NICE > NPSA > SIGN > RCPCH > National specialist society > BNFC > Cochrane > Meta-analysis > systematic review > RCT > other peer review research > review > local practice.

## ***Evidence base***

These have been written with reference to published medical literature and amended after extensive consultation. Wherever possible, the recommendations made are evidence based. Where no clear evidence has been identified from published literature the advice given represents a consensus of the expert authors and their peers and is based on their practical experience.

## ***Supporting information***

Where supporting evidence has been identified it is graded I to V according to standard criteria of validity and methodological quality as detailed in the table below. A summary of the evidence supporting each statement is available, with the original sources referenced. The evidence summaries are being developed on a rolling programme which will be updated as each guideline is reviewed.

Level	Treatment benefits	Treatment harms	Prognosis	Diagnosis
1	Systematic review of randomized trials or n-of-1 trials	Systematic review of randomized trials, systematic review of nested case-control studies, n of-1 trial with the patient you are raising the question about, or observational study with dramatic effect	Systematic review of inception cohort studies	Systematic review of cross sectional studies with consistently applied reference standard and blinding
2	Randomized trial or observational study with dramatic effect	Individual randomized trial or (exceptionally) observational study with dramatic effect	Inception cohort studies	Individual cross sectional studies with consistently applied reference standard and blinding
3	Non-randomized controlled cohort/follow-up study	Non-randomized controlled cohort/follow-up study provided there are sufficient numbers to rule out a common harm	Cohort study or control arm of randomized trial	Non-consecutive studies, or studies without consistently applied reference standards
4	Case-series, case-control studies, or historically controlled studies	Case-series, case-control, or historically controlled studies	Case-series or case-control studies, or poor quality prognostic cohort study	Case-control studies, or poor or non-independent reference standard
5	Mechanism-based reasoning	Mechanism-based reasoning	n/a	Mechanism-based reasoning

Excerpt from: OCEBM Levels of Evidence Working Group. The Oxford Levels of Evidence 2. Oxford Centre for Evidence-Based Medicine. 2011. <http://www.cebm.net/index.aspx?o=5653>

### **Feedback**

Evaluating the evidence-base of these guidelines involves continuous review of both new and existing literature. The editors encourage you to challenge the evidence provided in this document. If you know of evidence that contradicts, or additional evidence in support of the advice given in these guidelines please contact us.

The accuracy of the detailed advice given has been subject to exhaustive checks. However, if any errors or omissions become apparent contact us so these can be amended in the next review, or, if necessary, be brought to the urgent attention of users. Constructive comments or suggestions would also be welcome.

### **Contact**

Partners in Paediatrics, via <http://www.partnersinpaediatrics.org/>, or Bedside Clinical Guidelines Partnership via e-mail: [bedsideclinicalguidelines@uhn.nhs.uk](mailto:bedsideclinicalguidelines@uhn.nhs.uk)

# APLS – CARDIORESPIRATORY ARREST • 1/3

## MANAGEMENT

- Stimulate patient to assess for signs of life and shout for help
- Establish basic life support: Airway – Breathing – Circulation
- Connect ECG monitor: identify rhythm and follow **Algorithm**
- Control airway and ventilation: preferably intubate
- Obtain vascular access, peripheral or intraosseous (IO)
- Change person performing chest compressions every few minutes

### Airway (A)

- Inspect mouth: apply suction if necessary
- Use either head tilt and chin lift or jaw thrust
- Oro- or nasopharyngeal airway
- Intubation – see **Aide memoire (APLS Recognition and assessment of the sick child guideline)**
- If airway cannot be achieved, consider laryngeal mask or, failing that, cricothyrotomy

### Breathing (B)

- Self-inflating bag and mask with 100% oxygen
- Ventilation rate
  - unintubated: 2 inflations for every 15 compressions
  - intubated: 10–12/min, with continuous compressions
- Consider foreign body or pneumothorax

### Circulation (C)

- Cardiac compression rate: 100–120/min depressing lower half of sternum by at least one third (4 cm infant, 5 cm child, 6 cm adult): push hard, push fast
- Peripheral venous access: 1–2 attempts (<30 sec)
- Intraosseous access: 2–3 cm below tibial tuberosity (see **Intraosseous infusion guideline**)
- Use ECG monitor to decide between:
  - a non-shockable rhythm: asystole or pulseless electrical activity (PEA) OR
  - a shockable rhythm: ventricular fibrillation or pulseless ventricular tachycardia

**Algorithm** for managing these rhythms follows:

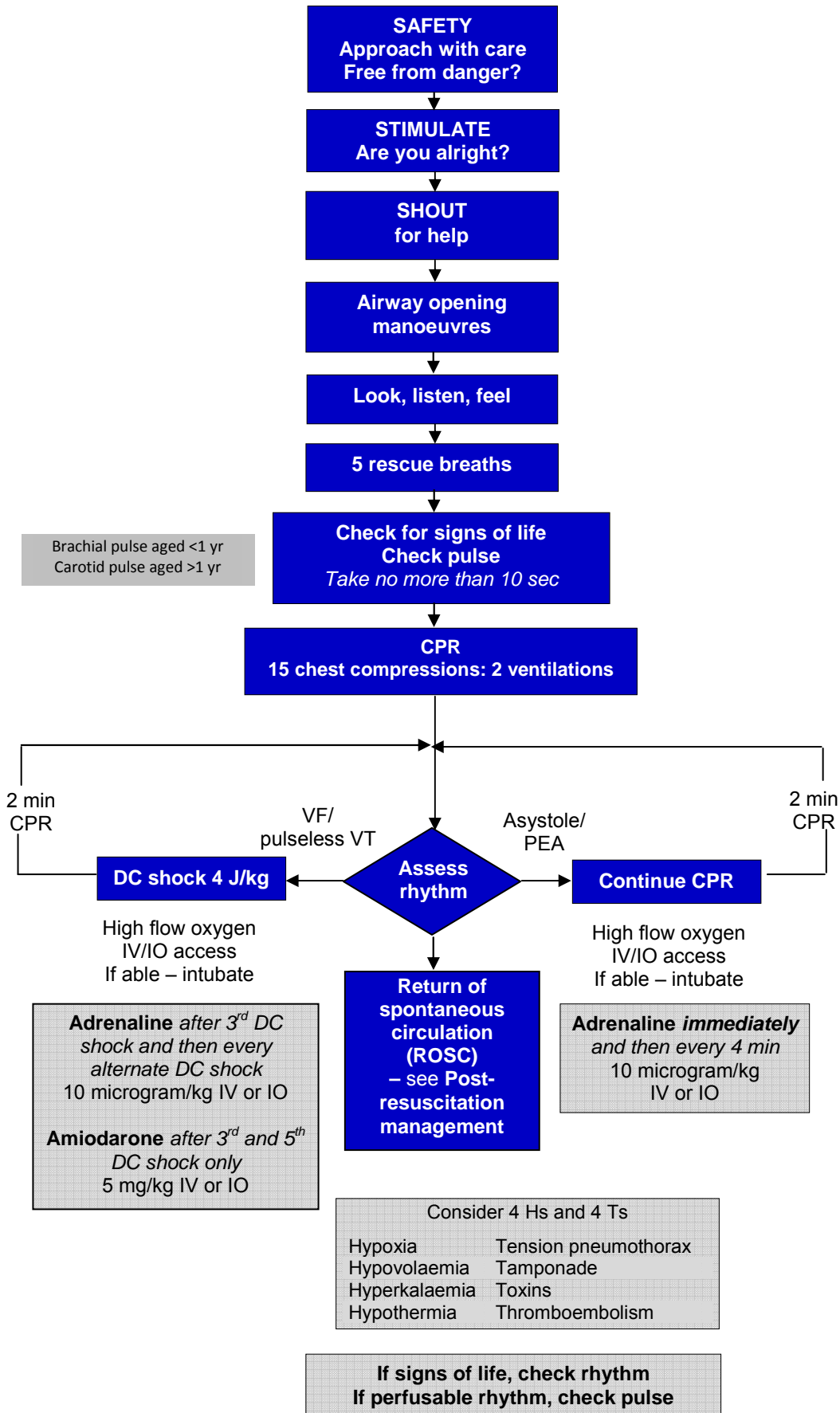
- If arrest rhythm changes, restart **Algorithm**
- If organised electrical activity seen, check pulse and for signs of circulation

### Adrenaline doses for asystole

Route	Aged <12 yr	Aged 12 yr–adult	Notes	
IV rapid bolus/ intraosseous	10 microgram/kg (0.1 mL/kg of 1:10,000)	1 mg (10 mL of 1:10,000)	Initial and usual subsequent dose	If given by intraosseous route flush with sodium chloride 0.9%



# APLS – CARDIORESPIRATORY ARREST • 2/3



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# APLS – CARDIORESPIRATORY ARREST • 3/3

## Defibrillation

- Use hands-free paediatric pads in children, may be used anteriorly and posteriorly
- Resume 2 min of cardiac compressions immediately after giving DC shock, without checking monitor or feeling for pulse
- Briefly check monitor for rhythm before next shock: if rhythm changed, check pulse
- Adrenaline and amiodarone are given after the 3<sup>rd</sup> and 5<sup>th</sup> DC shock, and then adrenaline only every other DC shock
- Automatic external defibrillators (AEDs) do not easily detect tachyarrhythmias in infants but may be used at all ages, ideally with paediatric pads, which attenuate the dose to 50–80 J

## PARENTAL PRESENCE

- Evidence suggests that presence at their child's side during resuscitation enables parents to gain a realistic understanding of efforts made to save their child. They may subsequently show less anxiety and depression
- Designate one staff member to support parents and explain all actions
- Team leader, not parents, must decide when it is appropriate to stop resuscitation

## WHEN TO STOP RESUSCITATION

- No time limit is given to duration of CPR
  - no predictors sufficiently robust to indicate when attempts no longer appropriate
  - cases should be managed on individual basis dependent on circumstances
- Prolonged resuscitation has been successful in:
  - hypothermia (<32°C)
  - overdoses of cerebral depressant drugs (e.g. intact neurology after 24 hr CPR)
- Discuss difficult cases with consultant before abandoning resuscitation

## POST-RESUSCITATION MANAGEMENT

### Identify and treat underlying cause

#### Monitor

- Heart rate and rhythm
- Oxygen saturation
- CO<sub>2</sub> monitoring
- Core and skin temperatures
- BP
- Urine output
- Arterial blood gases and lactate
- Central venous pressure

#### Request

- CXR
  - Arterial and central venous gases
  - Haemoglobin and platelets
  - Group and save serum for crossmatch
  - Sodium, potassium, urea and creatinine
  - Clotting screen
  - Blood glucose
  - LFTs
  - 12-lead ECG
- 
- Transfer to PICU
  - Hold a team debriefing session to reflect on practice

# APLS – RECOGNITION AND ASSESSMENT OF THE SICK CHILD • 1/6

## RAPID CLINICAL ASSESSMENT

### *Airway (A) and Breathing (B)*

- Effort of breathing
  - respiratory rate
  - recession
  - use of accessory muscles
  - additional sounds: stridor, wheeze, grunting
  - flaring of nostrils
- Efficacy of breathing
  - chest movement and symmetry
  - breath sounds
  - SpO<sub>2</sub> in air

### *Circulation (C)*

- Heart rate
- Pulse volume
  - peripheral
  - central (carotid/femoral)
- Blood pressure
- Capillary refill time
- Skin colour and temperature

### *Disability (D)*

- Conscious level
- Posture
- Pupils

### *Exposure (E)*

- Fever
- Skin rashes, bruising

### *Don't Ever Forget Glucose (DEFG)*

- Glucose stix

### **Actions**

- Complete assessment should take <1 min
- Treat as problems are found
- Once airway (A), breathing (B) and circulation (C) are clearly recognised as being stable or have been stabilised, definitive management of underlying condition can proceed
- Reassessment of ABCDE at frequent intervals necessary to assess progress and detect deterioration
- Hypoglycaemia: glucose 10% 2 mL/kg followed by IV glucose infusion

## CHILD AND PARENTS

- Give clear explanations to parents and child
- Allow and encourage parents to remain with child at all times

## STRUCTURED APPROACH TO THE SERIOUSLY ILL CHILD

### **Airway**

#### **Primary assessment of airway**

- Vocalisations (e.g. crying or talking) indicate ventilation and some degree of airway patency
- Assess patency by:
  - **looking** for chest and/or abdominal movement
  - **listening** for breath sounds
  - **feeling** for expired air

#### **Re-assess after any airway opening manoeuvres**

- Infants: a neutral head position; other children: 'sniffing the morning air'
- Other signs that may suggest upper airway obstruction:

# APLS – RECOGNITION AND ASSESSMENT OF THE SICK CHILD • 2/6

- stridor
- intercostal/subcostal/sternal recession

## **Breathing**

### ***Primary assessment of breathing***

- Assess
- effort of breathing
- efficacy of breathing
- effects of respiratory failure

### ***Effort of breathing***

- Respiratory rates 'at rest' at different ages – see **Aide memoire: boys/girls** below
- Respiratory rate:
  - tachypnoea: from either lung or airway disease or metabolic acidosis
  - bradypnoea: due to fatigue, raised intracranial pressure, or pre-terminal
- Recession:
  - intercostal, subcostal or sternal recession shows increased effort of breathing
  - degree of recession indicates severity of respiratory difficulty
  - in child with exhaustion, chest movement and recession will decrease
- Inspiratory or expiratory noises:
  - stridor, usually inspiratory, indicates laryngeal or tracheal obstruction
  - wheeze, predominantly expiratory, indicates lower airway obstruction
  - volume of noise is not an indicator of severity
- Grunting:
  - a sign of severe respiratory distress
  - can also occur in intracranial and intra-abdominal emergencies
- Accessory muscle use
- Gasping (a sign of severe hypoxaemia and can be pre-terminal)
- Flaring of nostrils

### ***Exceptions***

- **Increased effort of breathing DOES NOT occur in 3 circumstances:**
  - **exhaustion**
  - **central respiratory depression** (e.g. from raised intracranial depression, poisoning or encephalopathy)
  - **neuromuscular disease** (e.g. spinal muscular atrophy, muscular dystrophy or poliomyelitis)

### ***Efficacy of breathing***

- Breath sounds on auscultation:
  - reduced or absent
  - bronchial
  - symmetrical or asymmetric
- Chest expansion
- Pulse oximetry

### ***Effects of respiratory failure on other physiology***

- Heart rate:
  - increased by hypoxia, fever or stress
  - bradycardia a pre-terminal sign
- Skin colour:
  - hypoxia first causes vasoconstriction and pallor (via catecholamine release)
  - cyanosis is a late and pre-terminal sign
  - some children with congenital heart disease may be permanently cyanosed and oxygen may have little effect
- Mental status:
  - hypoxic child will be agitated first, then drowsy and unconscious
  - pulse oximetry can be difficult to achieve in agitated child owing to movement artefact

## **Circulation**

- Heart rates 'at rest' at different ages – see **Aide memoire: boys/girls** below

# APLS – RECOGNITION AND ASSESSMENT OF THE SICK CHILD • 3/6

## **Pulse volume**

- Absent peripheral pulses or reduced central pulses indicate shock

## **Capillary refill**

- Pressure on centre of sternum or a digit for 5 sec should be followed by return of circulation in skin within 2–3 sec
- can be prolonged by shock or cold environmental temperatures
- not a specific or sensitive sign of shock
- should not be used alone as a guide to response to treatment

## **BP**

- See **Aide memoire: boys/girls** below
- Cuff should cover >80% of length of upper arm
- Hypotension is a late and pre-terminal sign of circulatory failure

## **Effects of circulatory inadequacy on other organs/physiology**

- Respiratory system:
  - tachypnoea and hyperventilation occurs with acidosis
- Skin:
  - pale or mottled skin colour indicates poor perfusion
- Mental status:
  - agitation, then drowsiness leading to unconsciousness
- Urinary output:
  - <1 mL/kg/hr (<2 mL/kg/hr in infants) indicates inadequate renal perfusion

## **Features suggesting cardiac cause of respiratory inadequacy**

- Cyanosis, not relieved by oxygen therapy
- Tachycardia out of proportion to respiratory difficulty
- Raised JVP
- Gallop rhythm/murmur
- Enlarged liver
- Absent femoral pulses

## **Disability**

### **Primary assessment of disability**

- Always assess and treat airway, breathing and circulatory problems before undertaking neurological assessment:
- respiratory and circulatory failure have central neurological effects
- central neurological conditions (e.g. meningitis, raised intracranial pressure, status epilepticus) have both respiratory and circulatory consequences

## **Neurological function**

- Conscious level: **AVPU**; a painful central stimulus may be applied by sternal pressure, squeezing trapezius muscle or Achilles tendon, or supra-orbital ridge pressure
- **Alert**
- **Voice**
- **Pain** (equivalent to GCS <8)
- **Unresponsive**
- Posture:
  - hypotonia
  - decorticate or decerebrate postures may only be elicited by a painful stimulus
- Pupils, look for:
  - pupil size, reactivity and symmetry
  - dilated, unreactive or unequal pupils indicate serious brain disorders

## **Signs of raised intracranial pressure (Cushing's Triad)**

- Respiratory:
  - hyperventilation
  - Cheyne-Stokes breathing
  - slow, sighing respiration

# APLS – RECOGNITION AND ASSESSMENT OF THE SICK CHILD • 4/6

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- apnoea
- Systemic hypertension
- Sinus bradycardia

# APLS – RECOGNITION AND ASSESSMENT OF THE SICK CHILD • 5/6

APLS aide-memoire: boys

Age	Guide Weight (kg)	A ET tube		C Joules	C Fluids	C Adrenaline	D Lorazepam	D Glucose	RR At rest Breaths per minute 5th-95th centile	HR Beats per minute 5th-95th centile	BP Systolic		
		Int diameter mm	Length cm								4 J/kg	20 mL/kg (mL)	0.1 mL/kg of 1:10 000 (mL)
Birth	3.5	3.0/3.5	9	20	70	0.4	0.4	7	25–50	120–170	65–75	80–90	105
1 month	4.5	3.5	9	20	90	0.5	0.5	9	25–50	120–170	65–75	80–90	105
3 months	6.5	3.5	10	30	130	0.7	0.7	13	25–45	115–160	65–75	80–90	105
6 months	8	4	12	30	160	0.8	0.8	16	20–40	110–160	65–75	80–90	105
12 months	9.5	4.5	13	40	200	1.0	1.0	19	20–40	110–160	70–75	85–95	105
18 months	11	4.5	13	40	220	1.1	1.1	22	20–35	100–155	70–75	85–95	105
2 years	12	4.5	13	50	240	1.2	1.2	24	20–30	100–150	70–80	85–100	110
3 years	14	5	14	60	280	1.4	1.4	28	20–30	90–140	70–80	85–100	110
4 years	16	5	14	60	320	1.6	1.6	32	20–30	80–135	70–80	85–100	110
5 years	18	5.5	14	80	360	1.8	1.8	36	20–30	80–135	80–90	90–110	110–120
6 years	21	5.5	15	80	420	2.1	2.1	42	20–30	80–130	80–90	90–110	110–120
7 years	23	6	15	100	460	2.3	2.3	46	20–30	80–130	80–90	90–110	110–120
8 years	25	6	16	100	500	2.5	2.5	50	15–25	70–120	80–90	90–110	110–120
9 years	28	6.5	16	120	500	2.8	2.8	56	15–25	70–120	80–90	90–110	110–120
10 years	31	6.5	17	130	500	3.1	3.1	62	15–25	70–120	80–90	90–110	110–120
11 years	35	6.5	17	140	500	3.5	3.5	70	15–25	70–120	80–90	90–110	110–120
12 years	43	7.5	18	150	500	4.3	4.0	86	12–24	65–115	90–105	100–120	125–140
14 years	50	8	21	150	500	5.0	4.0	100	12–24	60–110	90–105	100–120	125–140
Adult	70	8	24	120–150 Joules biphasic	500	10 mL (i.e. 1 mg)	4 mg	100 mL	12–24	60–110	90–105	100–120	125–140

**TIP: if a child is particularly big go up one or two years; particularly small go down one or two years**  
*The final responsibility for delivery of the correct dose remains that of the physician prescribing and administering the drug*

# APLS – RECOGNITION AND ASSESSMENT OF THE SICK CHILD • 6/6

APLS aide-memoire: girls

Age	Guide Weight (kg)	A ET tube		C Joules	C Fluids	C Adrenaline	D Lorazepam	D Glucose	RR At rest Breaths per minute 5th-95th centile	HR Beats per minute 5th-95th centile	BP Systolic		
		Int diameter mm	Length cm	4 J/kg	20 mL/kg (mL)	0.1 mL/kg of 1:10 000 (mL)	0.1 mg/kg Max 4 mg (mg)	2 mL/kg of 10% glucose (mL)			5th centile	50th centile	95th centile
Birth	3.5	3.0/3.5	9	20	70	0.4	0.4	7	25–50	120–170	65–75	80–90	105
1 month	4.5	3.5	9	20	90	0.5	0.5	9	25–50	120–170	65–75	80–90	105
3 months	6	3.5	10	30	120	0.6	0.6	12	25–45	115–160	65–75	80–90	105
6 months	7	4	12	30	140	0.7	0.7	14	20–40	110–160	65–75	80–90	105
12 months	9	4.5	13	40	180	0.9	0.9	18	20–40	110–160	70–75	85–95	105
18 months	10	4.5	13	40	200	1.0	1.0	20	20–35	100–155	70–75	85–95	105
2 years	12	4.5	13	50	240	1.2	1.2	24	20–30	100–150	70–80	85–100	110
3 years	14	5	14	60	280	1.4	1.4	28	20–30	90–140	70–80	85–100	110
4 years	16	5	14	60	320	1.6	1.6	32	20–30	80–135	70–80	85–100	110
5 years	18	5.5	14	80	360	1.8	1.8	36	20–30	80–135	80–90	90–110	110–120
6 years	20	5.5	15	80	400	2.0	2.0	40	20–30	80–130	80–90	90–110	110–120
7 years	22	6	15	90	440	2.2	2.2	44	20–30	80–130	80–90	90–110	110–120
8 years	25	6	16	100	500	2.5	2.5	50	15–25	70–120	80–90	90–110	110–120
9 years	28	6.5	16	120	500	2.8	2.8	56	15–25	70–120	80–90	90–110	110–120
10 years	32	6.5	17	130	500	3.2	3.2	64	15–25	70–120	80–90	90–110	110–120
11 years	35	6.5	17	140	500	3.5	3.5	70	15–25	70–120	80–90	90–110	110–120
12 years	43	7.5	18	150	500	4.3	4.0	86	12–24	65–115	90–105	100–120	125–140
14 years	50	8	21	150	500	5.0	4.0	100	12–24	60–110	90–105	100–120	125–140
Adult	70	8	24	120-150 Joules biphasic	500	10 mL (i.e. 1 mg)	4 mg	100 mL	12–24	60–110	90–105	100–120	125–140

**TIP: if a child is particularly big go up one or two years; particularly small go down one or two years**  
*The final responsibility for delivery of the correct dose remains that of the physician prescribing and administering the drug*



# INTRASOSEOUS INFUSION • 1/3

## INDICATIONS

- Severely ill infants and children when immediate vascular access needed and peripheral access not possible (maximum 2 attempts)
- Cardiac arrest
- allows rapid expansion of circulating volume
- gives time to obtain IV access and facilitates procedure by increasing venous filling

## EQUIPMENT

- Intraosseous infusion needles for manual insertion or EZ-IO drill and needles (<40 kg: 15 mm pink; >40 kg: 25 mm blue) on resuscitation trolley
- Aseptic non-touch technique
- 5 mL syringe to aspirate and confirm correct position
- 10 mL sodium chloride 0.9% flush
- 20 or 50 mL syringe to administer fluid boluses
- Infusion fluid

**Manual insertion is painful, use local anaesthetic unless patient unresponsive to pain. Infiltrate with lidocaine 1% 1–2 mL [max dose 3 mg/kg (0.3 mL/kg)] and wait 90 sec**

## PROCEDURE

### Preferred sites

**Avoid fractured bones and limbs with fractures proximal to possible sites**

### Proximal tibia

- Identify anteromedial surface of tibia 1–3 cm below tibial tuberosity
- Direct needle away from knee at approx 90° to long axis of tibia
- Needle entry into marrow cavity accompanied by loss of resistance, sustained erect posture of needle without support and free fluid infusion
- Connect 5 mL syringe and confirm correct position by aspirating bone marrow contents or flushing with sodium chloride 0.9% 5 mL without encountering resistance
- Secure needle with tape
- Use 20 or 50 mL syringe to deliver bolus of resuscitation fluid

Figure 1: Access site on proximal tibia – lateral view

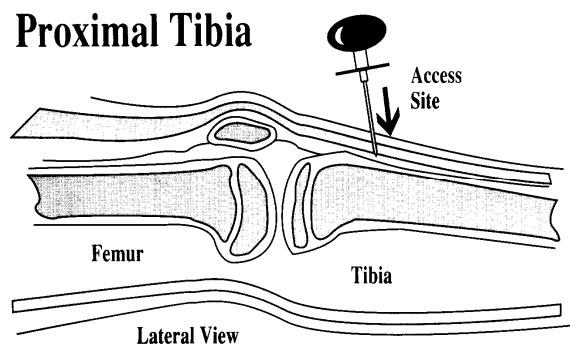
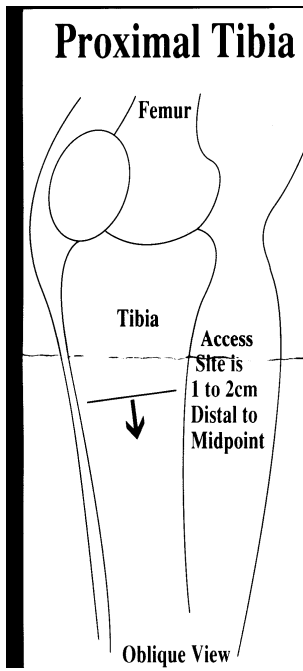


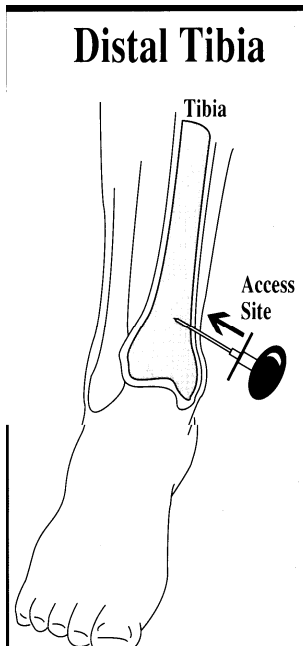
Figure 2: Access site on proximal tibia – oblique view



#### **Distal tibia**

- Access site on medial surface of tibia proximal to medial malleolus

**Figure 3: Access site on distal tibia**



#### **Distal femur**

- If tibia fractured, use lower end of femur on anterolateral surface, 3 cm above lateral condyle, directing needle away from epiphysis

#### **EZ-IO**

1. Locate landmarks
2. Aseptic non-touch technique: clean site
3. Choose appropriate size needle and attach to drill magnetically
4. Hold drill and needle at 90° to skin surface and push through skin without drilling, until bone is felt
5. Push drill button and drill continuously and push until there is loss of resistance – there is a palpable give as needle breaches the cortex
6. Remove drill and unscrew trocar
7. Aspirate the marrow if possible

# INTRAOSSUEOUS INFUSION • 3/3

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8. Attach pre-prepared connection tube
9. Secure needle (with EZ-IO fixator if available)
10. If awake give lidocaine 2% 0.5 mg/kg over 5 min
11. Proceed with required therapy

## COMPLICATIONS

- Bleeding
- Infection
- revert to central or peripheral venous access as soon as possible
- Compartment syndrome
- observe and measure limb circumference regularly
- palpate distal pulses and assess perfusion distal to IO access site
- Pain from rapid infusion: give lidocaine 2% 0.5 mg/kg over 5 min

# APPARENT LIFE THREATENING EVENT (ALTE) • 1/2

## DEFINITION

A sudden, unexpected change in an infant's behaviour that is frightening to the observer and includes changes in two or more of the following:

- Breathing: noisy, apnoea
- Colour: blue, pale
- Consciousness, responsiveness
- Movement, including eyes
- Muscle tone: stiff, floppy

## INVESTIGATION OF FIRST ALTE

### Clinical history

- Feeding
- Sleeping
- Infant and family illness and medicines
- Gestation at delivery

### Examination

- Full examination including signs of non-accidental injury

### Assessment

- SpO<sub>2</sub>
- Fundoscopy by paediatric ophthalmologist if:
  - recurrent
  - severe events (e.g. received CPR)
  - history or examination raises child safeguarding concerns (e.g. inconsistent history, blood in nose/mouth, bruising or petechiae, history of possible trauma)
- anaemic

### Investigations

Indicated if:

- Aged <1 month old
- <32 weeks gestation
- Previous illness/ALTE
- Examination abnormal
- Severe ALTE

### Immediate

- FBC
- U&E, blood glucose
- Plasma lactate
- Blood gases
- Blood culture

### Urgent

- Nasopharyngeal aspirate for virology
- Per-nasal swab for pertussis
- Urine microscopy and culture (microbiology)
- Urine biochemistry: store for possible further tests (see below)
- CXR
- ECG

If events recur during admission, discuss with senior role of further investigations (see below)

## MANAGEMENT

### Admit for observation

- SpO<sub>2</sub>, ECG monitoring
- Liaise with health visitor (direct or via liaison HV on wards)
- Check if child known to local authority children's social care or is the subject of a child protection plan

# APPARENT LIFE THREATENING EVENT (ALTE) • 2/2

## After 24 hr observation

- If event brief and child completely well:
- reassure parents and offer resuscitation training
- discharge (no follow-up appointment)
- All patients in following categories should have consultant review and be offered Care of Next Infant (CONI) Plus programme and/or home SpO<sub>2</sub> monitoring:
- parents remain concerned despite reassurance
- recurrent ALTE
- severe ALTE (e.g. needing cardiopulmonary resuscitation/PICU)
- <32 weeks gestation at birth
- a sibling was either a sudden unexplained death (SUD) or had ALTEs
- family history of sudden death

## If events severe (e.g. CPR given) or repeated events

- Multi-channel physiological recording

## Further investigations

Exclude following disorders:	
Gastro-oesophageal reflux	pH study +/- contrast swallow
Seizures	EEG
Intracranial abnormalities	CT or MRI brain
Cardiac arrhythmias	ECG and 24 hr ECG
Upper airway disorder	Sleep study
Hypocalcaemia	Ca and bone screen
Metabolic assessment	Urinary amino and organic acids Plasma amino acids and acylcarnitine
Abuse	Skeletal survey (including CT brain) Blood and urine toxicology (from admission) Continuous physiological or video recordings

# ANAPHYLAXIS • 1/2

## DEFINITION

Sudden onset systemic life-threatening allergic reaction to food, medication, contrast material, anaesthetic agents, insect sting or latex, involving either:

- Circulatory failure (shock)
- Difficulty breathing from 1 or more of following:
  - stridor
  - bronchospasm
  - rapid swelling of tongue, causing difficulty in swallowing or speaking (hoarse cry)

### Document

- Acute clinical features
- Time of onset of reaction
- Circumstances immediately before onset of symptoms

## IMMEDIATE TREATMENT

***Widespread facial or peripheral oedema with a rash in absence of above symptoms do not justify adrenaline or hydrocortisone. Give chlorphenamine orally***

- See **Management of anaphylaxis** algorithm
- Remove allergen if possible
- Call for help
- **IM** adrenaline: dose by age (see **Algorithm**) or 10 microgram/kg:
  - 0.1 mL/kg of 1:10,000 in infants (up to 10 kg = 1 mL)
  - 0.01 mL/kg of 1:1000 (max 0.5 mL = 0.5 mg)
  - give in anterolateral thigh
- ABC approach: provide BLS as needed
  - if airway oedema, call anaesthetist for potential difficult airway intubation
  - if not responding to IM adrenaline, give nebulised adrenaline 1:1000 (1 mg/mL) 400 microgram/kg (max 5 mg)
- treat shock with sodium chloride 0.9% 20 mL/kg bolus
- monitor SpO<sub>2</sub>, non-invasive blood pressure and ECG (see **Algorithm**)
- Repeat IM adrenaline after 5 min if no response, consider IV infusion

***Do not give adrenaline intravenously except in cardiorespiratory arrest or in resistant shock (no response to 2 IM doses)***

## SUBSEQUENT MANAGEMENT

- Admit for a minimum of 6 hr to detect potential biphasic reactions and usually for 24 hr, especially in following situations:
  - severe reactions with slow onset caused by idiopathic anaphylaxis
  - reactions in individuals with severe asthma or with a severe asthmatic component
  - reactions with possibility of continuing absorption of allergen
  - patients with a previous history of biphasic reactions
  - patients presenting in evening or at night, or those who may not be able to respond to any deterioration
  - patients in areas where access to emergency care is difficult
- Monitor SpO<sub>2</sub>, ECG and non-invasive BP, as a minimum
- Sample serum (clotted blood – must get to immunology immediately) for mast cell tryptase at the following times if clinical diagnosis of anaphylaxis uncertain and reaction thought to be secondary to venom, drug or idiopathic:
  - immediately after reaction
  - 1–2 hr after symptoms started when levels peak
  - >24 hr after exposure or in convalescence for baseline
- If patient presenting late, take as many of these samples as time since presentation allows

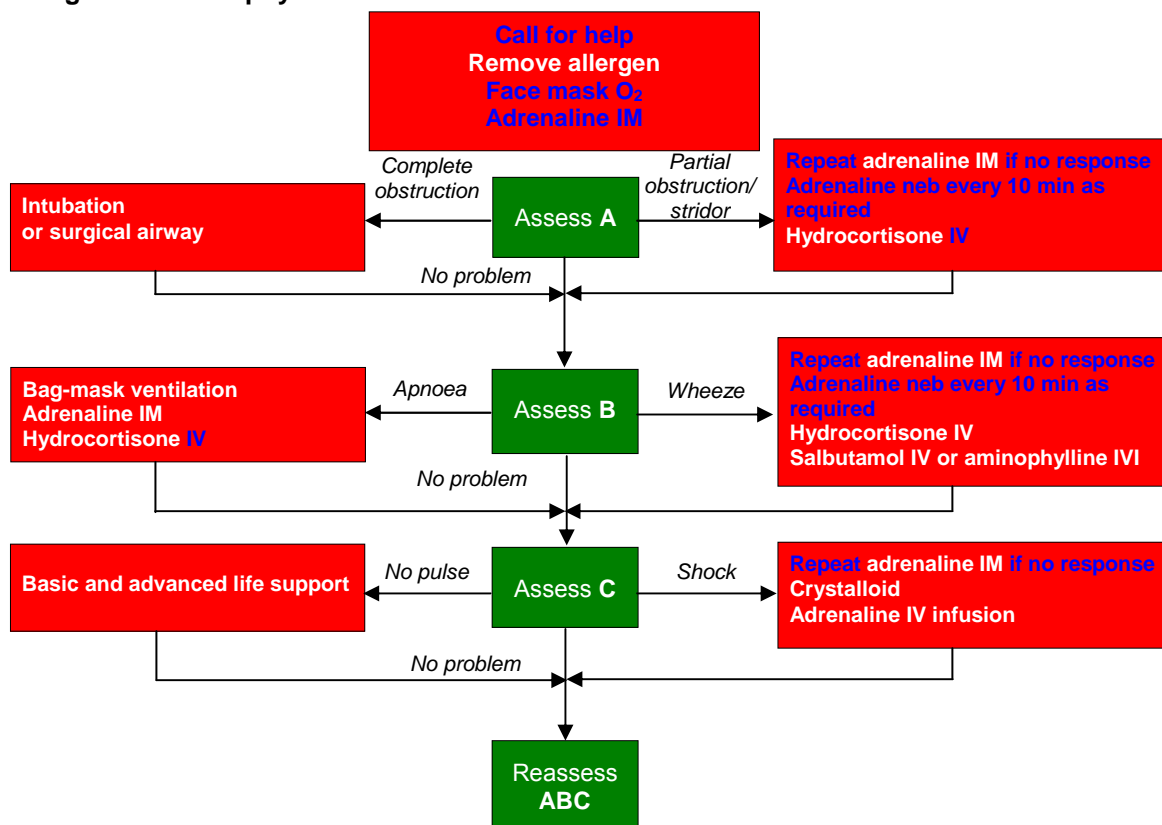
## DISCHARGE AND FOLLOW-UP

- Discuss all children with anaphylaxis with a consultant paediatrician before discharge
- Give following to patient, or as appropriate their parent and/or carer:

# ANAPHYLAXIS • 2/2

- information about anaphylaxis, including signs and symptoms of anaphylactic reaction
- information about risk of biphasic reaction
- information on what to do if anaphylactic reaction occurs (use adrenaline injector and call emergency services)
- demonstration of correct use of the adrenaline injector and when to use it
- advice about how to avoid suspected trigger (if known)
- information about need for referral to a specialist allergy service and the referral process
- information about patient support groups
- Discharge with an emergency plan, including 2 adrenaline pen auto-injectors after appropriate training
- If still symptomatic give oral antihistamines and steroids for up to 3 days
- Refer as out-patient to consultant paediatrician with an interest in allergy

## Management of anaphylaxis



Drugs in anaphylaxis	Dosage by age			
	<6 months	6 months–6 yr	6–12 yr	>12 yr
Adrenaline IM: pre-hospital practitioners	150 microgram (0.15 mL of 1:1000)		300 microgram (0.3 mL of 1:1000)	500 microgram (0.5 mL of 1:1000)
Adrenaline IM: in-hospital practitioners	10 microgram/kg 0.1 mL/kg of 1:10,000 (infants and young children) OR 0.01 mL/kg of 1:1000 (older children) <sup>1</sup>			
Adrenaline IV	1 microgram/kg = 0.01 mL/kg of 1:10,000 over 1 min, max 50 microgram			
Crystalloid	20 mL/kg			
Hydrocortisone (IM or slow IV)	25 mg	50 mg	100 mg	200 mg

<sup>1</sup> Strength of IM adrenaline not intended to be prescriptive, 1:1000 or 1:10,000 is used depending on what is practicable: e.g. use of 1:1000 involves drawing up too small volumes when used in infants

# PAIN ASSESSMENT • 1/1

<b>FLACC Behavioural</b>		<b>SUGGESTED AGE GROUP: 2 months to 7 years</b>	
<b>CATEGORIES</b>	<b>SCORING</b>		
	<b>0</b>	<b>1</b>	<b>2</b>
<b>Face</b>	No particular expression or smile	Occasional grimace or frown, withdrawn, disinterested	Frequent to constant quivering chin, clenched jaw
<b>Legs</b>	Normal position or relaxed	Uneasy, restless, tense	Kicking, or legs drawn up
<b>Activity</b>	Lying quietly, normal position, moves easily	Squirming, shifting back and forth, tense	Arched, rigid or jerking
<b>Cry</b>	No cry (awake or asleep)	Moans or whimpers, occasional complaint	Crying steadily, screams or sobs, frequent complaints
<b>Consolability</b>	Content, relaxed	Reassured by occasional touching, hugging or being talked to, distractible	Difficult to console or comfort

Each of the five categories: **(F)** Face; **(L)** Legs; **(A)** Activity; **(C)** Cry; **(C)** Consolability; is scored from 0 - 2 which results in a total score between 0 and 10  
*(Merkel et al, 1997)*

See management ladder below for score

## WONG AND BAKER PAIN ASSESSMENT – SELF REPORT

- Suggested age group ≥4 yr
- Point to each face using the words to describe the pain intensity
- Ask child to choose a face that best describes their own pain and record the appropriate number

### Wong-Baker FACES® Pain Rating Scale



Wong-Baker FACES Foundation (2016). Wong-Baker FACES® Pain Rating Scale. Retrieved 20.07.16 with permission from <http://www.WongBakerFACES.org>

See management ladder below for score

## ANALGESIC INTERVENTIONS

**Play specialist**

**Analgesic ladder** (omit NSAID's if contra-indicated)

- Review analgesia daily and step up or down dependent on pain score

**Intervention** by play staff

				Oral morphine (pain dose)	Systemic morphine
		Oral morphine (low dose)			
	NSAID	NSAID	NSAID	NSAID	NSAID
Paracetamol	Paracetamol	Regular Paracetamol	Regular Paracetamol	Regular Paracetamol	Regular Paracetamol
No pain	Mild	Mild to moderate	Moderate	Moderate to severe	Severe
0	2	4	6	8	10

**Preparation** aid used: doll, verbal

**Explanation**, photos

**Distraction**: toys, bubbles, music, multi sensory, books

Refer all in need of analgesia and with behavioural concerns

If learning disabilities apply assessment using tool appropriate for mental age

**Check BNFc for contraindications/interactions/precautions**



# ANALGESIA • 1/4

- For combination of analgesics to use, see **Analgesic ladder** in **Pain assessment** guideline

## TOPICAL

Age group	Preparation	Time to onset	Comments	
<1 month	Glucose syrup on pacifier (available as a tootsweet)	During procedure	For venepuncture or cannulation	
	Local anaesthetic cream	Lidocaine 4% LMX4®	30–60 min	Wait 5 min after removing cream before cannulation
		Lidocaine 2.5% with prilocaine 2.5% EMLA® Denela®	30–60 min	Remove after 1 hr
		<ul style="list-style-type: none"> <li>&lt;3 months: max 1 g in 24 hr</li> <li>&gt;3 months: max 2 g, 2 doses in 24 hr</li> <li>tube = 5 g</li> </ul>	<ul style="list-style-type: none"> <li>&lt;3 months: apply no later than 1 hr before procedure</li> <li>3 months–1 yr: max 2 doses in 24 hr, 4 hr before procedure</li> <li>&gt;1 yr–18 yr: 1–5 hr before procedure, max 2 doses in 24 hr</li> </ul>	
>5 yr	Ethyl chloride	Immediately	If cannot wait for cream	

## MILD PAIN – not impacting on activities (pain score 1–3)

Drug and preparation	Dose	Maximum dose	Comments
<b>Paracetamol [oral/nasogastric(NG)]</b> <ul style="list-style-type: none"> <li>Suspensions: <ul style="list-style-type: none"> <li>120 mg/5 mL</li> <li>250 mg/5 mL</li> </ul> </li> <li>Tablets/soluble 500 mg</li> </ul>	<ul style="list-style-type: none"> <li>Aged 1 month–children up to 50 kg: 15 mg/kg 4–6 hrly max QDS</li> <li>Aged 12–18 yr and weight &gt;50 kg: 500 mg–1g 4–6 hrly max QDS</li> <li>For TTO see BNFC banded doses</li> </ul>	Max total dose in 24 hr <ul style="list-style-type: none"> <li>Aged &lt;1 month (&gt;32 weeks corrected gestational age): 60 mg/kg/day</li> <li>Aged ≥1 month–18 yr: 75 mg/kg/day (up to max 4 g)</li> </ul>	<ul style="list-style-type: none"> <li>For mild pain</li> <li>Increase dose interval in renal impairment</li> <li>Avoid large doses in dehydration, malnutrition, hepatic impairment</li> <li>Review need for paracetamol at day 3</li> </ul>
<b>Paracetamol (rectal)</b> <ul style="list-style-type: none"> <li>Suppositories: <ul style="list-style-type: none"> <li>60 mg</li> <li>125 mg</li> <li>250 mg</li> <li>500 mg</li> <li>1 g</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Aged 1–3 months: 30–60 mg 8-hrly</li> <li>Aged 3–12 months: 60–125 mg 4–6 hrly as necessary</li> <li>Aged 1–5 yr: 125–250 mg 4–6 hrly as necessary</li> <li>Aged 5–12 yr 250–500 mg every 4–6 hrly as necessary</li> <li>Aged 12–18 yr: 500 mg–1 g 4–6 hrly</li> </ul>	<b>Max total dose in 24 hr:</b> <ul style="list-style-type: none"> <li>aged 1–3 months: 60 mg/kg daily in divided doses</li> <li>aged 3–12 months: 4 doses</li> <li>aged 1–5 yr: 4 doses</li> <li>aged 5–12 yr: 4 doses</li> <li>aged &gt;12 yr: 6 doses</li> </ul>	<ul style="list-style-type: none"> <li>As for oral paracetamol</li> <li>For mild pain when oral/NG route not possible</li> <li>Suspension can be given rectally</li> </ul>
<b>Paracetamol (IV)</b> 10 mg/mL (<33 kg use 50 mL vial via burette or in syringe) Prescribe in mg (not mL)	<ul style="list-style-type: none"> <li>&lt;10 kg 7.5 mg/kg 6-hrly</li> <li>10–50 kg 15 mg/kg 6-hrly</li> <li>&gt;50 kg 1 g 6-hrly</li> </ul>	<ul style="list-style-type: none"> <li>&lt;10 kg max 30 mg/kg/day</li> <li>10–50 kg max 60 mg/kg/day</li> <li>&gt;50 kg max 4 g/day</li> </ul>	<ul style="list-style-type: none"> <li>As for oral paracetamol</li> <li>For mild pain when oral/NG/PR route not possible</li> <li>Give over 15 min</li> </ul>

# ANALGESIA • 2/4

## MODERATE PAIN – some interference with activities (pain score 4–7)

Drug and preparation	Dose	Maximum dose	Comments
<b>Ibuprofen</b> <ul style="list-style-type: none"> <li>Liquid 100 mg/5 mL</li> <li>Tablets 200 mg and 400 mg</li> </ul>	<ul style="list-style-type: none"> <li>Aged 3 months–12 yr: 5 mg/kg 6–8 hrly</li> <li>Aged ≥12 yr: 200–600 mg 6–8 hrly</li> <li>See BNFC for banded doses for TTO</li> </ul>	<ul style="list-style-type: none"> <li>Aged &lt;12 yr: max 30 mg/kg/day</li> <li>Aged ≥12 yr: max 2.4 g/day</li> </ul>	<ul style="list-style-type: none"> <li>If aged &lt;3 months or &lt;5 kg use only if recommended by consultant</li> <li>Avoid in renal dysfunction</li> <li>Contraindications:               <ul style="list-style-type: none"> <li>shock</li> <li>bleeding disorders</li> <li>hypersensitive to aspirin or other NSAID</li> </ul> </li> <li>Can be given to asthmatics if no history of NSAID-induced wheeze and chest clear on auscultation</li> <li>Caution in hypertension, heart failure</li> </ul>
<b>Diclofenac sodium</b> <ul style="list-style-type: none"> <li>Tablets:               <ul style="list-style-type: none"> <li>enteric coated 25 mg and 50 mg</li> </ul> </li> <li>Suppositories 12.5 mg, 25 mg, 50 mg and 100 mg</li> </ul>	<ul style="list-style-type: none"> <li>Aged &gt;6 months: 300 microgram–1 mg/kg 8-hrly</li> </ul>	<ul style="list-style-type: none"> <li>Max 1 mg/kg up to 50 mg 8-hrly</li> </ul>	<ul style="list-style-type: none"> <li>As ibuprofen</li> <li>Second line NSAID – consultant led use only</li> <li>If liquid dose form required for chronic pain aged &gt;6 yr, consider piroxicam</li> </ul>
<b>Codeine</b> <ul style="list-style-type: none"> <li>Liquid 25 mg/5 mL</li> <li>Tablets 15 mg, 30 mg and 60 mg</li> </ul>	<ul style="list-style-type: none"> <li>Do not use aged &lt;12 yr or for adenotonsillectomy aged &lt;18 yr</li> <li>Aged 12–18 yr: 30–60 mg 6-hrly (1 mg/kg)</li> </ul>	<ul style="list-style-type: none"> <li>Max 240 mg/day</li> </ul>	<ul style="list-style-type: none"> <li>For moderate pain</li> <li>Caution in hepatic impairment</li> <li>Repeated doses increase risk of respiratory depression</li> <li>Caution if renal impairment, obstructive or inflammatory bowel disease, raised ICP, compulsive disorders</li> <li>Contraindications:               <ul style="list-style-type: none"> <li>acute respiratory depression</li> <li>paralytic ileus</li> </ul> </li> <li>Not to be given with other opioids</li> <li>Prescribe laxatives if given for &gt;24 hr</li> </ul>
<b>Morphine</b> <ul style="list-style-type: none"> <li>Low dose as alternative to codeine</li> </ul>	<ul style="list-style-type: none"> <li>50 microgram/kg 4–6 hrly</li> </ul>		<ul style="list-style-type: none"> <li>Respiratory rate, maintain:               <ul style="list-style-type: none"> <li>aged 1–2 yr: &gt;16 breaths/min</li> <li>aged 2–9 yr: &gt;14 breaths/min</li> <li>aged 10–16 yr: &gt;12 breaths/min</li> </ul> </li> <li>If rate reduced, contact medical staff</li> </ul>

# ANALGESIA • 3/4

## SEVERE PAIN IN CHILDREN AGED >1 YR – unable to perform activities (pain score 8–10)

*In head injuries/respiratory difficulties/upper airway obstruction, use opioids only with consultant advice. Monitor children needing oxygen and parenteral opioids with SpO<sub>2</sub> +/- TcCO<sub>2</sub> in an HDU setting*

Analgesic method and technique	Dose	Monitoring
<b>Oral morphine</b> <ul style="list-style-type: none"> <li>• Single dose before painful procedure may be useful</li> <li>• Use if no IV access or for weaning from IV opioid</li> <li>• If to be taken regularly consider use of prophylactic laxative</li> </ul>	<ul style="list-style-type: none"> <li>• Aged &gt;1–12 yr:               <ul style="list-style-type: none"> <li>• 200–300 microgram/kg 4-hrly</li> </ul> </li> <li>• Aged &gt;12 yr:               <ul style="list-style-type: none"> <li>• 5–10 mg 4-hrly (max 10 mg)</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Respiratory rate, maintain:               <ul style="list-style-type: none"> <li>• aged 1–2 yr, &gt;16 breaths/min</li> <li>• aged 2–9 yr, &gt;14 breaths/min</li> <li>• aged 10–16 yr, &gt;12 breaths/min</li> </ul> </li> <li>• if rate reduced, contact medical staff</li> </ul>
<b>Morphine patient/nurse-controlled analgesia (PCA/NCA)</b> <ul style="list-style-type: none"> <li>• PCA suitable for children aged &gt;5 yr (understand and will press button); NCA otherwise</li> <li>• Nurses must be certified competent in use of PCA/NCA</li> <li>• Use anti-reflux valve unless dedicated cannula</li> <li>• Use morphine 1 mg/kg made up to 50 mL with sodium chloride 0.9% maximum of 50 mg/50 mL</li> </ul>	<ul style="list-style-type: none"> <li>• If loading dose required:               <ul style="list-style-type: none"> <li>• <b>experienced staff only</b></li> <li>• 50–100 microgram/kg over 5 min (max 5 mg)</li> </ul> </li> <li>• Background infusion if used:               <ul style="list-style-type: none"> <li>• 4–10 microgram/kg/hr</li> </ul> </li> <li>• Bolus dose:               <ul style="list-style-type: none"> <li>• 10–20 microgram/kg</li> </ul> </li> <li>• Lockout time:               <ul style="list-style-type: none"> <li>• 5–30 min</li> </ul> </li> </ul>	<p>Hourly observations</p> <ul style="list-style-type: none"> <li>• Pain score</li> <li>• Sedation score</li> <li>• Pump displays</li> <li>• Syringe movement</li> <li>• Respiratory rate</li> <li>• SpO<sub>2</sub> if needed</li> <li>• TcCO<sub>2</sub> if needed</li> </ul> <p>4-hrly observations</p> <ul style="list-style-type: none"> <li>• Vomiting/itching</li> <li>• Urinary retention</li> <li>• Inspection of IV site</li> </ul>
<b>Morphine infusion</b> <ul style="list-style-type: none"> <li>• Use for severe pain when unable to use PCA/NCA</li> <li>• Use anti-reflux valve unless dedicated cannula</li> <li>• Use anti-siphon valve on line</li> <li>• Use morphine 1 mg/kg made up to 50 mL with sodium chloride 0.9%</li> <li>• max of 50 mg/50 mL</li> </ul>	<ul style="list-style-type: none"> <li>• Loading dose of 100 microgram/kg given over 5 min (max 5 mg)</li> <li>• Continuous infusion of 10–30 microgram/kg/hr</li> <li>• Start at 20 microgram/kg/hr except after major surgery when start at 30 microgram/kg/hr and adjust according to pain and sedation scores</li> </ul>	<p>Hourly observations</p> <ul style="list-style-type: none"> <li>• Pain score</li> <li>• Sedation score</li> <li>• Respiratory rate(as above)</li> <li>• SpO<sub>2</sub> monitoring</li> <li>• Syringe movement</li> <li>• IV site for infection</li> <li>• Urinary retention</li> </ul>
<b>IV intermittent morphine</b> <ul style="list-style-type: none"> <li>• Infusion preferable</li> </ul>	<ul style="list-style-type: none"> <li>• Give slowly over 5 min</li> <li>• Aged 1–12 yr:               <ul style="list-style-type: none"> <li>• 100 microgram/kg 4-hrly</li> </ul> </li> <li>• Aged &gt;12 yr:               <ul style="list-style-type: none"> <li>• 2.5–5 mg 4-hrly</li> </ul> </li> </ul>	<p>Hourly observations</p> <ul style="list-style-type: none"> <li>• Pain score</li> <li>• Sedation score</li> <li>• Respiratory rate (as above)</li> <li>• SpO<sub>2</sub> monitoring</li> </ul>
<b>SC intermittent opioid</b> <ul style="list-style-type: none"> <li>• IV preferable</li> <li>• Site 22/24 g SC cannula at time of surgery or using local anaesthetic cream</li> <li>• suitable sites: uppermost arm, abdominal skin</li> </ul>	<ul style="list-style-type: none"> <li>• Flush with sodium chloride 0.9% 0.3 mL</li> <li>• Prime cannula with morphine solution</li> <li>• Morphine:               <ul style="list-style-type: none"> <li>• 100–200 microgram/kg 4-hrly</li> <li>• max 6 times in 24 hr</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Pain score</li> <li>• Sedation score</li> <li>• Respiratory rate (as above)</li> </ul>

# ANALGESIA • 4/4

## SEVERE PAIN IN CHILDREN AGED <1 YR (pain score 8–10)

*In head injuries/respiratory difficulties/upper airway obstruction/ex-premature infant, only use opioids with consultant advice. Monitor children requiring oxygen and parenteral opioids with SpO<sub>2</sub> +/- TcCO<sub>2</sub> in an HDU setting*

Analgesic method and technique	Dose	Monitoring
<b>Oral morphine</b> <ul style="list-style-type: none"> <li>Use if no IV access or for weaning from IV opiate</li> </ul>	<ul style="list-style-type: none"> <li>Aged 1–6 months: 50–100 microgram/kg 6-hrly</li> <li>Aged 6–12 months: 100–200 microgram/kg 4-hrly</li> </ul>	<ul style="list-style-type: none"> <li>Pain score</li> <li>Sedation score</li> <li><b>Respiratory rate</b>, maintain: <ul style="list-style-type: none"> <li>if aged &lt;6 months, &gt;20 breaths/min</li> <li>if aged ≥6 months, &gt;16 breaths/min</li> <li>if rate reduced, contact medical staff</li> </ul> </li> <li>SpO<sub>2</sub></li> </ul>
<b>Morphine infusion</b> <ul style="list-style-type: none"> <li>Use anti-reflux valve unless dedicated cannula</li> <li>Use anti-siphon valve on line</li> <li>Use morphine 1 mg/kg made up to 50 mL with sodium chloride 0.9% <ul style="list-style-type: none"> <li>thus 1 mL/hr = 20 microgram/kg/hr</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Aged &lt;1 month: 50 microgram/kg over 5 min then 5–20 microgram/kg/hr</li> <li>Aged 1–12 months: <ul style="list-style-type: none"> <li>100 microgram/kg over 5 min then 10–30 microgram/kg/hr</li> </ul> </li> <li>Adjust in increments of 5 microgram/kg/hr according to response</li> </ul>	Hourly observations <ul style="list-style-type: none"> <li>Pain score</li> <li>Sedation score</li> <li>Respiratory rate (as above)</li> <li>SpO<sub>2</sub> monitoring</li> <li>Syringe movement</li> <li>Site for infection</li> <li>Urinary retention</li> </ul>
<b>IV intermittent morphine</b> <ul style="list-style-type: none"> <li>Infusion preferable</li> </ul>	<ul style="list-style-type: none"> <li>Aged &lt;1 month: 50 microgram/kg 6-hrly</li> <li>Aged 1–6 months: 100 microgram/kg 6-hrly</li> <li>Aged 6–12 months: 100 microgram/kg 4-hrly</li> </ul>	<ul style="list-style-type: none"> <li>Hourly observations for 24 hr then 4-hrly if stable</li> <li>Pain score</li> <li>Sedation score</li> <li>Respiratory rate (as above)</li> <li>SpO<sub>2</sub> monitoring</li> </ul>
<b>SC intermittent opiate</b> <ul style="list-style-type: none"> <li>IV preferable</li> <li>Site 24 g SC cannula at time of surgery or using local anaesthetic cream <ul style="list-style-type: none"> <li>suitable sites: uppermost arm, abdominal skin</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Flush with sodium chloride 0.9% 0.3 mL</li> <li>Morphine: <ul style="list-style-type: none"> <li>aged &lt;1 month: 100 microgram/kg 6-hrly</li> <li>aged 1–6 months 100–200 microgram/kg 6-hrly (aged ≥6 months 4–6 hrly)</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Pain score</li> <li>Sedation score</li> <li>Respiratory rate (as above)</li> <li>SpO<sub>2</sub></li> </ul>

# SEDATION • 1/3

## ASSESSMENT

Sedation and anaesthesia belong to the same spectrum of impaired consciousness

- In sedation, patient maintains the following vital functions without assistance:
  - protection of airway, swallowing, cough reflex
  - respiration
  - cardiovascular stability

### Cautions

**Discuss with anaesthetist before sedation if any of following present:**

- Abnormal airway (including large tonsils)
- Sleep apnoea
- Respiratory failure
- Respiratory disease with significant functional compromise
- Active respiratory tract infection
- Cardiac failure
- Raised intracranial pressure
- Decreased conscious level
- Neuromuscular disease
- Bowel obstruction
- Significant gastro-oesophageal reflux
- Renal impairment
- Liver impairment
- Previous adverse reaction to sedation
- Very distressed child

### Potential difficulties

**Sedation can be difficult in children:**

- Taking anti-epileptics (can result in increased or reduced effect of sedating drug)
- Already taking sedating drugs
- With behavioural difficulties

## PREPARATION FOR SEDATION

### Information required

- Age
- Weight
- Procedure for which sedation required
- Previous sedation history
- Other drugs being taken
- Other major diagnoses and implications in terms of respiratory function and upper airway competence
- Current health, including coughs, colds, pyrexia
- Oral intake status

### Consent for sedation (all cases)

Discuss with parent(s):

- Unpredictable response to medication
- Paradoxical excitation
- Failure of sedation (may need repeat dose or general anaesthetic at future date)
- Over-sedation (maintaining airway, aspiration)

### Fasting for moderate–heavy sedation

- There should be the following interval before procedure:
  - after a full meal: 6 hr
  - after milk: 4 hr
  - after clear fluids: 2 hr

***For short, painless procedures (e.g. CT or X-ray), give infants aged <4 months normal milk feed only and allow them to sleep naturally***

## EQUIPMENT

- Portable oxygen

## SEDATION • 2/3

- Portable suction
- Appropriately sized face mask and self-inflating resuscitation bag
- 2 healthcare professionals trained in airway management with patient during sedation

### DRUG CHOICE

#### Sedation drugs

Drug	Route	Onset	Duration	Dose	Comments
Chloral hydrate	• Oral • Rectal	45 min–1 hr	1–2 hr	<ul style="list-style-type: none"> <li>• Night sedation: 30 mg/kg</li> <li>• Pre-anaesthesia: 50 mg/kg</li> <li>• Scans: 70 mg/kg</li> <li>• max dose 2 g</li> </ul>	<ul style="list-style-type: none"> <li>• More efficacious in infants &lt;15 kg or aged &lt;18 months</li> </ul>
Melatonin	• Oral	30 min	2–5 hr	<ul style="list-style-type: none"> <li>• Aged ≤5 yr: 5 mg</li> <li>• Aged &gt;5 yr: 5–10 mg</li> </ul>	<ul style="list-style-type: none"> <li>• Use for sedation before EEG</li> <li>• Use 5 mg initially, if no response, give further 5 mg</li> </ul>
Temazepam	• Oral	45–90 min	up to 4 hr	<ul style="list-style-type: none"> <li>• Aged 12–18 yr: 10–20 mg 1 hr before procedure</li> </ul>	<ul style="list-style-type: none"> <li>• Only if aged ≥12 yr</li> <li>• CT, MAG3 scan</li> </ul>
Lorazepam	• Oral	1 hr	up to 4 hr	<ul style="list-style-type: none"> <li>• Aged 6 months–11 yr: 50–100 microgram/kg (max 4 mg)</li> <li>• Aged 12–17 yr: 1–4 mg</li> <li>• 1 hr before procedure</li> </ul>	<ul style="list-style-type: none"> <li>• Do not use with other benzodiazepines</li> </ul>
Midazolam	• Oral	30 min	1–2 hr	<ul style="list-style-type: none"> <li>• Aged 1 month–18 yr: 500 microgram/kg (max 20 mg)</li> </ul>	<ul style="list-style-type: none"> <li>• Have flumazenil ready to give for all routes</li> <li>• Buccal and IV routes – consultant led only (anaesthetist or PICU)</li> <li>• IV preparation can be given orally diluted in juice</li> <li>• IV cannulation (+ local anaesthetic cream)</li> <li>• More suitable for older children (not suitable for infants)</li> <li>• Not for CT scan</li> </ul>
	• Rectal	15–30 min		<ul style="list-style-type: none"> <li>• Aged 6 months–12 yr: 300–500 microgram/kg (max 20 mg)</li> </ul>	
	• Buccal	15 min		<ul style="list-style-type: none"> <li>• Aged 6 months–10 yr: 200–300 microgram/kg (max 5 mg)</li> <li>• Aged &gt;10 yr: 6–7 mg</li> <li>• &gt;70 kg: 6–8 mg</li> </ul>	
	• IV	2–3 min		<ul style="list-style-type: none"> <li>• 25–50 microgram/kg over 2–3 min, 5–10 min before procedure (aged 1–6 yr max 2 mg; aged 6–12 yr max 6 mg; aged 12–18 yr max 7.5 mg)</li> </ul>	
Morphine sulphate	• Oral	30 min	2–3 hr	<ul style="list-style-type: none"> <li>• Aged &gt;1 yr: 200–300 microgram/kg (max 10 mg)</li> </ul>	<ul style="list-style-type: none"> <li>• May be combined with midazolam 500 microgram/kg oral for painful procedures</li> </ul>

### MONITORING

- Keep under direct observation
- Once asleep or if <1 yr, monitor saturation continuously
- Record saturation, heart rate and colour every 15 min
- Discontinue once conscious level returned to normal

### SUBSEQUENT MANAGEMENT

#### Failed sedation

- Do not repeat maximum dose of initial drug used after expected period of onset unless patient has spat it out
- If repeat dose fails:
  - call anaesthetist who may give IV sedation (apply local anaesthetic cream), **or**
  - reschedule procedure for later time/date under general anaesthetic

## SEDATION • 3/3

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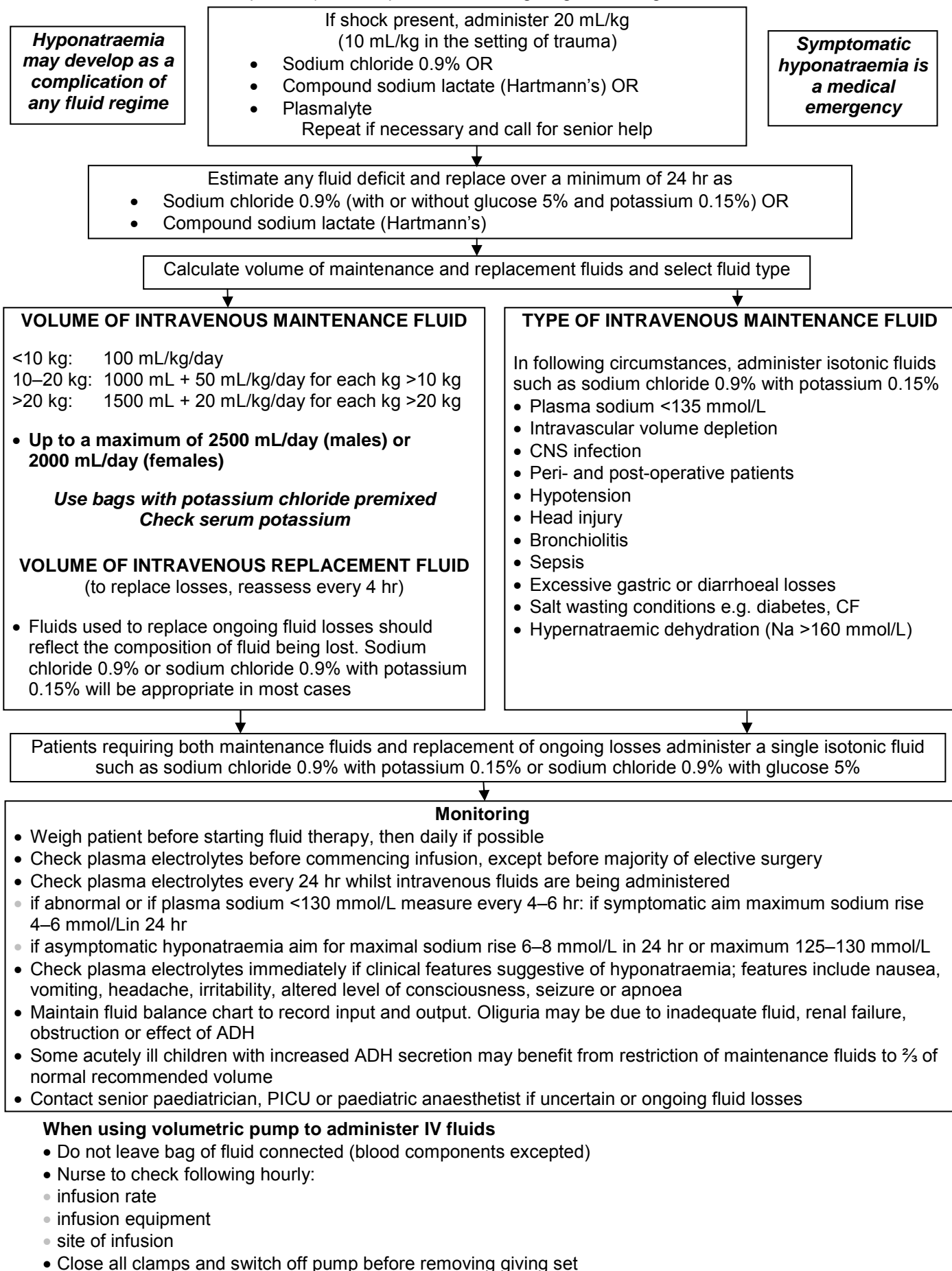
- If change in breathing pattern or concern of aspiration, CXR may be required; call for review by paediatric registrar or consultant

### ***Paradoxical excitement***

- Do not attempt further drug dose
- Discuss with anaesthetist. If unavailable that day, reschedule procedure for later date under general anaesthetic

# IV FLUID THERAPY • 1/1

For previously well children aged 1 month–16 yr (excluding renal, cardiac, endocrinology, diabetic ketoacidosis and acute burns patients). See <https://www.nice.org.uk/guidance/ng29>





# LONG LINE INSERTION • 1/3

## INDICATIONS

- Midlines for patients where proposed IV therapy is 5–14 days duration and not requiring central administration
- Peripherally inserted central catheter (PICC)
- for drugs that have to be given centrally (e.g. if they cause phlebitis)
- if risk of infection high (e.g. parenteral nutrition)
- for access >14 days

## EQUIPMENT

- Assistant
- Midline:
  - Leaderflex 22 G (2.5 F) line 8 or 20 cm
- PICC:
  - Vygon PICC 3, 4 or 4.5 F 60 cm Lifecath (expert silver coated)
  - Vygon Nutriline 2, 3 or 4 F 30 cm
  - Vygon Neocath or Epicutaneo-cave catheter 2 F (23 G) 15, 30 or 50 cm has different insertion technique, not recommended except neonates

**DO NOT ATTEMPT INSERTION UNLESS YOU ARE FULLY TRAINED**  
**Use whichever line you have been trained to use**

- Flush solution: sodium chloride 0.9% 5 mL
- Single dressing pack
- Sterile gloves
- Sterile scissors
- 2 extra sterile towels
- 5 mL syringe/green needle
- Tape measure
- Sterile clear dressing (e.g. Opsite<sup>®</sup>/Tegaderm<sup>®</sup>)
- Incontinence pad
- 2 extra packs gauze swabs
- chlorhexidine 2% in 70% alcohol, or if aged <8 weeks aqueous chlorhexidine (or iodine if allergic to chlorhexidine)
- 1 injectable bung
- 3 wide Steri-strips<sup>®</sup> (optional to secure line)
- Sterile untoothed forceps (to feed line up butterfly)

## PROCEDURE

### PICC line preparation

- Check patient's notes for comments about previous line insertions. Some veins can be particularly difficult and patient can often provide guidance
- Assess whether patient will need sedation. Rarely, children with needle phobia will need the line inserted under general anaesthetic. Arrange appropriate person to administer sedation
- If necessary, shave arm to avoid hair plucking when dressing removed
- Specify exactly where you would like topical local anaesthetic cream sited. Basilic vein (medial) is usually best. Apply anaesthetic cream to chosen veins (3 sites) at least 1 hr before starting procedure
- A BP cuff inflated to 80 mmHg is a more reliable tourniquet than either an elastic strip or a nurse's squeeze
- Check whether blood samples are required
- Gather all necessary equipment including a spare line (unopened)

### Consent

- Explain procedure and reassure patient
- Obtain and record consent

### Premedication and position of patient

- Position patient seated in chair or lying with his/her arm stretched out and supported by table or bed (on a utility drape)

# LONG LINE INSERTION • 2/3

- ensure patient in position and comfortable, and lighting optimal
- Measure distance from site of insertion to sternal notch (if inserting in arm) or umbilicus (if inserting in leg) so catheter tip is placed outside heart (for upper limb lines tip in SVC at junction with atrium)

## Sterile technique

- Wash hands, and put on apron/gown and sterile gloves
- Clean patient's skin thoroughly with alcoholic chlorhexidine and allow to dry in area of planned insertion
- Drape sterile sheet to expose only chosen vein, and cover surrounding areas to provide working room and a flat surface on which to rest your line, forceps and flush

## Lifecath or Nutriline PICC line

- Assemble line fully and flush with sodium chloride 0.9% 1 mL to ensure patency
- Lifecath can be cut to desired length
- Place everything you will need onto sterile sheet within reach
- Ask assistant to apply tourniquet (or squeeze patient's arm), but remain ready to release
- Check patient is ready for you to start
- Be careful: introducer for the PICC line is **much stiffer** than a standard cannula and more likely to perforate the entire vein
- Insert peelable cannula until blood flowing freely (it is not necessary to thread needle into vein) in some patients this will come quite quickly so have catheter ready
- Ask assistant to release tourniquet to reduce blood flow
- Taking the PICC line in forceps, pass it up through cannula. At about 5 cm, you will reach tip of the cannula. If line passes easily beyond 6 cm, you have probably succeeded. Resistance at any point usually indicates failure to thread vein, or curling of line. Rotating butterfly needle so that the bevel faces downwards may help to introduce line into vein if it will not thread more than 5 cm
- Insert line to previously measured distance from site of insertion
- When tip of line is judged to be in correct position, carefully withdraw sheath and remove from around line by pulling apart the two blue wings
- Pressing firmly on insertion site with a piece of gauze, remove cannula
- Without releasing pressure on entry site (it may bleed for a few minutes), reassemble line and flush with sodium chloride 0.9% 2 mL
- With sterile scissors, cut rectangle of gauze (1 x 2 cm) to prevent hub of line rubbing skin
- Check all connections are firmly tightened. Coil any unused line next to insertion site and secure with Steri-strips<sup>®</sup>
- Cover entry site, connections and all exposed line with one piece of clear dressing (e.g. Opsite<sup>®</sup>)
- X-ray line with 0.5 mL of contrast (e.g. Omnipaque 240) in the line to check tip position if near heart or if no blood flushes back up line. Do not draw blood back up line (this increases risk of line blockage)
- Flush once more and line is then ready to use

## Leaderflex lines

- These are inserted using Seldinger technique
- Cannulate target vein with either needle provided or a blue cannula
- Feed guidewire into vein through cannula sheath and remove sheath leaving wire *in situ*
- Feed line over guidewire and into vein with a gentle twisting action. It is important that, at any time, operator is able to grasp directly either free end of wire or wire itself as it passes through skin, to ensure that it does not pass entirely into vein
- Remove guidewire and secure line in place
- It is not necessary to verify position of 8 cm lines radiologically

**Use an aseptic technique when accessing the system or for dressing changes**

## AFTERCARE

- Place a folded half gauze swab under the blue hub before taping down with adhesive, then cover with transparent dressing, minimising contact between gauze and transparent dressing in case removal is required for troubleshooting
- Flush after each use with sodium chloride 0.9% 2 mL in 10 mL syringe (or bigger) using a pulsed, push-pause technique, and clamped whilst flushing to create positive pressure in the line
- Use heparin 100 units/mL to line lock if line accessed less than every 7 days
- Change dressings and bungs every 7 days (sooner if visibly soiled or coming away)

## LONG LINE INSERTION • 3/3

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- Maintain aseptic technique for accessing system and dressing changes. Before accessing system, disinfect hub and ports with disinfectant compatible with catheter (e.g. alcohol or povidone-iodine)
- Assess site at least daily for any signs of infection and remove if signs of infection are present (only short-term CVCs)
- Replace administration sets every 12 hr for blood (or on completion of transfusion), 24 hr for TPN and others 96 hr. Routine catheter replacement is unnecessary
- Assess need for device daily and remove as soon as possible
- Document insertion and all interventions in patient notes

# PRE-OPERATIVE FASTING • 1/1

## PRINCIPLES

- Do not fast patients for longer than necessary for their safety under general anaesthesia
- Do not deny fluids for excessively long periods; allow patients to drink within these guidelines
- Use theatre time efficiently

***Ideally give all children (especially those aged <2 yr) clear fluids up to 2 hr pre-operatively. Liaise closely with theatre to discover approximate time of patient's operation***

## POLICY

- Solid food and milk (including formula) up to 6 hr before elective surgery
- Breast milk up to 4 hr before elective surgery
- Encourage patients to take clear oral fluids up to 2 hr before elective surgery. Thereafter, sips of water may be taken to enable tablets to be swallowed
- clear fluids do **not** include fizzy drinks

## PROCEDURE

### All children aged ≥1 yr

#### ***Morning operating lists***

- No solid food after midnight
- Water or diluted squash to finish before 0630 hr

#### ***Afternoon operating lists***

- Light breakfast (including toast, or small bowl of cereal), to finish before 0700 hr
- Water or diluted squash to finish before 1100 hr

### Infants/children aged <1 yr

#### ***Morning operating lists***

- Last formula milk feed before 0230 hr
- Last breast milk feed before 0430 hr
- Water or diluted squash to finish before 0630 hr

#### ***Afternoon operating lists***

- Last formula milk feed before 0700 hr
- Last breast milk feed before 0900 hr
- Water or diluted squash to finish before 1100 hr

***Nursing and medical staff should ensure that all children are encouraged to drink clear fluids (e.g. water or diluted squash) until 2 hr before anaesthesia/surgery***

# MONITORING EX-PREMATURE INFANTS POST GENERAL ANAESTHETIC • 1/1

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- Risk of apnoea after general anaesthetic (GA)
- increased if anaemic
- with chronic lung disease who have required oxygen treatment within last 6 months

## MANAGEMENT

### Pre-operative

- Check haemoglobin
- if Hb <90 g/L, arrange transfusion
- Arrange overnight stay for post-operative monitoring if:
  - full term ( $\geq 37$  weeks), and aged <1 month
  - preterm (<37 weeks), and <60 weeks post-conceptual age
- Overnight stay may also be at discretion of anaesthetist and surgeon

### Immediate post-GA period

- Transfer patient with oxygen supply, continuous SpO<sub>2</sub> monitoring and full resuscitative equipment
- Admit patient to a designated HDU ward area

### Subsequent post-GA management

- High dependency nursing care
- Monitoring to include:
  - continuous pulse oximetry
  - continuous ECG
  - continuous respiratory rate
  - transcutaneous CO<sub>2</sub>
- If apnoea >15 sec:
  - immediate respiratory support by nurse (airway manoeuvres, bag and mask ventilation)
  - contact on-call paediatric SpR, or resident anaesthetist in charge
  - liaise with anaesthetist responsible for patient
  - review period of HDU care

## DISCHARGE AND FOLLOW-UP

- Discharge patient home same day or next day providing there have been no apnoeic episodes

# POST-OPERATIVE NAUSEA AND VOMITING AGED >2 YR • 1/1

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## AT RISK

- History of travel sickness or post-operative nausea/vomiting
- Pre-operative pain
- Opioid analgesics
- Post pubertal girls
- >30 min surgery

### Prophylaxis

- Ondansetron 100 microgram/kg (max 4 mg) IV over 3–5 min OR
- Ondansetron oral:
  - <10 kg: 2 mg
  - ≥10 kg: 4 mg

## HIGH RISK

- Tonsillectomy
- Adenoidectomy
- Strabismus surgery

### Prophylaxis

- Ondansetron 100 microgram/kg IV over 3–5 min AND
- Dexamethasone 150 microgram/kg IV over 3–4 min

## PERSISTENT NAUSEA/>1 EPISODE VOMITING

### Ondansetron within last 8 hr

- Dexamethasone 150 microgram/kg IV slowly
- if history of motion sickness and symptoms persist: cyclizine 1 mg/kg IV slowly OR
- P6 acupressure

### No ondansetron within last 8 hr

- Ondansetron 100 microgram/kg (max 4 mg) IV over 3–5 min OR
- Ondansetron oral:
  - <10 kg: 2 mg
  - ≥10 kg: 4 mg

## STIMULATION OF P6 ACUPUNCTURE POINT

- P6 acupressure point:
  - 1/6 distance from wrist crease to elbow crease/2–3 finger breadths proximal to wrist crease, between the 2 prominent tendons in centre of forearm
- Apply gentle pressure with finger-tip

# ASTHMA – ACUTE MANAGEMENT • 1/5

## RECOGNITION AND ASSESSMENT

### Definition

- Asthma is a chronic inflammatory disorder of the airways with reversible obstruction

***In children aged <2 yr who have an initial poor response to  $\beta_2$  agonists administered with adequate technique, continue treatment if severe (see definition below), but consider alternative diagnosis and other treatment options***

### Symptoms and signs

- Breathlessness
- Wheeze
- Cough
- Nocturnal cough
- Tight chest
- Bilateral wheeze
  
- Symptoms and signs tend to be:
  - variable
  - intermittent
  - worse at night
  - provoked by triggers, including exercise

### Mild/moderate

- Normal vital signs
- Mild wheeze
- Speaks in complete sentences or feeding
- SpO<sub>2</sub> >92% in air
- PEF >50% in patient aged ≥5 yr

### Severe

- Too breathless to talk/feed
- Tachypnoea
  - aged <5 yr: >40 breaths/min
  - aged 5–12 yr: >30 breaths/min
  - aged 12–18 yr: >25 breaths/min
- Tachycardia
  - aged <5 yr: >140 beats/min
  - aged 5–12 yr: >125 beats/min
  - aged 12–18 yr: >110 beats/min
- Use of accessory muscles, recession subcostal and intercostal, flaring of alae nasi
- SpO<sub>2</sub> <92% in air
- Peak expiratory flow (PEF) ≤50% predicted/best

### Life-threatening

- Cyanosis/pallor
- Decreased air entry/silent chest
- Poor respiratory effort
- Altered conscious level
- Irritable/exhausted
- SpO<sub>2</sub> <92% in air
- PEF ≤33% in those aged ≥5 yr

***Patients with severe or life-threatening attacks may not be distressed and may not have all these abnormalities. Presence of any one of these should alert doctor***

### Differential diagnosis

- Foreign body
- Pneumonia

# ASTHMA – ACUTE MANAGEMENT • 2/5

- Pneumothorax
- Aspiration
- Cystic fibrosis
- Tracheobronchomalacia
- Gastro-oesophageal reflux

## Assessment

- Record:
  - respiratory rate and effort
  - recession
  - heart rate
  - air entry
  - oxygen saturation in air
  - if  $\geq 5$  yr, peak expiratory flow (PEF)
  - conscious level
  - CXR if severe and life threatening sign/symptoms, and when patient does not improve with medical management

***Do not take any samples for routine blood tests or routine blood gases.  
Routine CXR is unnecessary in a child with asthma***

## IMMEDIATE TREATMENT

- Follow algorithm **Management of acute wheezing in children**
- Prescribe oxygen on drug chart if required

### Senior assessment

If you are worried about child's conscious level or there is no response to nebulised salbutamol or poor respiratory effort:

- Call senior doctor for further assessment
- Site an IV line
- Initial dose of salbutamol IV over 5 min
  - aged  $< 2$  yr: 5 microgram/kg
  - aged  $> 2$  yr: 15 microgram/kg (max 250 microgram)
- Using 500 microgram/mL injection preparation dilute to a concentrate of 50 microgram/mL with sodium chloride 0.9%
  - e.g. withdraw 250 microgram = 0.5 mL and make up to a total volume of 5 mL using sodium chloride 0.9% = 250 microgram in 5 mL

### Not responding within 15 min

- Salbutamol 1–2 microgram/kg/min continuous infusion
  - use 1 mg/mL solution for IV infusion dilute 10 mg (10 mL) to concentration of 200 microgram/mL made up to 50 mL with sodium chloride 0.9%
  - If not responding increase up to 5 microgram/kg/min for 1 hr then reduce back to 2 microgram/kg/min
  - If requiring  $> 2$  microgram/kg/min admit to HDU or PICU depending on severity of illness
- Use TcCO<sub>2</sub> monitor
- Continue with high flow oxygen and continuous salbutamol nebuliser while waiting

### Drug doses

- Salbutamol nebulised, driven by 6–8 L/min oxygen:
  - aged  $< 5$  yr: 2.5 mg
  - aged  $> 5$ –12 yr: 2.5–5 mg
  - aged  $> 12$  yr: 5 mg
- Ipratropium bromide (Atrovent<sup>®</sup>) nebulised:
  - aged  $< 12$  yr: 250 microgram
  - aged  $> 12$  yr: 500 microgram
- Prednisolone 0.5 mg/kg oral (round up to nearest 5 mg):
  - aged  $< 2$  yr: max 10 mg once daily



# ASTHMA – ACUTE MANAGEMENT • 3/5

- aged 2–5 yr: max 20 mg once daily
- aged >5 yr: max 30 mg once daily
- if on oral corticosteroids for more than few days give: prednisolone 2 mg/kg (max 60 mg) for 5 days
  
- Hydrocortisone slow IV injection:
  - aged <2 yr: 4 mg/kg (max 25 mg) 6-hrly
  - aged 2–5 yr: 50 mg 6-hrly
  - aged 5–18yr: 100 mg 6-hrly
  
- Magnesium sulphate IV injection over 20 min (aged 2–17 yr): 40 mg/kg single dose (max 2 g)
  
- Do not give antibiotics routinely
- If high prevalence of influenza with fever, coryza, generalised symptoms (headache, malaise, myalgia, arthralgia) give oseltamivir

## Monitoring

If on nebulised or IV salbutamol:

- Record heart rate and respiratory rate every 10 min
- Continuous SpO<sub>2</sub>
- Cardiac monitoring
- Baseline U&Es
- Capillary blood gas and lactate
- 12-hrly potassium (for hypokalaemia)

## SUBSEQUENT MANAGEMENT

Follow algorithm **Management of acute wheezing in children**

### Previous history

- When recovering, ask about:
  - previous episodes of wheeze, similar episodes
  - triggering factors, seasonal variation
  - nocturnal cough
  - family history of asthma, hay fever, eczema, other atopy
  - smokers in the family (including child)
  - days off school because of asthma
  - number of courses of prednisolone used in last year
  - pets
  - drug history (device and dose) especially any bronchodilators/inhaled corticosteroids and their effect, particularly need to use beta-agonists

## DISCHARGE AND FOLLOW-UP

### Discharge criteria

- SpO<sub>2</sub> in air >94%
- Respiratory rate:
  - aged <5 yr: <40 breaths/min
  - aged 5–12 yr: <30 breaths/min
  - aged 12–18 yr: <25 breaths/min
- Heart rate:
  - aged <5 yr: <140 beats/min
  - aged 5–12 yr: <125 beats/min
  - aged 12–18 yr: <110 beats/min
- Peak flow: ≥75% predicted/best
- Stable on 4-hrly treatment

### Discharge home same day if:

- Child has made a significant improvement and has remained stable for 4 hr
- Parents:
  - understand use of inhalers
  - have a written personal asthma action plan

# ASTHMA – ACUTE MANAGEMENT • 4/5

- have a written discharge/weaning salbutamol information leaflet
- know how to recognise signs of deterioration and the actions to take

## Discharge treatment

- Prescribe beta-agonist with spacer (e.g. Volumatic) with mask for <3 yr
- Give prednisolone daily for 3–5 days (if already on oral prednisolone maintenance therapy speak to respiratory consultant/nurse)
- Educate on use of PEF meter if aged >6 yr (not if child has never used one before)
- Prescribe or adjust dose of previously prescribed preventer as appropriate
- Inhaled corticosteroids not required for recurrent viral induced wheeze
- Discuss follow-up in either nurse-led asthma clinic or consultant clinic
- Advise follow up with GP ≤48 hr
- Refer smokers to suitable agencies
- Identify trigger of acute attack and discuss future management plan for exposure
- Arrange follow up:
  - primary care services ≤48 hr
  - paediatric asthma clinic within 1–2 months
- If there have been life-threatening features refer to paediatric respiratory specialist

## Chronic management

- Give inhaled corticosteroid if any of following:
  - frequent episodes
  - bronchodilators used most days (>3 days/week)
  - nocturnal and/or exercise-induced symptoms
  - other atopic symptoms and strong family history of atopy
- If recurrent upper respiratory tract problems or allergic rhinitis triggering attacks, give oral antihistamines +/-steroid nasal spray

# ASTHMA – ACUTE MANAGEMENT • 5/5

## Algorithm: Management of acute wheezing in children

### Assessment

#### MILD/MODERATE

Normal vital signs  
Mild wheeze  
Speaking in complete sentences or feeding  
SpO<sub>2</sub> >92% in air  
PEF >50% in those aged ≥5 yr

Salbutamol MDI 2–10 puffs (200–1000 microgram) via large volume spacer (LVS) +/- face mask  
Oxygen if SpO<sub>2</sub> <94% in air  
Once daily oral prednisolone, if on maintenance therapy, discuss with respiratory consultant/nurse

- Aged <2 yr = max 10 mg once daily
- Aged 2–5 yr = max 20 mg once daily
- Aged >5 yr = max 30 mg once daily

RE-ASSESS EVERY 15–30 MIN

#### DISCHARGE CRITERIA MET

SpO<sub>2</sub> >94% in air

Age	Respiratory rate	Heart rate
<5 yr:	<40 breaths/min	<140 beats/min
5–12 yr:	<30 breaths/min	<125 beats/min
12–18 yr:	<25 breaths/min	<110 beats/min

Peak flow ≥75% predicted/best  
Stable on 4-hrly inhaled treatment

YES

#### DISCHARGE HOME

Continue once daily oral prednisolone, complete a 3 day course  
Review long-term asthma control + treatment

- Check inhaler technique
- Provide personal asthma action plan
- Agree follow-up plan
- Complete respiratory discharge letter

DISCHARGE

#### SEVERE

Too breathless to talk/feed  
SpO<sub>2</sub> <92% in air  
Use of accessory muscles

Age	Respiratory rate	Heart rate
<5 yr:	>40 breaths/min	>140 beats/min
5–12 yr:	>30 breaths/min	>125 beats/min
12–18 yr:	>25 breaths/min	>110 beats/min

Peak flow ≤50% predicted/best

High flow oxygen via mask or nasal cannula  
Salbutamol MDI 10 puffs (1000 microgram) via LVS +/- facemask, or:  
Salbutamol nebulised, driven by 6–8 L/min oxygen:

- aged <5 yr: 2.5 mg
- aged >5–12 yr: 2.5–5 mg
- aged >12 yr: 5 mg

If poor response, give ipratropium bromide nebulised:

- Aged <12 yr = 250 microgram
- Aged >12 yr = 500 microgram

Once daily oral prednisolone, if on maintenance therapy, discuss with respiratory consultant/nurse

- Aged <2 yr: max 10 mg once daily
- Aged 2–5 yr: max 20 mg once daily
- Aged >5 yr: max 30 mg once daily

If oral steroids not tolerated give hydrocortisone by slow IV injection

- Aged <2 yr: 4 mg/kg (max 25 mg) 6-hrly
- Aged 2–5 yr: 50 mg 6-hrly
- Aged 5–18 yr: 100 mg 6-hrly

DISCHARGE CRITERIA MET

NO

#### ADMIT

Continue high flow oxygen via mask/nasal cannula  
Nebulised salbutamol ¼–4 hrly  
Repeat ipratropium bromide. If poor response, give every 20–30 min for first 2 hr

REASSESS FREQUENCY OF BRONCHODILATOR THERAPY

SYMPTOMS IMPROVING

#### LIFE-THREATENING

Assess ABC  
Cyanosis/pallor  
Silent chest  
Poor respiratory effort  
Altered consciousness  
SpO<sub>2</sub> <92% in air  
Irritable/exhausted  
PEF ≤33% in those aged ≥5 yr

Inform on-call consultant and PICU  
High flow oxygen via mask/nasal cannula  
Continuous salbutamol nebulised, driven by 6–8 L/min oxygen

Ipratropium bromide nebulised:

- Aged <12 yr = 250 microgram
- Aged >12 yr = 500 microgram

Hydrocortisone by slow IV injection

- Aged <2 yr: 4 mg/kg (max 25 mg) 6-hrly
- Aged 2–5 yr: 50 mg 6-hrly
- Aged 5–18 yr: 100 mg 6-hrly

If signs of shock, sodium chloride 0.9% 20 mL/kg IV bolus

Consider anaphylaxis

NO IMPROVEMENT

REASSESS

SYMPTOMS IMPROVING

NO CHANGE WORSENING

Continuous nebulised salbutamol  
Repeat ipratropium bromide. If poor response, give every 20–30 min for first 2 hr

Salbutamol IV (see Salbutamol infusion)  
Consider magnesium sulphate IV  
Blood gas  
Chest X-ray

SYMPTOMS IMPROVING

### Check

#### Has patient received:

- Continuous salbutamol nebulised?
- Ipratropium bromide nebulised?
- Hydrocortisone IV?

Is patient still not improving/worsening and meets severe/life-threatening criteria?

YES

#### SALBUTAMOL BOLUS

- Aged 1 month–2 yr: 5 microgram/kg
- Aged 2–18 yr: 15 microgram/kg (max 250 microgram)

Using 500 microgram/mL injection preparation, dilute to a concentration of 50 microgram/mL with sodium chloride 0.9% (e.g. withdraw 250 microgram = 0.5 mL and make up to a total volume of 5 mL using sodium chloride 0.9% = 250 microgram in 5 mL). Calculate dose per kg as above and administer as a slow bolus over 5 min

#### MONITORING

- Record heart rate and respiratory rate every 10 min
- Continuous SpO<sub>2</sub> and CO<sub>2</sub> monitoring
- ECG monitoring
- Baseline U&E (capillary blood gas for potassium)

REASSESS

IMPROVING

NO

#### SALBUTAMOL INFUSION

Using 1 mg/mL solution for IV infusion dilute to a concentration of 200 microgram/mL with sodium chloride 0.9% [e.g. take 10 mg (10 mL) of 1 mg/mL solution for IV infusion and make up to 50 mL with sodium chloride 0.9% = 200 microgram/mL solution]

Infuse at 60–300 microgram/kg/hr = 0.3 mL/kg/hr–1.5 mL/kg/hr when using 200 microgram/mL solution

- If >2 microgram/kg/min in PICU

#### MONITORING

- Continuous SpO<sub>2</sub> and CO<sub>2</sub> monitoring
- ECG monitoring
- Repeat bloods at 2 hr, 4 hr, then 4-hrly

# BRONCHIOLITIS • 1/3

## RECOGNITION AND ASSESSMENT

### Definition

- Acute viral inflammatory illness of small airways that occurs in winter epidemics and affects children aged <2 yr, with peak incidence at around 6 months

### Symptoms and signs

- Coryzal symptoms for 2–5 days before presentation
- Cough (sometimes paroxysmal)
- Intermittent wheeze
- Irritability and poor feeding
- Mild pyrexia – rarely higher than 38.5°C
- Respiratory distress with progressive tachypnoea, flaring of alae nasi and intercostal recession
- Apnoea or hypoventilation
- Hyperinflated chest on examination
- Widespread fine crackles and wheeze over both lung fields

### Differential diagnosis

- Recurrent viral-induced wheeze
- Early asthma
- Cystic fibrosis
- Pertussis
- Recurrent aspiration
- Foreign body in trachea
- Congenital lung anomaly

### Investigations

- SpO<sub>2</sub> while breathing air
- Capillary blood gas if:
  - respiratory rate >80 breaths/min
  - transcutaneous PCO<sub>2</sub> >6 kPa
  - SpO<sub>2</sub> <92% in >50% inspired oxygen
  - severe respiratory distress
- Avoid tests that do not contribute to immediate management. Perform following only for specific indications:
  - viral nose swab for respiratory virus PCR
    - when flu prevalence high. Prescribe oseltamivir if admission required
    - in severely immunocompromised patient to plan antiviral treatment
  - CXR if there are localising signs, cardiac murmur or atypical presentation (e.g. aged >18 months)
  - U&E if there is a plan for IV fluids
  - blood cultures if signs of sepsis or temperature >38.5°C

## IMMEDIATE TREATMENT

- Nurse in cubicle, or in bay with children with same diagnosis
- Strict hand washing to support infection control and use apron for patient contact
- Nurse head up to reduce splinting of diaphragm
- Clear airway by careful suction of nares and mouth
- Use sodium chloride 0.9% nose drops before suction

### Respiratory

- If oxygen saturation ≤92% in air, prescribe oxygen via face mask with a reservoir bag
- if mask not tolerated, use nasal prongs for oxygen flow up to 1 L/min in children ≤5 kg body weight or up to 2 L/min in children >5 kg
- use heated humidified oxygen if available
- In patients with impending respiratory failure
- SpO<sub>2</sub> <90% in >50% oxygen or in 2 L/min oxygen via nasal prongs, or cyanotic episodes despite supplemental oxygen (except cyanotic congenital heart disease)
- review hourly
- consider additional respiratory support with humidified high flow nasal cannula oxygen (2 L/kg/min, maximum 20 L/min). Review <1 hr: treatment effective if heart and respiratory rate reduced

# BRONCHIOLITIS • 2/3

- Consider additional respiratory support with CPAP if:
  - no response to humidified high flow oxygen
  - respiratory rate >60 breaths/min or bradypnoea
  - severe intercostal recession
  - rising PaCO<sub>2</sub> (>3 kPa from baseline)
  - respiratory acidosis (pH <7.20)

## Circulation and hydration

- Assess circulation and treat shock if present
- Correct dehydration if present
- Use IV fluids if oral fluids not tolerated or significantly increased work of breathing
- restrict intake to 80% of estimated maintenance requirements (see **IV fluid therapy** guideline) using sodium chloride 0.9% in glucose 5% with 10 mmol potassium chloride per 500 mL
- check U&E at least once every 12 hr while giving intravenous fluids (more frequently if abnormal), and adjust volume and potassium content accordingly

## Feeds

- Normal feeds (breast, bottle, solids) if tolerated
- NG tube feeds if:
  - oral intake by normal route insufficient **and**
  - airway protective reflexes test normal on suctioning **and**
  - patient well enough to tolerate NG feeds
- IV fluids (as above) if:
  - persistent respiratory rate >80 breaths/min
  - persistent vomiting
  - oxygen saturation <92% despite supplemental oxygen
  - deterioration of respiratory status during nasogastric feeding
  - marked increase in work of breathing with poor coordination of sucking, swallowing and breathing

## Drug treatment

- In immunocompetent patients, drug treatment and physiotherapy (in acute phase) are ineffective. **Do not routinely prescribe** salbutamol, ipratropium bromide (Atrovent<sup>®</sup>), adrenaline, antibiotics or corticosteroids
- For babies aged <6 weeks or patients with temperature >39°C, discuss antibiotics with consultant
- If symptoms <48 hr and influenza test positive (or high prevalence influenza) and risk factors (chronic respiratory, renal, liver, neurological or cardiovascular disease, diabetic or immunocompromised) prescribe oseltamivir

## Criteria for admission

### Absolute

- Apnoea
- Underlying cardiac defects, especially large left to right shunt
- SpO<sub>2</sub> <92% in air in a child in the early phase of the illness
- Inadequate feeding (<75% of normal)
- Dehydration
- Diagnostic uncertainty

### Relative

- Re-attends A&E or CAU in <48 hr
- Aged <6 weeks (corrected gestational age)
- Difficult family circumstances and impaired ability to care for unwell child
- Younger children (i.e. aged <6 months), presenting earlier in illness (<3 days symptoms)
- Pre-existing lung disease, including chronic lung disease, ex-preterm, cystic fibrosis: inform speciality consultant
- Other pre-existing chronic disease (e.g. neurodegenerative)

## MONITORING TREATMENT

- Standard nursing observations
- Continuous oxygen saturation monitoring if patient requires supplemental oxygen

## **BRONCHIOLITIS • 3/3**

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- Transcutaneous CO<sub>2</sub> monitoring (if available) if SpO<sub>2</sub> <90% in nasal prongs oxygen at 2 L/kg/min (approximately ≥60% oxygen) or has history of apnoea or colour changes
- Continuous heart and respiratory rate monitoring if patient requires additional respiratory support

### **SUBSEQUENT MANAGEMENT**

- Fluid balance
- Oxygen support:
  - test the need for support 6-hrly
  - keep oxygen saturation ≥92% in recovery phase
  - wean from nasal prongs to air as tolerated

### **DISCHARGE AND FOLLOW-UP**

- Discharge home when:
  - fully fed orally
  - SpO<sub>2</sub> >92% in air
- Hospital follow-up if:
  - ventilated on PICU
  - consolidation on CXR (first reassess clinically, do not request 'routine' follow-up X-ray)
  - ex-preterm with chronic lung disease
- GP follow-up in all other cases

# CROUP • 1/2

## DEFINITION

- Acute viral inflammation of upper airway causing oedema of larynx and trachea and presenting with barking cough, stridor and respiratory distress
- Causative agent: parainfluenza virus (sometimes influenza, respiratory syncytial virus, rhinovirus)

### Aetiology

- Aged 6 months–6 yr (peak age 2 yr)
- Seasonal peak: Spring and Autumn
- Transmission: usually by droplet spread
- Incubation period 2–6 days

### Differential diagnosis of stridor

#### Acute

- Croup
- Epiglottitis (rare since immunisation against *Haemophilus influenzae* type B)
- Bacterial tracheitis
- Foreign body

#### Chronic

- Allergic airways disease
- Congenital abnormality e.g. laryngeal haemangioma
- Laryngomalacia
- Foreign body
- Laryngeal papilloma

## CROUP

### Symptoms and signs

- Preceding coryzal illness
- Fever
- Harsh bark/seal-like cough
- Hoarse voice
- Inspiratory stridor
- Symptoms worse at night
- Child does not look toxic

### Assessment

- Record croup severity:
  - C – Cyanosis
  - R – Recession of chest
  - O – Oxygen saturations (keep >92%)
  - UP – Upper airway obstruction e.g. stridor
- Respiratory rate
- Heart rate
- Level of consciousness
- **Do not examine throat as it may cause acute severe/total obstruction**
- Do not distress child
- Any clinical concerns call consultant paediatrician immediately

### Severity

#### Mild croup

- Barking cough
- Mild stridor
- No recession
- No cyanosis

#### Moderate croup

- Intermittent stridor at rest
- Mild recession
- Alert and responsive

# CROUP • 2/2

## **Severe croup**

- Stridor at rest
- Cyanosis
- Oxygen saturation <92% in air
- Moderate to severe recession
- Apathetic/restless

## **Investigations**

- No investigations necessary, do not attempt to take blood or put in cannula
- If diagnosis unclear, or child severely unwell, call consultant as an emergency measure

## **IMMEDIATE MANAGEMENT**

### **Mild to moderate croup**

- Analgesia e.g. paracetamol or ibuprofen for discomfort
- Adequate fluid intake
- Leaflet on croup and reassurance
- Oral dexamethasone 150 microgram/kg
- Admit/observe moderate croup for 4 hr and reassess
- Dexamethasone dose can be repeated after 12 hr or if well, patient can be discharged with a single dose of prednisolone 1 mg/kg rounded up to nearest 5 mg to take 12–24 hr later

***If parents do not clearly understand what to do, do not discharge***

### **Severe croup**

- Keep child and parents calm: do not upset child e.g. by forcing oxygen mask onto face or examining throat; nurse on parents lap and in position they find comfortable
- Nebulised adrenaline 400 microgram/kg to max 5 mg (0.4 mL/kg to max 5 mL of 1:1000 injection) relieves symptoms, but short duration of action: repeat after 30 min if necessary; if given before discharge observe for at least 3 hr
- Dexamethasone 150 microgram/kg oral (or if child refuses to swallow oral medication, nebulised budesonide 2 mg)
- High flow oxygen 15 L/min via mask with reservoir bag which must be prescribed
- Contact on-call consultant paediatrician urgently to assess clinical situation
- discuss whether to involve on-call paediatric anaesthetist and ENT surgeon
- If no sustained improvement with adrenaline and dexamethasone:
  - secure airway in theatre by experienced anaesthetist
  - transfer to PICU

## **DISCHARGE AND FOLLOW-UP**

- Leaflet on croup
- Antibiotics, antitussives and humidified air do not help
- Encourage oral fluid intake
- Advise parents to seek help urgently if any of the following are present:
  - drooling
  - laboured breathing
  - persistent fever
  - biphasic/worsening stridor
  - cyanosis
  - reduced level of consciousness/confusion
- No need for follow-up of croup



# CYSTIC FIBROSIS – ADMISSION • 1/2

## ARRANGING ADMISSION

- Elective – via CF nurse specialist and ward sister
- Refer to admission plan in notes or clinic letter
- Always admit to a cubicle

## ADMISSION PROCEDURE

- Plot baseline weight, height
- Perform flow volume loop spirometry on admission day (aged ≥6 yr)
- Review drug history with patient/parent/carer and last clinic letter
- Prescribe all medication
- Check whether annual bloods could conveniently be taken now (see **Annual bloods**)
- Ask nursing staff to inform physiotherapist and dietitian on day of admission
- Check specific aspects of management or investigations, as described by CF team
  - for IV antibiotics, see **Cystic fibrosis – Exacerbation** guideline
  - for bowel blockage, see **Cystic fibrosis – Distal intestinal obstructive syndrome (DIOS)** guideline

## INVESTIGATIONS

### Bloods

- If child admitted for IV antibiotics send bloods when the cannula/long-line is inserted or Port-a-cath accessed
- Send: FBC, U&E, CRP, LFT and blood cultures
- If indicated, consider screening for allergic bronchopulmonary aspergillosis (ABPA) by requesting total IgE, specific IgE to aspergillus and aspergillus precipitins

### Microbiology

- On admission, request sputum/cough swab for MC&S
- If clinically indicated consider sending nose and throat viral swabs
- Also consider sending sputum for screening for non-tuberculous mycobacterium
- Repeat sputum/cough swabs for MC&S 1–2 x per week during admission (usually performed by physiotherapist but check this has been done)
- If new pathogen found, see **Cystic fibrosis – Microbiology** guideline and cross-infection

### Chest X-ray

- If new clinical signs present when examining chest, order CXR
- Most children have CXR every 12 months, check when last one was performed; if in doubt, discuss with CF consultant
- If new CXR performed always compare with previous
- If recent CT performed review findings and discuss with CF consultant and radiologist

### Lung function and oxygen saturation

- Perform spirometry on admission, then weekly on all children who are can blow reliably (usually aged >6 yr)
  - undertaken by physiotherapist or trained nurse. If evidence of airway obstruction repeat spirometry 15 min after inhalation of salbutamol MDI 4 puffs via a spacer
- Monitor oxygen saturation overnight for first 2 nights after admission
  - if saturations <91%, prescribe oxygen via nasal cannulae or face mask

### Screening for hyperglycaemia

***About 8% of children with CF develop diabetes after age 10 yr, usually manifests as weight loss; ketoacidosis is rare***

- If taking regular oral corticosteroids, screen for glucose intolerance at admission
- During first 24 hr after admission request fingerprick blood glucose before breakfast, 1–2 hr after every meal, and at 0200 hr if on overnight feeds
- If prednisolone started or dosage increased during admission, repeat fingerprick blood glucose
- If blood glucose elevated, discuss with CF team

### Annual bloods

- All children attending CF clinics have annual blood screening
- Perform annual bloods if admission within a month of annual screening (usually at time of birthday) during insertion of a long line or Port-a-cath needle, or when checking tobramycin level

# CYSTIC FIBROSIS – ADMISSION • 2/2

## All ages

- FBC and film
- Vitamins A, D, E
- Parathyroid hormone
- U&E, CRP, LFTs, chloride, bone profile, magnesium, *Pseudomonas aeruginosa* antibodies
- Glucose

## If aged >5 yr

All of the above **plus**:

- If symptoms suggest allergic bronchopulmonary aspergillosis: total IgE, specific IgE to aspergillus and aspergillus precipitins. If diabetic, HbA<sub>1c</sub>

## If aged ≥10 yr

- Add glucose tolerance test (at 0, 60 and 120 min)

## NUTRITION

- Always involve dietitians
- Weigh twice weekly, **in nightwear** and **before breakfast** (weigh babies naked if possible)
- Continue normal supplements

## Pancreatic enzyme supplements

- Continue same type and dose of pancreatic supplement as already prescribed

## Starting dosage for newly diagnosed child

### • Infants

- Creon<sup>®</sup> Micro for children ½ scoop (2500 units lipase) to 1 scoop (5000 units lipase) per 120 mL milk or breast feed

OR

- Creon<sup>®</sup> 10,000 one-quarter (2500 units lipase) to one-half capsule (5000 units lipase) per 120 mL milk or breast feed

### • Children

- starting dose Creon<sup>®</sup> 10,000 – 2 capsules per meal, 1 capsule per snack
- Dose titrated with fat content of meals and snacks to control symptoms of malabsorption
- maximum 10,000 units lipase/kg/day, higher doses can result in colonic strictures

## Signs of malabsorption

- Fatty pale stools, frequent, smelly, orange oil, excess flatulence, abdominal pains
- discuss with CF team

## H<sub>2</sub>-receptor antagonists

- If taking large doses of pancreatic enzymes (e.g. >10,000 units lipase), discuss with CF team need for concurrent ranitidine to reduce deactivation of pancreatin

## Vitamins A, D and E

Starting dosage for newly-diagnosed

### • Infants

- 0.6 mL Dalivit<sup>®</sup> and 0.5 mL (50 mg) alpha tocopheryl acetate (Vitamin E)

### • Children

- 1 mL Dalivit<sup>®</sup> or 3 BPC multivitamin capsules and 100 mg alpha tocopheryl acetate (Vitamin E) (2 x 50 mg capsule)

OR

- continue dose as prescribed in CF clinic
- Vitamin levels are checked annually and dosage adjusted accordingly

## Oral sodium chloride

- Only if prescribed by CF team
- Often needed in first year of life after diagnosis has been made

# CYSTIC FIBROSIS – EXACERBATION • 1/2

## RESPIRATORY INFECTION/EXACERBATION

If unusual symptoms, such as haemoptysis, abdominal pain (distal intestinal obstruction syndrome), or bleeding varices, discuss urgently with CF consultant

### Symptoms and signs

- Increasing cough and sputum production
- Increasing dyspnoea
- Weight loss with loss of appetite
- Thick, tenacious sputum
- Coarse crepitations
- Haemoptysis

### Investigations

- See investigations in **Cystic fibrosis – Admission** guideline

### Differential diagnosis

- Non-CF bronchiectasis
- Chronic obliterative bronchiolitis

## ADDITIONAL ADMISSION PROCEDURE

- All admissions must be discussed with CF consultant
- Trained nursing staff needed to needle Port-a-cath
- CXR not performed routinely – request if pneumothorax or lobar collapse is suspected

## IMMEDIATE TREATMENT

- Use IV antibiotic regimen suggested following discussion with CF team
- If no discussion possible, stop oral antibiotics and start the same IV antibiotics used during the last exacerbation
- If patient has never had IV antibiotics give first-line regimen (see below)
- Take into account any past allergic reactions

### First-line regimen

- Sputum culture
- *Pseudomonas aeruginosa*: ceftazidime 50 mg/kg 8-hrly (max 3 g/dose) and tobramycin 10 mg/kg once daily (max 660 mg) given over 30 min – use ideal body weight for height to avoid overdose
- no *Pseudomonas aeruginosa*: cefuroxime 50 mg/kg 8-hrly (max 1.5 g/dose)
- Courses usually last 2 weeks
- For cephalosporins (but not tobramycin), aim to use whole vials by rounding doses +/-10% considering vial size

### Nebulised antibiotics

- Prescribe children's routine nebulised antibiotics and administer as normal. Do not start new nebulised treatment without discussion with CF team

### Oral antibiotics

**Children's routine prophylactic antibiotics should be prescribed and administered as normal during an admission, even when receiving IV antibiotics**

### Bronchodilators

- Salbutamol by MDI and spacer may be used before nebulised treatments or physiotherapy, discuss with CF team

### Inhaled corticosteroids

- There is no evidence these are of benefit. Discuss with CF team re stopping

## TOBRAMYCIN MONITORING

Once daily regimen:

# CYSTIC FIBROSIS – EXACERBATION • 2/2

- Trough level immediately before 2<sup>nd</sup> and 8<sup>th</sup> doses
- Should be <1 mmol/L
- **High levels need to be discussed with CF consultant**
- No need to determine peak
- **Always discuss dose or interval changes with CF team beforehand and ensure level taken at correct time**
- Do not check tobramycin dose via Port-a-cath or long line

## SUBSEQUENT MANAGEMENT

- Do not change antibiotics before discussing with CF team
- If no chest improvement has occurred after 1 week of IV antibiotics – consider repeat CXR

### Oral corticosteroids

- If no chest improvement after a week of IV antibiotics, consider starting 7 day course of prednisolone 1 mg/kg/day rounded to nearest 5 mg
- If already taking alternate-day prednisolone at lower dosage, review dosage needed at discharge
- For children with allergic bronchopulmonary aspergillosis (ABPA), continue prednisolone for longer (e.g. at least 1 month then wean)

### Nebulised mucolytics [dornase alfa (DNase)/hypertonic saline]

- During admission prescribe patient's routine nebulised mucolytics and administer as normal
- If thick secretions are a particular problem a new nebulised mucolytic may be started or frequency of existing treatments increased. Discuss with CF team
- discuss timing of these treatments in relation to chest physiotherapy with CF physiotherapist and patient
- Patients should bring their own nebuliser into hospital

## DISCHARGE AND FOLLOW-UP

- On advice of CF team

### Self-administration of IV antibiotics – home IV therapy

- It is appropriate in some patients for the IV antibiotic course to be completed at home
- Patients/families must receive appropriate training and achieve the necessary competences whilst on the ward
- Service managed by CF nurse in conjunction with hospital pharmacy
- Discuss fully with CF nurse before making any changes or arrangements

### *Criteria for home administration of IV antibiotics*

Ensure that:

- CF team and ward staff happy for patient to be discharged
- Patient and parents **entirely happy, confident and competent** to administer IV antibiotics at home
- Patient/parent has been assessed before discharge by CF team
- Parents have written guidelines and **24 hr** contact numbers
- If patient considered responsible enough to self-administer IV antibiotics, important that parent/carer also has adequate instruction and guidance
- Anaphylaxis kit at home and family know how to use
- Notify CF liaison nurses of any patient discharged on home antibiotic therapy so they can arrange support at home or at school if necessary
- CF liaison nurse will visit patient at home during his/her course of IV therapy, to monitor progress
- Feedback any concerns to CF team

# CYSTIC FIBROSIS – MICROBIOLOGY • 1/2

In addition to standard precautions and hand hygiene, the following precautions are required for patients infected/colonised with transmissible pathogens

- Do not share equipment between patients
- Nurse children with CF in a cubicle
- Prevent contact between CF patients

## PATIENT NEWLY DIAGNOSED WITH CF

- Prophylaxis with flucloxacillin 125 mg oral 12-hrly until aged 2 yr
- If newly diagnosed CF patient has chest infection requiring IV antibiotics:
  - commence cefuroxime IV for 2 weeks
- Subsequent treatment depends on microbiology

## PSEUDOMONAS AERUGINOSA

### First isolations in sputum or cough/throat swabs

- If asymptomatic with first isolation from sputum/cough swab:
  - ciprofloxacin: aged 1 month–18 yr 20 mg/kg oral 12-hrly (max 750 mg) for 6 weeks and nebulised colistimethate sodium aged <2 yr 1 million units 12-hrly, aged ≥2 yr 2 million units 12-hrly via nebuliser for 3 months
- If symptomatic:
  - tobramycin and ceftazidime IV for 2 weeks, followed by: nebulised colistimethate sodium at doses listed above. If organism is not successfully eradicated after 2 months of treatment consider 4 week course of nebulised tobramycin as directed by the CF team

### *Pseudomonas* chronic infection

- Defined as >50% of microbiology samples positive for *Pseudomonas aeruginosa* in previous 12 months (minimum of 4 samples)
- **Patients with chronic *Pseudomonas aeruginosa* should receive nebulised antibiotic prophylaxis. The choice of agent (colistimethate sodium/tobramycin/aztreonam) will be decided by the CF team according to clinical status and microbiology sensitivities**

## BURKHOLDERIA CEPACIA COMPLEX COLONISATION

- **Report any new cases to CF team immediately**
- Children with transmissible strains of *Burkholderia Cepacia Complex* need to be nursed in cubicle on a separate ward from other CF children
- Use **separate spirometer with disposable filters**

## MRSA COLONISATION

- **Report any new cases to CF team immediately**
- Use normal spirometer with a **disposable filter**

## CHICKENPOX AND CF

- Varicella infection can have serious consequences in immunosuppressed children
- CF patients taking oral corticosteroids are at high risk
- If no history of chickenpox and no antibodies, vaccinate

### Exposure

- Ask about exposure to a known case:
  - being in the same room (e.g. in the house, classroom or hall in school) for ≥15 min
  - face-to-face contact, for example whilst having a conversation
- If exposure significant, check notes to determine immune status (history of chickenpox or antibody status before corticosteroids)
- If non-immune and taking a high dose of oral corticosteroid (prednisolone 1 mg/kg/day for one month or 2 mg/kg/day for 1 week), and exposure occurred <96 hr earlier, request varicella-zoster immunoglobulin (VZIG) from microbiology aged <6 yr 250 mg; aged 6–10 yr 500 mg; aged 11–14 yr 750 mg; aged >15 yr 1 g, or IV immunoglobulin 0.2 g/kg
- If non-immune and taking a modest dose of oral corticosteroid (prednisolone <1 mg/kg/day) or higher dose >96 hr since exposure, give aciclovir prophylaxis 6-hrly: 10 mg/kg oral 6-hrly from 7–21 days after exposure

# **CYSTIC FIBROSIS – MICROBIOLOGY • 2/2**

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## **Infected**

- If chickenpox appears in a child not taking oral corticosteroid, give aciclovir 10 mg/kg oral 6-hrly for 7 days (IV if chickenpox severe) and a course of oral antibiotics (e.g. amoxicillin and flucloxacillin)

## **INFLUENZA AND PNEUMOCOCCAL VACCINE**

- Influenza vaccine every October
- Conjugate pneumococcal vaccine (Prevenar13®)
- Usually prescribed by patient's own GP but obtainable from pharmacy

## **PORT-A-CATH**

- Use in children requiring frequent IV antibiotics
- Manufacturer's instructions found on ward
- Observe sterile precautions whenever Vascuport accessed
- Accessed only by trained nursing staff

### **Routine flushing of Port-a-cath (usually by nursing staff)**

- Every 4 weeks (coincide with clinic appointment where possible)
- Use a straight Port-a-cath needle and 4 mL heparinised sodium chloride 0.9% 100 units/mL (e.g. Canusal®, not Hepsal®), withdrawing needle while injecting last mL

# CYSTIC FIBROSIS – DISTAL INTESTINAL OBSTRUCTION SYNDROME (DIOS) • 1/1

## RECOGNITION AND ASSESSMENT

- Faeces can accumulate in distal ileum and caecum causing varying degrees of intestinal obstruction
- Patients present with constipation, intermittent abdominal pain, abdominal distension and faecal masses
- Abdominal X-ray (AXR) may be performed to evaluate degree of bowel dilatation and obstruction
- If diagnostic doubt CT abdomen may be helpful – discuss with CF and radiology consultants

## MANAGEMENT

- If symptoms are mild, prescribe daily macrogol laxative (e.g. Movicol<sup>®</sup>) see BNFC, and encourage fluids
- Consider adjusting pancreatic enzymes – but discuss with CF team
- If unresponsive, or symptoms more severe:
  - ensure adequate pre-hydration (low threshold for IV fluids and essential for all neonates and infants) and for ≥3 hr after administration of treatment. Monitor fluid balance and allow food
- Sodium amidotrizoate (Gastrografin<sup>®</sup>):
  - aged 1 month–2 yr: 15–30 mL Gastrografin<sup>®</sup> diluted in 90 mL water or fruit juice
  - 15–25 kg: 50 mL Gastrografin<sup>®</sup> diluted in 150 mL water or fruit juice
  - >25 kg: 100 mL Gastrografin<sup>®</sup> diluted in 200 mL water or fruit juice
- The above can be given as a single dose or as 4 divided doses. If no effect after 24–48 hr or if patient deteriorates, bowel lavage with Klean-Prep<sup>®</sup> (usually requires a nasogastric tube)
- 1 sachet Klean-Prep<sup>®</sup> in 1 L water give (clear fruit cordials may be added):
  - 10 mL/kg/hr for 30 min
  - then 20 mL/kg/hr for 30 min
  - then 25 mL/kg/hr up to max total dose of 100 mL/kg or 4 L
- Start early in the morning and continue until stools are yellow, watery and free of solid matter
- 2 L in first instance, increasing to 3 or 4 L depending on response, age and size of child (most children with DIOS will be teenagers)
- Withhold food but, if success not achieved after 12 hr, stop, give an evening meal and repeat following morning
- Monitor effectiveness with plain AXR before and after lavage
- If signs of complete intestinal obstruction, stop lavage, give IV fluids and discuss contrast enema with CF team

# PNEUMONIA • 1/3

*If aged <1 month-old, refer to Neonatal guidelines*

## RECOGNITION AND ASSESSMENT

### Definition

- Inflammation and consolidation of the lung caused by a bacterial, viral or mycoplasma infection
- Absence of clinical signs **AND** negative CXR makes pneumonia unlikely
- Up to 35% of lower respiratory tract infections have single virus as causative organism
- Can be presenting illness in cystic fibrosis and immunodeficiency states

### Symptoms and signs

- Cough
- Fever
- Irritability
- Poor feeding
- Vomiting
- Tachypnoea at rest (most useful sign)

***Awake or unsettled infants can have high respiratory rate on a single measurement; measure at rest and repeat***

**Table 1: WHO definition of tachypnoea**

Age	Counted breath rate
<2 months	≥60/min
2–11 months	≥50/min
1–5 yr	≥40/min

- Bronchial breathing, inspiratory crackles
- Recession
- Abdominal pain (referred pleural pain)

### Severe pneumonia

- >1 of following:
  - temp >38.5°C
  - respiratory rate >50 (>70 infant)
    - infant: moderate – severe recession, not feeding, apnoea; severe – difficulty breathing, nasal flaring, grunting
  - cyanosis
  - tachycardia, capillary refill time >2 sec
  - signs of dehydration

### Investigations if severe

- Pulse oximetry
- CXR
- FBC, blood culture
- Serum electrolytes (may have hyponatraemia owing to SIADH), CRP
- If mycoplasma pneumonia suspected, mycoplasma titre (indicate date of onset on request form)
- Sputum if able to provide good quality specimen
- Nasopharyngeal aspirate or nasal swab in viral transport medium for respiratory viruses
- If pertussis suspected, pernasal swab in charcoal transport medium
- Pleural fluid culture and pneumococcal PCR if aspirated
- If severe pneumonia, pneumococcal antigen in urine

### Differential diagnosis

- Bronchiolitis with atelectasis (usually aged <1 yr)
- Foreign body aspiration
- Tumour ('round' pneumonia)
- Empyema/lung abscess
- Tracheobronchitis
- Whooping cough



## IMMEDIATE TREATMENT

See Flowchart

### Pleural effusion

- See **Pleural effusion** guideline

## SUBSEQUENT MANAGEMENT

- Change IV to oral within 24–48 hr
- If uncomplicated, total antibiotic course 7 days
- If complicated or staphylococcal pneumonia, treat for 14 days and 14–21 days for severe CAP
- Physiotherapy once cough productive
- important if neuromuscular impairment results in poor clearance
- Maintain hydration
- oral fluids if tolerated
- if unable to take oral fluids use sodium chloride 0.9% with glucose 5% with potassium via IV infusion
- restrict IV fluid replacement to 80% maintenance
- monitor electrolytes

## MONITORING TREATMENT

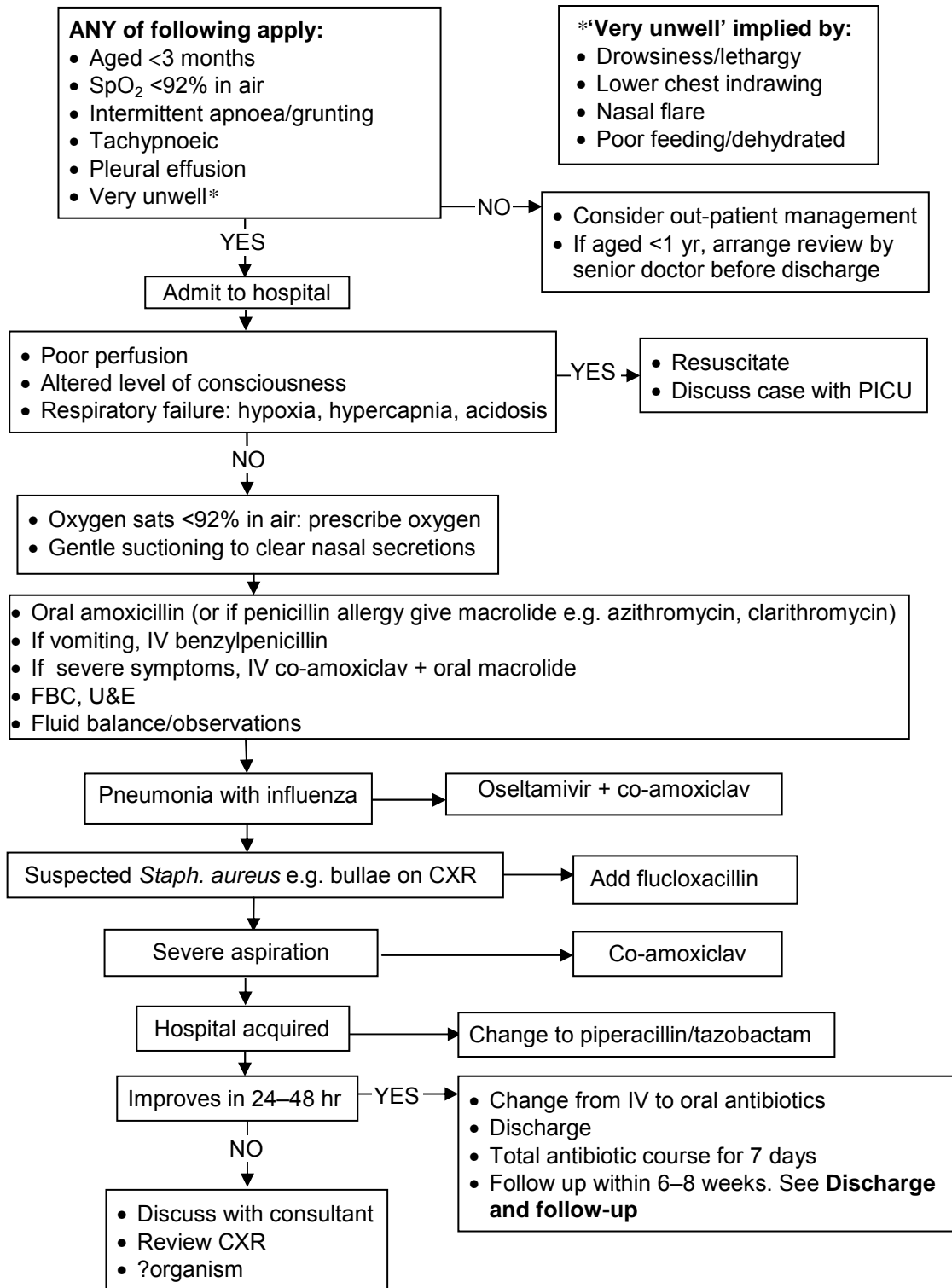
- Continuous SpO<sub>2</sub> monitoring if needing oxygen
- 1–4 hrly observation depending on severity of illness
- If no improvement in 24–48 hr, review diagnosis (repeat CXR) or treatment

## DISCHARGE AND FOLLOW-UP

- Follow-up within 6–8 weeks with CXR if:
  - lobar collapse
  - significant pleural effusion
  - 'round' pneumonia on CXR
- no radiograph follow-up needed unless symptoms persist after treatment, or initial X-rays showed unusual appearance of infection
- previous lower respiratory tract infections
- failure to thrive
- GP follow-up for all others within 6–8 weeks
- Convalescent mycoplasma titre can be obtained at this visit (indicate date of onset on request form)

# PNEUMONIA • 3/3

**Flowchart 1: Management of community acquired pneumonia in a previously well patient aged >1 month-old**



# PLEURAL EFFUSION • 1/2

## RECOGNITION AND ASSESSMENT

### Symptoms and signs

- Investigate for effusion if persistent pyrexia or unwell 48 hr after treatment started for pneumonia

### Differential diagnosis

- Uncomplicated pneumonia
- Malignancy
- Heart failure
- Pancreatitis
- Pulmonary embolism

### Investigations

- FBC, clotting screen, U&E, LDH, protein, albumin, glucose, CRP
- Blood cultures
- Sputum culture, if possible
- If recurrent infections, investigate for immune deficiency (first line: FBC, IgG, A, M, functional antibodies and HIV antibody)
- CXR PA or AP (no need for lateral)
- Ultrasound (US) scan to:
  - confirm presence of effusion
  - max depth in dependent position
  - differentiate between simple and complicated effusion (e.g. loculations, heterogeneous material)
  - localise effusion at time of drain insertion
- If history, CXR or US suggestive of malignancy, request CT chest
- If risk factors for coagulopathy or thrombocytopenia check and correct before drain insertion
- Pleural fluid analysis for:
  - Gram stain and bacterial culture
  - differential cell count
  - cytology
  - AAFB and TB PCR and culture

***If cause likely to be infective, it is not necessary to obtain sample for pleural fluid culture routinely before chest drain insertion. If alternative cause suspected, try to avoid unnecessary chest drain insertion by obtaining diagnostic aspirate of pleural fluid for cytology***

## IMMEDIATE TREATMENT

### Supportive

- ABC
- Oxygen and fluid resuscitation as indicated
- Analgesia

### Antibiotic therapy

Type of effusion suspected	Choice of antibiotics
Effusion following community-acquired pneumonia	Co-amoxiclav IV + clindamycin IV (Penicillin allergy: clindamycin IV alone)
Effusion following hospital-acquired pneumonia, trauma, aspiration or in immune-compromised child	Piperacillin/tazobactam (Penicillin allergy: clindamycin IV)
Effusion possibly tuberculous	Discuss with TB team

- Narrow antibiotic spectrum with culture results

### ***Refer to respiratory paediatrician***

- Early active treatment reduces length of illness
- Except small effusions (<2 cm deep) which are not enlarging or compromising respiratory function and do not need to be drained
- Underlying cavitating disease may lead to bronchopleural fistulae

### Chest drain insertion

- Discuss with respiratory team, consultant paediatrician, paediatric anaesthetic team (usually GA used)
- support may also be required from cardiothoracic team +/- interventional radiologist

# PLEURAL EFFUSION • 2/2

- Consider simultaneous insertion of long line during general anaesthetic, if possible
- Ensure vascular access before starting procedure
- CXR after drain insertion

## **Chest drain management**

- Ensure nursing staff trained in care of children with chest drains
- Attach chest drain to low level suction (5–10 cm H<sub>2</sub>O) via underwater seal
- If altitude chest drainage system used, set wall suction to 160 mmHg/22 kPa and set dial on drainage system to 20
- Keep underwater seal below level of chest at all times
- If >10 mL/kg/hr has been drained, clamp chest drain for 1 hr to prevent re-expansion pulmonary oedema
- **Never clamp a bubbling chest drain** – this indicates presence of pneumothorax
- If clamped and chest pain or breathlessness, unclamp immediately
- When there is a sudden cessation of fluid draining, the drain must be checked for obstruction (blockage or kinking) by flushing
- Ensure adequate analgesia (see **Analgesia** guideline) and encourage patient to move freely when well enough

## **Intrapleural fibrinolytics**

- Indicated if thick fluid with loculations or pus
- Instill urokinase in all patients, as follows:
  - ≥10 kg, urokinase 40,000 units in 40 mL sodium chloride 0.9%
  - <10 kg, urokinase 10,000 units in 10 mL sodium chloride 0.9%
  - administer via chest drain 12-hrly for 3 days (total 6 doses)
  - clamp chest drain for 4 hr after instillation of urokinase, then drain for 8 hr
- Record fluid volumes into and out of pleural space carefully and accurately

## **SUBSEQUENT MANAGEMENT**

Act on response to treatment and clinical assessment of patient

- Monitor symptoms and re-examine patient to assess progress
- Repeat CRP as needed
  - if falling rapidly, continue with current regimen
  - if not falling after 72 hr, treat as non-resolution (see below)
- Chase pleural fluid aspirate results
  - if unexpected organisms grown, adjust antibiotic therapy with antibiotic sensitivities
  - if differential cell count shows lymphocytosis, discuss with TB team, send aspirate for cytology and consider CT scan of chest
- Chase blood and sputum culture results – if no growth, continue empirical treatment until patient improves
- Remove chest drain when drainage minimal and in agreement with respiratory paediatrician: appose skin with Steristrips® rather than sutures
- Continue IV antibiotics at least until afebrile. Change to oral co-amoxiclav (penicillin allergy: oral clindamycin) when clinical improvement obvious. Complete minimum 14 days antibiotics
- Continue antibiotics until CRP <10
- Encourage early mobilisation and exercise

## **Non-resolution**

- Non-resolution of effusion after 3 days or further complications occur, consider CT scan of chest
- If no fluid draining, check for obstruction by flushing
- If drain cannot be unblocked, remove and replace if significant effusion remains
- Discuss referral for thoracotomy with respiratory paediatrician

## **Surgery**

- Discuss with paediatric thoracic surgeon if:
  - effusion has not resolved
  - child is still septic

## **DISCHARGE AND FOLLOW-UP**

- Arrange review by respiratory paediatrician, initial appointment 6 weeks after discharge (CXR on arrival)
- if symptoms persist or recur, early referral to respiratory paediatrician

# PNEUMOTHORAX • 1/2

## RECOGNITION AND ASSESSMENT

### Symptoms and signs

#### *Tension pneumothorax (very rare)*

- Severe dyspnoea
- Circulatory compromise
- Trachea +/- apex beat displaced
- Hyperresonant percussion note
- Absent or decreased breath sounds on affected side

#### Treat immediately

- Give oxygen 15 L/min with mask with reservoir bag
- Insert a large bore cannula (14 or 16 G) of at least 4.5 cm in length into 2<sup>nd</sup> anterior intercostal space, midclavicular line
- Insert chest drain mid axillary line 5<sup>th</sup> intercostal space
- Remove emergency cannula when bubbling in underwater seal system confirms intercostal tube system functioning

#### *Spontaneous pneumothorax*

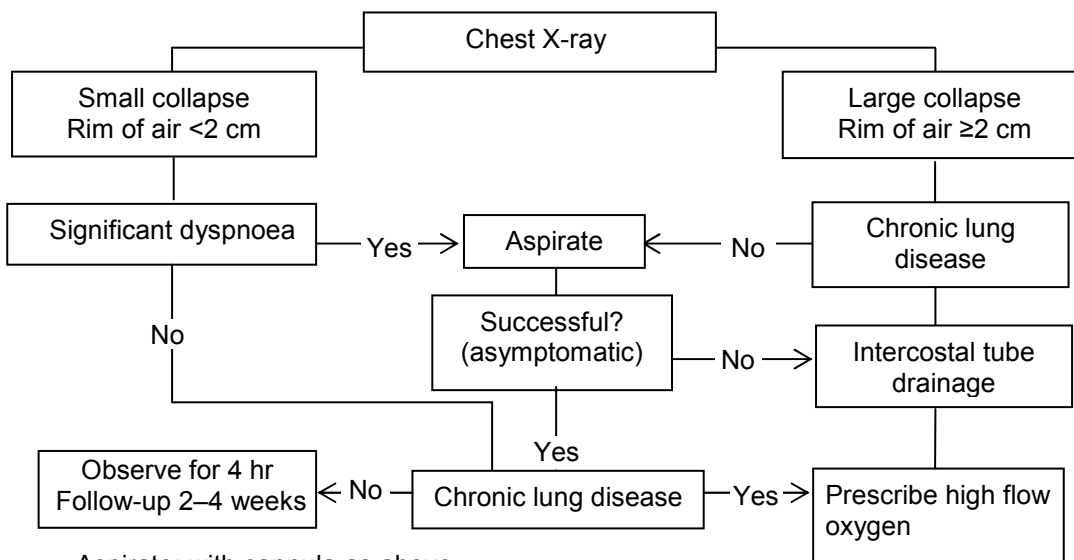
- Symptoms may be minimal
- Sudden onset, occasionally at rest
- Chest pain (unilateral)
- Dyspnoea
- Resonance on percussion, with reduced vocal fremitus and breath sounds (if moderate-large)

#### Investigations

- PA chest X-ray
- If findings are unclear on PA, lateral (if possible, decubitus) film may help
- If findings obscured by surgical emphysema or complex bulla disease, CT scan may help

**BEWARE: suspected basal pneumothorax usually implies a bulla. CT scan will differentiate bullae from pneumothorax**

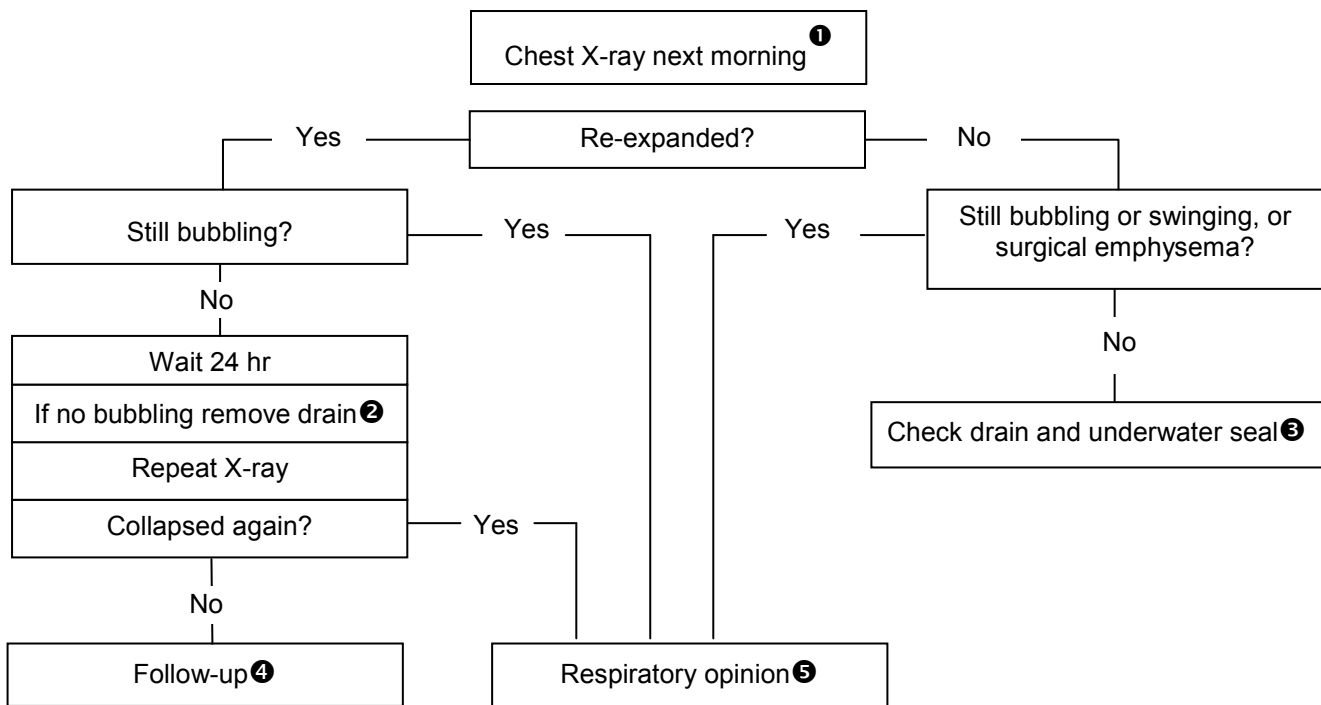
## IMMEDIATE TREATMENT



- Aspirate: with cannula as above
- Suction is not routinely required for chest drain
- Discuss all with respiratory paediatrician within 24 hr

# PNEUMOTHORAX • 2/2

## Management of intercostal drains



**Do not clamp chest tube unless advised by respiratory paediatrician or thoracic surgeon. If clamped and chest pain or breathless unclamp immediately**

- **1: Chest X-ray**
  - keep underwater seal below level of chest at all times
- **2: Removal of chest drain:**
  - bubbling stopped for at least 24 hr
  - cut drain-securing suture
  - withdraw tube while patient holds breath in expiration
  - close wound with remaining sutures
- **3: Check drain:**
  - if lung not re-inflated and no bubbling in underwater bottle: Try to remove **block** or **kink**
  - if unsuccessful, remove drain. Insert new drain through clean incision
- **4: Follow-up:**
  - in 7–10 days then with respiratory paediatrician
  - patient given discharge letter and written advice to return immediately if deteriorates
  - no air travel until chest X-ray changes resolved
- **5: Respiratory paediatrician's opinion:**
  - if no re-expansion consider air leak, displaced/blocked tube, bronchopleural fistula, underlying pulmonary disease
  - use high volume/low pressure suction, 1–2 kPa/Barr, (8–16 mmHg; 8–20 cm H<sub>2</sub>O)
  - if altitude chest drainage system used, set wall suction to 160 mmHg/22 kPa and set dial on drainage system to 20
  - early thoracic surgery. Refer when pneumothorax fails to resolve after 5 days of above management or after 3 days if patient has chronic lung disease

# CYANOTIC CONGENITAL HEART DISEASE • 1/2

## RECOGNITION AND ASSESSMENT

### Symptoms and signs

- Central cyanosis may be respiratory or cardiac in origin
- Respiratory illness producing cyanosis will usually have signs of respiratory distress (e.g. cough, tachypnoea, recession and added respiratory sounds)
- Cardiac decompensation may occur with a respiratory infection: they may co-exist
- Cyanosis more likely due to cardiac disease if:
  - SpO<sub>2</sub> responds poorly to high flow oxygen (15 L/min) via face mask with reservoir bag
  - marked tachycardia
  - enlarged heart (clinically or on CXR)
  - gallop rhythm/murmur
  - enlarged liver/raised JVP
  - basal crackles
  - absent femoral pulses
  - finger clubbing occurs after a few months (also consider endocarditis)

### Causes of cardiac cyanosis

#### **Significant right-to-left shunt**

- Transposition with inadequate mixing, pulmonary or tricuspid atresia
- Fallot's tetralogy: hypercyanotic episodes follow emotional or painful upset

#### **Duct-dependent pulmonary circulation**

- Commonly presents in first 10–14 days of life
- severely blue, breathless or shocked
- pulmonary atresia
- critical pulmonary valve stenosis
- tricuspid atresia
- severe Fallot's tetralogy
- transposition of the great arteries without septal defect
- single ventricle anatomy

#### **Acute pulmonary outflow obstruction (cyanotic episodes)**

- Fallot's tetralogy or other complex congenital cyanotic heart disease
- severe pallor
- loss of consciousness
- convulsions

### Physical examination

- Remember to check femoral pulses
- If coarctation of the aorta suspected: check BP in upper and lower limbs – normal difference <15 mmHg

### Investigations

***If infant cyanosed or in heart failure, discuss urgency of investigations with consultant***

#### **SpO<sub>2</sub>**

- Check pre- (right arm) and post-ductal (lower limbs)
- when breathing air before oxygen given
- after giving 15 L/min oxygen by mask with a reservoir bag for 10 min

#### **Chest X-ray**

- For cardiac conditions, specifically record:
  - cardiac situs (normal or right side of chest)
  - aortic arch left or right-sided
  - bronchial situs (is right main bronchus on the right?)
  - cardiac size and configuration
  - size of pulmonary vessels and pulmonary vascular markings

# CYANOTIC CONGENITAL HEART DISEASE • 2/2

## **Electrocardiogram**

See ECG interpretation guideline

## **Nitrogen washout in cyanosed babies**

- Monitor SpO<sub>2</sub> in air then in headbox after breathing 100% oxygen for 10 min
- in cyanotic congenital heart disease, PaO<sub>2</sub> will remain below 20 kPa with SpO<sub>2</sub> unchanged
- not as reliable as echocardiogram

## **Echocardiogram**

- Locally, if available, or refer to regional paediatric cardiac centre

## **IMMEDIATE TREATMENT**

***If infant cyanosed or in heart failure, discuss urgency of referral to local paediatric cardiac surgical centre with consultant***

### **Duct-dependent congenital heart disease**

- Immediate treatment before transfer to a paediatric cardiac centre:
- open duct with alprostadil (prostaglandin E1) or dinoprostone (E2) same dose:
- 5 nanogram/kg/min IV infusion to start (administer alone i.e. not alongside other drugs or infusions in the same lumen). See BNFC for administration guidance
- increase in steps of 5 nanogram/kg every 5 min up to max 100 nanogram/kg/min on specialist advice
- then reduce to lowest dose needed
- May cause apnoea and patients may need ventilation
- Beware of giving high concentrations of oxygen as this encourages duct closure

### **Acute pulmonary outflow obstruction (cyanotic episodes)**

- Immediate treatment before transfer to a paediatric cardiac centre:
- do not upset child
- give morphine 50–100 microgram/kg IV over 5 min or IM
- provide high concentration facemask oxygen (15 L/min with reservoir bag)
- if Fallot's tetralogy has been diagnosed by echocardiography, discuss with cardiologist use of IV beta-blocker

## **SUBSEQUENT MANAGEMENT**

- On advice of consultant and paediatric cardiac centre



# HEART FAILURE • 1/2

## CAUSES

- Congenital heart malformations
  - aortic stenosis
  - coarctation of the aorta
  - hypoplastic left heart
- Cardiomyopathies
- Pericardial effusion
- Myocarditis
- Arrhythmias
- Hypoxia
- Hypovolaemia
- Acidosis
- Toxins

## RECOGNITION AND ASSESSMENT

### Presentation

- Usually during first few weeks of life
- Later triggered by an intercurrent infection, with associated myocarditis or prolonged arrhythmia

### Symptoms and signs

- Failure to thrive
- Rapid weight gain
- Sweating
- Breathlessness, particularly during feeding
- Tachypnoea
- Tachycardia
- Absent or low volume peripheral or central pulses
- Enlarged heart
- Prominent cardiac impulses
- Quiet heart sounds in pericardial effusion
- Thrill
- Gallop rhythm
- Enlarged liver

### Recognition of cardiogenic shock

- For definition of shock see **Sepsis (including meningococcal)** guideline
- Cardiogenic shock should be considered:
  - when septic shock fails to improve after adequate fluid replacement (e.g.  $\geq 40$  mL/kg)
  - with a known heart condition
  - in the presence of a large heart on CXR
  - shock, with a history of poisoning
  - when there is a murmur/pulmonary oedema, or both

## INVESTIGATIONS

- Check BP in upper and lower limbs (normal  $< 15$  mmHg difference)

### SpO<sub>2</sub>

- Check pre- (right arm) and post-ductal (lower limbs)
- In air and after giving oxygen

### Chest X-ray

- For cardiac conditions, specifically record:
  - cardiac situs (normal or right side of chest)
  - aortic arch left- or right-sided
  - bronchial situs (is right main bronchus on the right?)
  - cardiac size and configuration
  - size of pulmonary vessels and pulmonary vascular markings

### Electrocardiogram

- See **ECG interpretation** guideline

# HEART FAILURE • 2/2

## Echocardiogram

- Locally, if available, or refer to local paediatric cardiac centre

## MONITORING

- ECG monitor
- Non-invasive BP
- Pulse oximetry
- Core-skin temperature difference
- Daily weights
- Urine output ( $\geq 1$  mL/kg/hr)
- If shocked or  $\geq 40$  mL/kg fluid resuscitation:
  - intra-arterial BP monitoring
  - CVP

## THERAPEUTIC MEASURES

### In all children with heart failure

1. If breathless, elevate head and trunk
2. If infant not feeding well, give nasogastric feeds
3. In moderate-to-severe failure or if patient hypoxic or distressed, prescribe oxygen therapy via nasal cannulae (max 2 L/min) or face mask with reservoir bag (max 15 L/min) aiming for SpO<sub>2</sub> 94–98%
4. Diuretics: furosemide 1 mg/kg oral or by slow IV injection over 5–10 min (max rate 500 microgram/kg/min up to 4 mg/min) and amiloride 100 microgram/kg (max 10 mg) oral 12-hrly (doses can be repeated if not responding to initial dose) max IV dose 1 mg/kg 24-hrly if <31 weeks corrected gestation
5. If on IV furosemide check potassium 12-hrly; repeat 4–6 hrly if outside normal range. If serum potassium <4.5 mmol/L, give additional potassium chloride 1 mmol/kg 12-hrly enterally
6. Correct acidosis, hypoglycaemia and electrolyte imbalance
7. Relieve pain with morphine: loading dose 100 microgram/kg IV over 5 min (aged >1 month), followed by 50 microgram/kg IV 4–6 hrly over 5 min or 10 microgram/kg/hr via IV infusion (doses can be doubled if necessary)
8. If anaemic (Hb <100 g/L), correct with infusion of packed cells over 3–4 hr to bring Hb to 120–140 g/L

### If cardiogenic shock present

1. Monitor CVP and ensure adequate pre-load: give human albumin solution (HAS) 4.5% 10 mL/kg as IV bolus or, if HAS not available, sodium chloride 0.9% 10 mL/kg as IV bolus
2. If shock severe, see **Sepsis (including meningococcal)** guideline, start mechanical ventilation with positive end-expiratory pressure early; if pulmonary oedema present, start urgently
3. If shock severe, give early inotropic drug support: dopamine, dobutamine, adrenaline or noradrenaline as per NNU/PICU protocols

## DUCT-DEPENDENT CONGENITAL HEART DISEASE

- May present in first 2 weeks of life

### Duct-dependent systemic circulation

- Breathless, grey, collapsed, poor pulses
- severe coarctation of the aorta
- critical aortic stenosis
- hypoplastic left heart syndrome

### Duct-dependent pulmonary circulation

- Blue, breathless or shocked
- pulmonary atresia
- critical pulmonary valve stenosis
- tricuspid atresia
- severe Fallot's tetralogy
- transposition of the great arteries

### Treatment

- See **Cyanotic congenital heart disease** guideline

# ECG INTERPRETATION • 1/(

- All ECGs, check:
  - P-wave size and axis
  - axis of QRS complex
  - R-S pattern in chest leads
  - P-R, QRS and Q-T intervals
  - P- and T-wave configuration
  - size of QRS in chest leads

## PAPER SPEED

- ECG normally recorded at 25 cm/sec
- 1 mm (1 small square) = 0.04 sec
- 5 mm (1 large square) = 0.2 sec

## P WAVE

- Reflects atrial activity
- Duration shorter than in adults
- infants: 0.04–0.07 sec
- adolescents: 0.06–0.1 sec
- Height  $\leq 2.5$  mm
- Varying P wave morphology may indicate wandering atrial pacemaker

### Right atrial hypertrophy (RAH)

- Increased P wave amplitude in leads II, V1, and V4R

#### Causes

- Pulmonary hypertension
- Pulmonary stenosis
- Pulmonary atresia
- Tricuspid atresia

### Left atrial hypertrophy (LAH)

- Biphasic P wave (later depolarization of LA)

#### Causes

- Mitral valve disease
- LV obstruction and disease

## P-R INTERVAL

- Atrial depolarization varies with age and rate

### Normal range of P-R interval (time in sec)

Heart rate	P-R interval (sec)			
	0–1 month	0–12 months	1–12 yr	12–16 yr
<60	-	-	-	0.1–0.19
60–99	-	-	0.1–0.16	0.1–0.17
100–139	0.08–0.11	0.08–0.12	0.1–0.14	-
140–180	0.08–0.11	0.08–0.12	0.1–0.14	-
>180	0.08–0.09	0.08–0.11	-	-

### Prolonged interval

- Normal
- Myocarditis
- Ischaemia
- Drugs
- Hyperkalaemia

### Short interval

- Wolff-Parkinson-White syndrome
- Lown-Ganong-Levine syndrome
- Glycogen storage disease

### Variable interval

- Wandering atrial pacemaker
- Wenckebach phenomenon

# ECG INTERPRETATION • 2/(

## QRS COMPLEX

- Ventricular activity
- Duration: 0.06–0.08 sec

### Prolonged

- Ventricular hypertrophy
- Bundle branch block
- Electrolyte disturbance
- Metabolic disease
- Drugs (e.g. digoxin)

### Normal range of R and S waves (height in mm)

Age	R and S waves (height in mm)					
	V4-R	V1-R	V1-S	V5-R	V6-R	V6-S
Birth	4–12	5–20	0–20	2–20	1–13	0–15
6–12 months	2–7	3–17	1–25	10–28	5–25	0–10
1–10 yr	0–7	2–16	1–12	5–30	5–25	0–7
>10 yr	0–6	1–12	1–25	5–40	5–30	0–5

## Q WAVE

- Normal in II; III; aVF; V5-6
- Depth 2–3 mm
- pathological if >4 mm (i.e. septal hypertrophy)
- May be found in other leads in:
  - anomalous coronary arteries
  - hypertrophic obstructive cardiomyopathy
  - transposition of great arteries (with opposite polarity)

## Q-T INTERVAL

Inversely proportional to rate

- Calculate ratio of Q-T interval to R-R interval
- $QTc = \frac{Q-T}{\sqrt{R-R}}$
- QTc is usually less than 0.44 s
- prolonged QTc is associated with sudden death: alert consultant immediately

### Prolonged interval

- Hypocalcaemia
- Myocarditis
- Jervell-Lange-Nielsen syndrome
- Romano-Ward syndrome
- Head injuries or cerebrovascular episodes
- Diffuse myocardial disease
- Antiarrhythmics

### Short interval

- Hypercalcaemia
- Digitalis effect

## T WAVE

- Ventricular repolarization

### Normal

- T inversion V4R/V1 (from third day of life until 10 yr)
- Amplitude is 25–30% of R-wave
- Aged <1 yr: V5 ≤11 mm; V6 ≤7 mm
- Aged >1 yr: V5 ≤14 mm; V6 ≤9 mm
- Adolescence reduces amplitude

### Peaked T wave

- Hyperkalaemia
- LVH

# ECG INTERPRETATION • 3/(

- Cerebrovascular episode
- Post-MI

## Flat T wave

- Normal newborn
- Hypothyroidism
- Hypokalaemia
- Hyper/hypoglycaemia
- Hypocalcaemia
- Peri/myocarditis
- Ischaemia
- Digoxin effect

## MEAN QRS AXIS

### Vertical plane (limb leads)

#### *Normal axis in vertical plane*

- Birth +60° to +180° (av +135°)
- Aged 1 yr +10° to +100° (av +60°)
- Aged 10 yr +30° to +90° (av +65°)

#### *Right axis deviation*

- Right ventricular hypertrophy (RVH)
- Left posterior hemiblock
- Ostium secundum atrial septal defect (ASD)/right bundle branch block (RBBB)

#### *Left axis deviation*

- Left ventricular hypertrophy (LVH)
- Ostium primum ASD (+ RBBB)
- Often in conduction defects

### Horizontal plane (anterior chest leads)

#### *Normal*

- Transition at around V3

#### *Clockwise rotation*

- S>R in V4 = RA/RV hypertrophy

#### *Anticlockwise rotation*

- R>S in V2 = cardiac shift (e.g. pneumothorax)

## LEFT VENTRICULAR HYPERTROPHY

### Diagnosis

- SV1 + RV5  $\geq$ 40 mm (30 mm aged <1 yr)
- +/- prolonged QRS
- Flat T wave
- T wave inversion V5-V6 (LV strain)
- Left bundle branch block

### *Causes include*

- Aortic stenosis
- Aortic regurgitation
- Hypertension
- Moderate VSD
- Hypertrophic obstructive cardiomyopathy
- Patent ductus arteriosus
- Mitral regurgitation

## RIGHT VENTRICULAR HYPERTROPHY

### Diagnosis

- RAD and RV1 > SV1 (aged >1 yr)
- SV6 above maximum for age:
  - 0–6 months 15 mm
  - >6 months 10 mm
  - >12 months 7 mm

# ECG INTERPRETATION • 4/()

- 10 yr 5 mm
- R waves in V4R/V1 >normal
- T wave changes
- upright in V1/V4R (aged from 3 days to 10 yr)

## Causes include

- Pulmonary stenosis/atresia
- Transposition of great arteries
- Pulmonary regurgitation
- Total anomalous pulmonary drainage
- Tricuspid regurgitation
- Fallot's tetralogy
- Pulmonary hypertension

## BIVENTRICULAR HYPERTROPHY

### Diagnosis

- R + S >50 mm in V3-V4
- LVH + bifid R <8 mm in V1
- RVH + LV strain
- Q waves V3-V6 imply septal hypertrophy

## TYPICAL ECG ABNORMALITIES

Heart lesion	ECG abnormalities
PDA	LVH > RVH; LAH
VSD	LVH > RVH; +/- RBBB; T inv LV. leads
ASD	Secundum RAD; RBBB; +/- increased P-R; AF Primum LAD; RBBB; BVH; RAH
Eisenmenger's	RVH; P pulmonale
Aortic stenosis	LVH + strain
Aortic regurgitation	LVH
Coarctation	Newborn: RVH Older: Normal or LVH +/- strain; RBBB
Mitral regurgitation	LVH
Pulmonary stenosis	RVH; RAH
Ebstein's anomaly	Prolonged P-R interval; gross RAH; RBBB
Fallot's tetralogy	Newborn: Normal or T +ve V1 Older: RVH; RAH
Pulmonary atresia	RAH
Tricuspid atresia	LAD; RAH; LVH

## SUPRAVENTRICULAR TACHYCARDIA

*Early diagnosis and effective management of supraventricular tachycardia (SVT) are vital as there is a small risk of mortality*

### RECOGNITION AND ASSESSMENT

#### Symptoms and signs

- Recurrent condition
- family may identify as 'another attack'
- Infants
  - gradual onset of increasing tachypnoea
  - poor feeding
  - pallor
  - occasionally more dramatic presentation with a rapid onset of severe cardiac failure
- Toddlers
  - recurrent episodes of breathlessness, cold sweats and pallor
- Older children
  - recurrent palpitations, episodes of dizziness and pallor

#### Investigations

- Confirm diagnosis with 12-lead ECG
- Continuous ECG monitoring **and** recording is essential
- Assess for cardiac failure

#### Differential diagnosis

- Sinus tachycardia, particularly in infants, can be >200/min. However, rates of 220–300/min are most likely to be SVT
- If first presentation, check for any other cause of cardiac failure
- Failure to respond to adenosine can be used to distinguish origin of a tachycardia in a stable patient

#### Causes of tachyarrhythmias

- Re-entrant congenital conduction pathway abnormality (common)
- Poisoning
- Metabolic disturbance
- After cardiac surgery
- Cardiomyopathy
- Long QT syndrome

### ECG DIAGNOSIS

#### Infants

- Majority have a P wave before every QRS complex, usually by >70 msec (2 mm at 25 mm/sec)
- QRS complexes are generally normal but may be wide
- Accessory pathway frequently capable of anterograde as well as retrograde conduction
- this will be revealed during normal sinus rhythm by short P-R interval and presence of a delta wave (classic Wolff-Parkinson-White syndrome)

#### Older children

- Nodal tachycardias become more common with increasing age
- characterised by fast, regular, narrow QRS complexes without visible P waves
- Wide QRS complex or bundle branch block in childhood is rare
- changes also present in sinus rhythm
- review previous ECGs

*If in doubt, seek more experienced help*

### IMMEDIATE TREATMENT

- Resuscitate (ABC) first
- If first presentation, refer to consultant
- See following **Algorithms**

# TACHYCARDIA AND BRADYCARDIA • 2/5

## Vagal manoeuvres

These may include:

- Diving reflex
- wrap infants in a towel and immerse their whole face into iced water for about 5–10 sec, or in children place a bag or rubber glove containing iced water over face
- One side carotid massage
- Valsalva manoeuvre
- Where possible, maintain ECG monitoring **and** recording during all procedures

***Do NOT use eyeball pressure because of risk of ocular damage***

## Adenosine

- Drug of choice as it has a rapid onset of action and not negatively inotropic
- Very short half-life (10–15 sec) giving short-lived side-effects (flushing, nausea, dyspnoea, chest tightness)
- Effective in >80% of junctional tachycardias and will not precipitate ventricular tachycardias into ventricular fibrillation
- Can be used in broad-complex tachycardia of uncertain origin
- Must be given as a rapid bolus IV via a large peripheral or central vein and followed by sodium chloride 0.9% flush
- In patients with sinus tachycardia, heart rate will slow to bradycardia but will rapidly increase again

## Other drugs

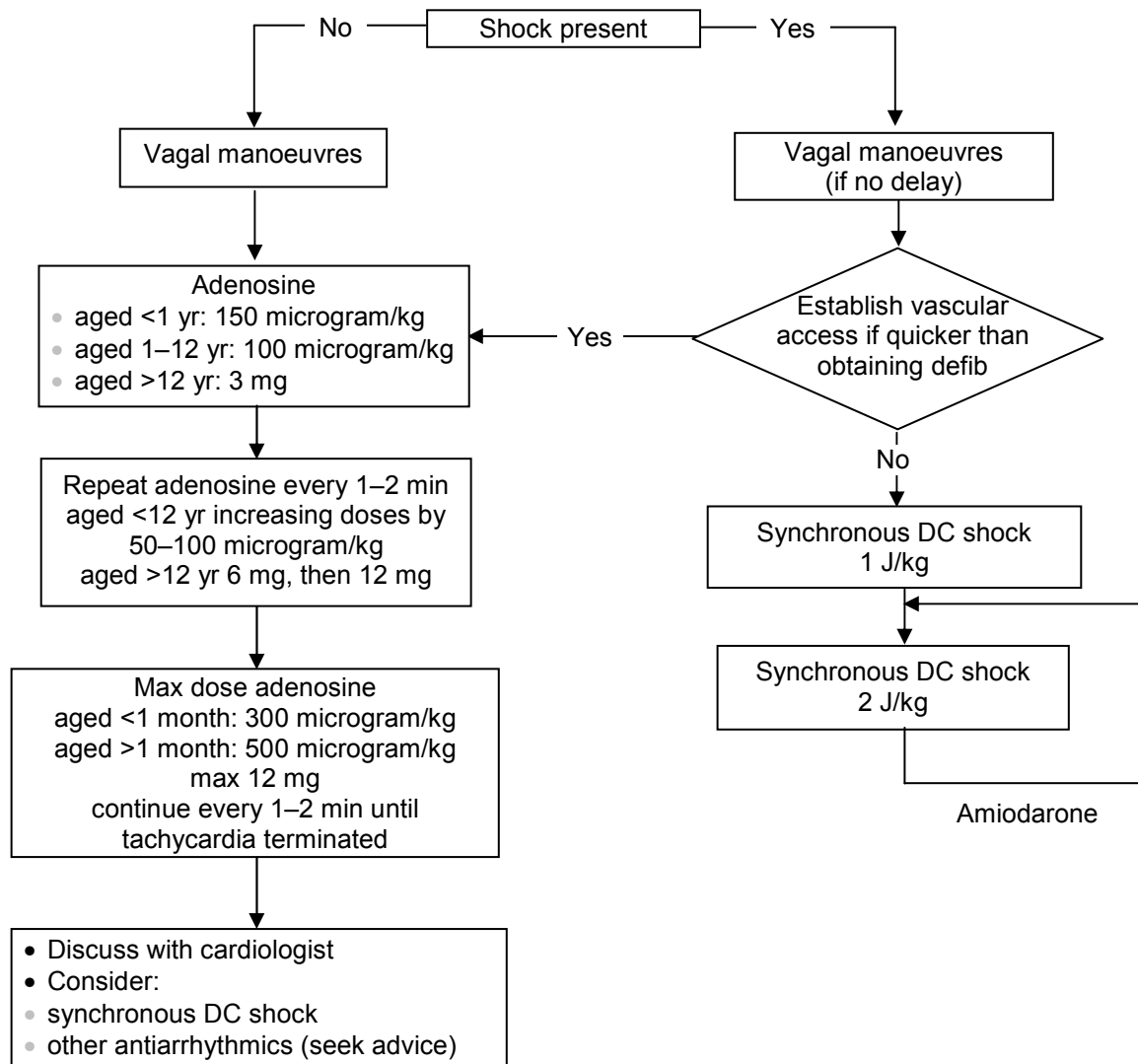
- If adenosine ineffective, seek advice from a paediatric cardiologist
- In refractory Wolff-Parkinson-White tachycardia, flecainide is particularly useful
- In refractory atrial tachycardia, amiodarone is useful

***Do not use verapamil and propranolol in same patient, as both have negative inotropic effects. Do not use verapamil in children aged <1 yr***



# TACHYCARDIA AND BRADYCARDIA • 3/5

## Supraventricular tachycardia



- Adenosine may be used in preference to electrical shock
- if patient taking dipyridamole or has had a heart transplant give  $\frac{1}{4}$  adenosine dose
- An anaesthetic must be given for DC shock if patient responsive to pain

## WIDE COMPLEX TACHYCARDIA RECOGNITION AND ASSESSMENT

### Definition

- Ventricular tachycardia
- $\geq 3$  successive ectopic ventricular beats
- sustained if it continues >30 sec

### Causes

- Underlying cause (e.g. myocarditis, cardiomyopathy, or patient with congenital heart disease)
- Poisoning (e.g. phenothiazines, tricyclic antidepressants, quinidine and procainamide)
- Electrolyte disturbance (e.g. hypokalaemia, hypomagnesaemia)
- Ventricular tachycardia can degenerate into ventricular fibrillation

### Diagnosis

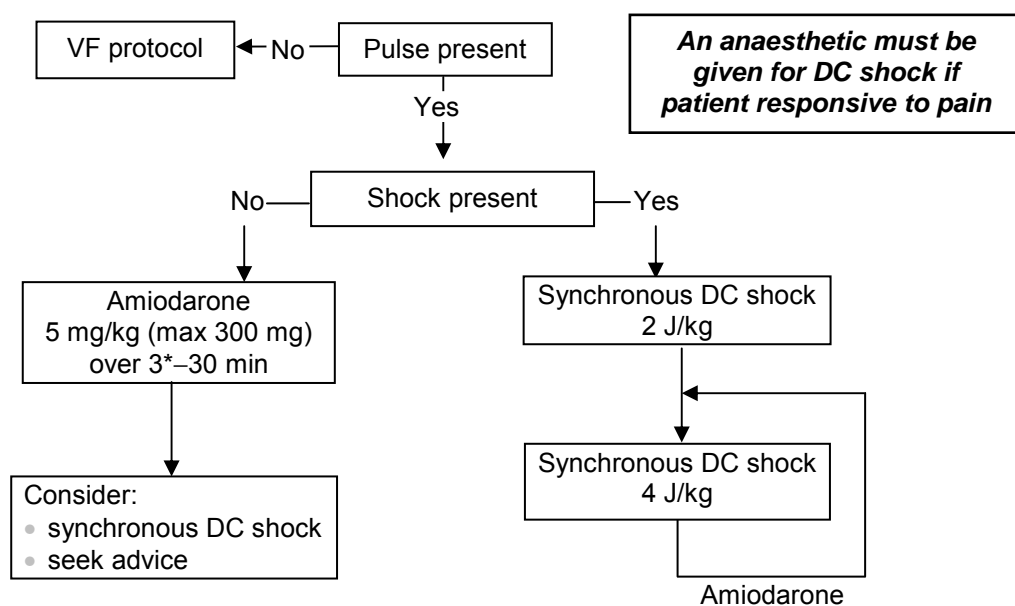
- Wide-QRS SVT (SVT with aberrant conduction) is uncommon in infants and children. Correct diagnosis and differentiation from VT depends on careful analysis of at least a 12-lead ECG +/- an oesophageal lead

# TACHYCARDIA AND BRADYCARDIA • 4/5

- Assess patient and obtain family history to identify presence of an underlying condition predisposing to stable ventricular tachycardia
- SVT or VT can cause haemodynamic instability: response to adenosine can help identify underlying aetiology of the arrhythmia, but adenosine should be used with extreme caution in haemodynamically stable children with wide-complex tachycardia because of the risk of acceleration of tachycardia and significant hypotension. This should not delay definitive treatment in children with shock
- Seek advice
- Ventricular tachycardia not always obvious on ECG, clues are:
  - rate varies between 120 and 250 beats/min (rarely 300 beats/min)
  - QRS complexes are almost regular though wide
  - QRS axis abnormal for age (normal for aged >6 months is <+90°)
  - no preceding P wave, or A-V dissociation
  - fusion beats (normally conducted QRS complex merges with an abnormal discharge)

## IMMEDIATE TREATMENT

### Ventricular tachycardia



- Treatment of haemodynamically stable child with ventricular tachycardia should always include early consultation with a paediatric cardiologist. They may suggest amiodarone: can cause hypotension, which should be treated with volume expansion
- Use synchronous shocks initially, as these are less likely than an asynchronous shock to produce ventricular fibrillation. If synchronous shocks are ineffectual, and child is profoundly hypotensive, subsequent attempts will have to be asynchronous
- Treatment of torsade de pointes ventricular tachycardia is magnesium sulphate 25–50 mg/kg (up to 2 g) diluted to 100 mg/mL in sodium chloride 0.9% over 10–15 min. Can be repeated once if necessary
- \*Amiodarone 5 mg/kg (max 300 mg) may be given over 3 min in ventricular tachycardia if child in severe shock

## BRADYARRHYTHMIAS

- Urgently manage:
  - pre-terminal event in hypoxia or shock
  - raised intracranial pressure
  - vagal stimulation

### Investigations

- ECG to look for:
  - conduction pathway damage after cardiac surgery
  - congenital heart block (rare)
  - long QT syndrome

# TACHYCARDIA AND BRADYCARDIA • 5/5

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## Management

- ABC approach: ensure adequate oxygenation and ventilation
- if above ineffective give a bolus of adrenaline 10 microgram/kg IV and
- if above ineffective try an infusion of adrenaline 0.05–2 microgram/kg/min IV
- If vagal stimulation is cause
- give atropine 20 microgram/kg (min 100 microgram; max 600 microgram)
- dose may be repeated after 5 min [max total dose 20–40 microgram/kg (1–2 mg)]
- Contact paediatric cardiologist for advice
- send ECG to cardiologist

# ENDOCARDITIS PROPHYLAXIS • 1/1

## INDICATIONS

Antibiotic prophylaxis should be considered for patients at highest risk for infective endocarditis (IE):

- Patients with any prosthetic valve
- Patients with previous episode of IE
- Patients with any type of cyanotic congenital heart disease, or where congenital heart disease was repaired with prosthetic material, up to 6 months after the procedure, or lifelong if residual shunt or valvular regurgitation remain

## ANTIBIOTIC PROPHYLAXIS

- Give for dental procedures requiring:
  - manipulation of the gingiva or periapical region of the teeth
  - perforation of the oral mucosa
- Not needed for non-infected tissues, oral trauma, respiratory, gastrointestinal or urogenital endoscopies unless there are infected tissues
- Single dose 30–60 min before procedure: amoxicillin (max 2 g) oral/IV
- If penicillin allergy: clindamycin 20 mg/kg (max 600 mg) oral/IV

***If there is uncertainty, seek advice from cardiology team at regional paediatric cardiac centre***

## MANAGEMENT

- Patients at risk of endocarditis should undertake the following prevention measures:
  - maintain good oral hygiene (dental follow-up twice yearly if high risk, otherwise annual)
  - eradicate chronic bacterial carriage, e.g. on skin, in urine
  - peripheral cannulae in preference over central
  - told how to recognise signs of infective endocarditis, and advised when to seek expert advice
- Investigate promptly any infection in patients at risk of endocarditis and manage appropriately to reduce the risk of endocarditis

# POISONING AND DRUG OVERDOSE • 1/3

*Always follow your local child safeguarding policies and procedures.  
The safety of children is everyone's responsibility*

## Toxbase

- [www.toxbase.org](http://www.toxbase.org) access and password available in A&E
- if further information required, contact UK National Poisons Information Service (0344 892 0111)

## The poisoned

- Toddlers (typically accidental poisoning)
- Older children, particularly girls (intentional self-poisoning most common)

## The poisoners

- Most childhood poisonings are accidental
- Intentional poisoning may be by the child or an adult
- Inadvertent poisoning may occur in a medical setting

## The poison

- Children will eat and drink almost anything

## RECOGNITION AND ASSESSMENT

### Symptoms and signs

- Depressed respiration suggests centrally-acting drug
- Skin blisters (between knees/toes) common after barbiturates and tricyclics
- Hypothermia after exposure or barbiturates
- Venepuncture marks and pinpoint pupils suggest opioid overdose
- Burns around mouth

### Life-threatening features

- Coma
- Cyanosis
- Hypotension
- Paralytic ileus

### Poison(s)/drug(s) information

- Ask patient, relatives, GP, ambulance crew. Retain any containers found
- if identification doubtful, ask parents to retrieve poison from home
- Ask about visitors to the house/visits to other houses (e.g. grandparents)
- Quantity ingested: difficult to quantify but parents may know how full a bottle should have been
- assume child has ingested something even if found with a few tablets or an empty bottle
- Time of ingestion, including multiple doses/staggered overdose
- Other possible poisons/drugs taken

### Investigations

- Save blood and urine for toxicological analysis
- all suspected cases of paracetamol ingestion should have concentrations measured
- if history of ingestion, urgent measurement of plasma/serum concentration is essential in diagnosis and management of poisoning with ethylene glycol, iron, lithium, methanol, paracetamol, theophylline and salicylate
- Other investigations as recommended by Toxbase or clinical condition: U&E, blood gases and acid-base

***Request plasma paracetamol concentration in all unconscious patients in whom drug overdose considered***

***Always admit a child who is symptomatic or who has ingested iron, digoxin, aspirin or a tricyclic antidepressant***

# POISONING AND DRUG OVERDOSE • 2/3

## IMMEDIATE MANAGEMENT

*Separate guidelines give more detailed advice on management of overdose with alcohol, iron, paracetamol, phenothiazines, salicylates and tricyclic antidepressants*

### Assess airway, breathing and circulation

- Maintain airway
- if airway not protected, consider airway adjunct or intubation and ventilation
- if cyanosed or rate and depth of respiration obviously low, arterial blood gases indicated
- if PaCO<sub>2</sub> high or rising, mechanical ventilation indicated
- Correct hypotension
- raise foot of bed
- if in haemodynamic shock, give IV bolus of sodium chloride 0.9% (20 mL/kg over 10 min). Assess and repeat if still in shock
- consider need for central venous pressure (CVP) monitoring

### Neurological

- Control convulsions (follow local seizure protocol)
- if unconscious, treat as head injury until proved otherwise

### Drug absorption

- Give antidote if appropriate – see Toxbase
- Consider activated charcoal in patients who have ingested life-threatening amounts of a toxic agent up to 1 hr previously, provided patient conscious or airway can be protected. Give 1 g/kg (max 50 g) oral (disguised with soft drink/fruit juice) or via nasogastric tube. Activated charcoal does not affect absorption of acids, alkalis, alcohols, cyanide, ethylene glycol, petroleum distillates, malathion, and metal salts including iron or lithium
- Do not give ipecacuanha, it does not empty the stomach reliably and can be dangerous
- Do not consider gastric lavage, or whole bowel irrigation, unless specifically recommended by Toxbase, or after consultation with NPIS
- Stop any regular medication that might enhance effect of substance taken in overdose

### Button (disc) battery ingestion

- A battery lodged in the oesophagus is a medical emergency
- Perform plain chest and abdomen X-rays to locate battery and exclude placement in oesophagus/airway. In young children fluoroscopy may be the investigation of choice if available
- battery and its contents are radiopaque
- Batteries lodged in oesophagus or airway should be removed immediately. Endoscopic removal recommended as extent of damage can also be visualised
- In-patients in whom the battery has not passed the pylorus at first X-ray, or for those ingesting multiple batteries, perform repeat X-ray 2 days post-ingestion
- if battery not passed pylorus, repeat X-ray after further 2 days and consider endoscopic removal if battery remains in stomach
- Patients with batteries in small/large intestine which have passed the pylorus on initial X-ray, and who remain asymptomatic, do not require hospital admission
- ask patient to inspect stools to ensure passage of battery
- give advice to return if symptoms develop
- If symptomatic or clinical features of gastrointestinal bleeding/obstruction at any time repeat X-ray to locate battery
- battery removal may be indicated either by endoscopy/surgical removal

## SUBSEQUENT MANAGEMENT

- Follow additional guidance on [www.toxbase.org](http://www.toxbase.org)
- If unconscious, admit to a high-dependency nursing area and attach an ECG monitor
- Supportive care alone required for majority of acutely poisoned patients
- If deliberate self harm, follow local protocol for referral – see **Self harm** guideline
- Information sharing with other agencies as relevant e.g. school nurse, social services
- Give advice to seek further medical assistance if symptoms develop after discharge

# POISONING AND DRUG OVERDOSE • 3/3

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## Monitoring treatment

- Monitor conscious level, temperature, respiration, pulse and BP until these return to normal
- No need to monitor drug concentrations other than to guide use of measures to enhance drug elimination
- If unconscious, make full head injury observations
- Record pulse, respiratory rate, BP, pupil size and reaction, and level of consciousness hourly for at least 4 hr then increase interval if stable

## PSYCHIATRIC REVIEW

- All deliberate acute self-poisoning or drug overdose must be seen by the psychiatric priority referral team within 24 hr of admission or regaining consciousness before discharge

## Safeguarding

- If not referred to social services complete information sharing form for all deliberate or accidental poisonings or overdoses

## DISCHARGE AND FOLLOW-UP

- **When discharged from hospital patients should have:**
  - been conscious and alert with normal vital signs for at least 6 hr
  - no evidence of significant organ dysfunction as a result of poisoning/drug toxicity
  - been interviewed by a member of the psychiatric priority referral team where indicated
  - follow-up appointment in psychiatric clinic (if recommended by psychiatrist)
  - follow-up appointment in paediatric clinic (if persistent sequelae of poisoning require review)

# ALCOHOL POISONING • 1/2

*Always follow your local child safeguarding policies and procedures.  
The safety of children is everyone's responsibility*

All children with features of alcohol intoxication should be referred to hospital. Remember that other substances/drugs may also have been ingested

## TYPES OF PRODUCT (% ALCOHOL BY VOLUME)

- Absolute ethanol (up to 100)
- Methylated spirits (up to 95)
- Perfumes, colognes and aftershaves (up to 90)
- Spirits (20–70)
- Fortified wines (16–22)
- Wines (8–14)
- Beers (3–10)
- Alcopops (3–7)

## RECOGNITION

- Fatal dose of alcohol in children is approximately 3 g/kg (4 mL/kg absolute ethanol)

**Table 1: Signs and symptoms of alcohol poisoning**

<b>Mild toxicity</b>	Impaired visual acuity Impaired co-ordination Disinhibition Excitability Emotional lability
<b>Moderate toxicity</b>	Ataxia +/- lack of co-ordination Slurred speech Violence Confusion Tachycardia Sweating Nausea +/- vomiting Diplopia +/- blurred vision
<b>Severe toxicity</b>	Hypothermia Hypotension Respiratory depression Stupor or coma Dilated pupils Loss of protective airway reflexes Convulsions Cardiac arrhythmias Metabolic disturbance e.g. acidosis, severe hypoglycaemia
<b>Potentially fatal toxicity</b>	Deep coma Respiratory depression or arrest Circulatory failure

## IMMEDIATE MANAGEMENT

- Ensure clear airway and adequate ventilation – if GCS <8 call anaesthetist to assess for intubation
- Prescribe and carefully titrate administration of oxygen by mask/nasal cannulae to achieve SpO<sub>2</sub> 94–98%. Monitor CO<sub>2</sub> and respiratory effort, as risk of rising CO<sub>2</sub> and respiratory failure (despite normal oxygen saturations) if hypoxic respiratory drive overcome by oxygen therapy
- Blood glucose: correct hypoglycaemia (<3 mmol/L) as quickly as possible:
  - if awake, give oral glucose
  - if drowsy or unconscious, give 10% glucose 2 mL/kg IV followed by infusion of 10% glucose with sodium chloride 0.9%
  - check blood glucose hourly if consciousness impaired
  - if no IV access give glucagon:
    - <25 kg 0.5 mg IM



# ALCOHOL POISONING • 2/2

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- $\geq 25$  kg 1 mg IM
- Give IV maintenance fluids if unable or unsafe to take oral fluids (see **IV fluid therapy** guideline)
- Actively warm if temperature  $< 35.5^{\circ}\text{C}$
- Correct hypotension (see **Poisoning and drug overdose** guideline)
- Correct any metabolic disturbances
- Control convulsions (see **Status epilepticus** guideline)
- Gut decontamination is unlikely to be of benefit (activated charcoal does not significantly reduce rate of absorption)
- Monitor conscious level, pulse, respiratory rate, oxygen saturations, blood pressure, and temperature

## INVESTIGATIONS

- In moderate to severe toxicity:
  - U&E
  - LFTs
  - arterial blood gases
  - 12-lead ECG
  - blood ethanol concentration
  - urine toxicology (contact laboratory regarding suspected substance(s) prior to sending sample)

## SUBSEQUENT MANAGEMENT

- Observe for at least 4 hours if  $> 0.4$  mL/kg body weight of absolute ethanol has been ingested (e.g. 1 mL/kg 40% spirit, 4 mL/kg 10% wine or 8 mL/kg 5% beer)
- Manage children with comorbidities e.g. type 1 diabetes, with appropriate sub-speciality input
- If blood ethanol  $> 5$  g/L (108 mmol/L) or if arterial pH  $< 7.0$ , discuss with UK National Poisons Information Service (NPIS) (0344 892 0111)
- Follow additional guidance on [www.toxbase.org](http://www.toxbase.org)
- See **Poisoning and drug overdose** guideline
- If deliberate self-harm is suspected, follow local protocol for referral (also see **Self-harm** guideline)
- Information sharing with other agencies as relevant e.g. school nurse, social services

# IRON POISONING • 1/2

*Always follow your local child safeguarding policies and procedures.  
The safety of children is everyone's responsibility.*

## RECOGNITION AND ASSESSMENT

- Consult [www.toxbase.org](http://www.toxbase.org) for more detailed management and discuss **all** cases with UK National Poisons Information Service (NPIS) 0344 892 0111
- Estimate ingested dose of elemental iron (BNFc lists amounts in various preparations e.g. iron supplements, multivitamins)
- Toxic dose of iron in children is 20 mg/kg and the fatal dose 150–200 mg/kg

### Features of severe poisoning (at any time):

- Reduced consciousness
- Shock
- Metabolic acidosis
- Hypotension
- Rectal bleeding
- Convulsions
- Haematemesis
- Haemolysis
- Positive anion gap

**Table 1: Signs and symptoms of iron poisoning**

Time after ingestion	Symptoms and signs
<6 hr	<ul style="list-style-type: none"><li>• Nausea, vomiting, abdominal pain, and diarrhoea</li><li>• Vomit and stools may be grey or black</li><li>• Features of severe poisoning may occur in some cases</li></ul>
6–12 hr	<ul style="list-style-type: none"><li>• Early features improve in mild cases</li><li>• More serious cases may have evidence of:<ul style="list-style-type: none"><li>• hypoperfusion</li><li>• metabolic acidosis</li><li>• systemic toxicity</li></ul></li></ul>
>12 hr	<ul style="list-style-type: none"><li>• Serious cases may have evidence of:<ul style="list-style-type: none"><li>• vomiting +/- gastrointestinal bleeding</li><li>• shock (hypovolaemic or as result of cardiotoxicity)</li><li>• hepatocellular necrosis leading to jaundice, bleeding, hypoglycaemia, encephalopathy and metabolic acidosis</li><li>• renal failure</li></ul></li></ul>

## IMMEDIATE MANAGEMENT

### Unconscious, in shock, or has other features of severe poisoning

- Assess and manage airway, breathing, and circulation
- Establish IV access and give IV fluids to ensure adequate hydration
- Monitor cardiac rhythm, BP and urine output
- Take blood for urgent measurement of serum iron (do not wait for result before commencing treatment), U&E, FBC, glucose, LFTs, INR, and blood gases
- Commence desferrioxamine 15 mg/kg/hr IV (see BNFc)
- If metabolic acidosis persists despite correction of hypoxia and hydration, correct with sodium bicarbonate – see [www.toxbase.org](http://www.toxbase.org) for detail
- If patient stable and airway protected, consider whole bowel irrigation – discuss with NPIS (0344 892 0111) before commencing
- Observe for signs of gut perforation/infarction
- Monitor renal and liver function; treat failure
- Control seizures (see **Status epilepticus** guideline)
- Do not use activated charcoal – it does not bind iron

### Conscious, not in shock, no features of severe poisoning

#### **Presenting within 6 hr of ingestion**

- Assess and manage airway, breathing, and circulation

# IRON POISONING • 2/2

- Establish IV access and give IV fluids to ensure adequate hydration
- Monitor cardiac rhythm, BP, and urine output
- Take blood for U&E, FBC, glucose, LFTs, INR, blood gases, and for urgent measurement of serum iron at 4 hr and 6 hr post-ingestion (to ensure capture of 6 hr peak); use of desferrioxamine precludes interpretation of subsequent iron concentrations
- Administer desferrioxamine 15 mg/kg/hr IV, depending on peak (6 hr) serum iron concentrations, but do not delay therapy if child develops features of severe poisoning
- <3 mg/L (55 micromol/L)
  - desferrioxamine not required
  - discharge once asymptomatic
- 3–5 mg/L (55–90 micromol/L)
  - repeat serum levels after 2 hr
  - if level falling and patient asymptomatic: unlikely to need further intervention
  - if level falling and patient symptomatic: monitor until clinically well
  - if level rising and patient asymptomatic: continue with supportive management until >12 hr post-ingestion
  - if level rising and patient symptomatic or has biochemical disturbance: give desferrioxamine >5 mg/L (90 micromol/L)
- if patient symptomatic or has biochemical disturbance, give desferrioxamine
- if patient asymptomatic
  - if clinical deterioration, continue with supportive management and give desferrioxamine
  - repeat serum levels after 2 hr; if level rising, give desferrioxamine
- If metabolic acidosis persists despite correction of hypoxia and hydration, correct with sodium bicarbonate
- If patient stable and airway protected consider whole bowel irrigation – discuss with NPIS (0344 892 0111) before commencing
- Observe for signs of gut perforation/infarction
- Monitor renal and liver function; treat failure

## ***Presenting >6 hr after ingestion and experienced symptoms within 6 hr***

- Assess and manage airway, breathing, and circulation
- Establish IV access and give IV fluids to ensure adequate hydration
- Monitor cardiac rhythm, BP, and urine output
- Take blood for U&E, FBC, glucose, LFTs, INR, blood gases, and for urgent measurement of serum iron (**NOTE** that levels will have peaked at 6 hr, so interpretation difficult); repeat serum iron level 2 hr later to confirm
- If serum iron concentration is >5 mg/L (90 micromol/L) administer desferrioxamine 15 mg/kg/hr IV
- If metabolic acidosis persists despite correction of hypoxia and hydration, correct with sodium bicarbonate
- Observe for signs of gut perforation/infarction
- Monitor renal and liver function; treat failure

## ***Presenting >6 hr after ingestion and asymptomatic throughout***

- Ingestion of significant amount unlikely
- No further intervention needed

## **SUBSEQUENT MANAGEMENT**

- Follow additional guidance on [www.toxbase.org](http://www.toxbase.org)
- See **Poisoning and drug overdose** guideline
- If deliberate self-harm is suspected, follow local protocol for referral (see **Self-harm** guideline)
- Information sharing with other agencies as relevant e.g. school nurse, social services
- Give advice to seek further medical assistance if symptoms develop after discharge

# PARACETAMOL POISONING • 1/5

## RECOGNITION AND ASSESSMENT

### Symptoms and signs

- Common: nausea and vomiting
- Rare: coma and metabolic acidosis
- Late: abdominal pain

### Management

- Paracetamol dose >6 g or >75 mg/kg
- Staggered overdose [including chronic therapeutic excess >75 mg/kg/d (>60 mg/kg in neonate)]
- Symptomatic  
OR
- INR >1.3 or ALT >upper limit of normal, or abnormal acid/base or bicarbonate

Time from overdose (hr)	Guidance on use of acetylcysteine
<1	Give activated charcoal 1 g/kg (max 50 g) oral or via nasogastric tube (gastric lavage is not indicated) if >150 mg/kg paracetamol has been ingested in previous hour
1–4	Wait 4 hr before checking paracetamol levels
4–7	Await paracetamol level if available <8 hr from ingestion. Treat if level ≥ 'treatment line' OR if biochemical tests (INR, ALT) suggest acute liver injury
8–14	Give at once while awaiting paracetamol concentration result. Cease if concentration well below appropriate 'treatment line' and ALT within normal limit, INR ≤1.3
15–24	Give at once. Cease at 24 hr after ingestion if patient asymptomatic, and INR ≤1.3, and ALT <upper limit of normal. Otherwise complete antidote course
Multiple/staggered overdose	Plasma paracetamol will confirm ingestion but cannot be related to nomogram. Start acetylcysteine and discuss with NPIS
>24	Give if paracetamol still detectable in the blood (>5 mg/L), or INR >1.3 or ALT >twice upper limit of normal, or symptomatic. If patient has, or is at risk of developing, fulminant hepatic failure (see <b>life-threatening features</b> below), continue to give 50 mg/kg in 500 mL every 8 hr Discuss with NPIS and follow Toxbase guidance

- Follow guidance on [www.toxbase.org](http://www.toxbase.org) (password from Emergency Dept)
- Further advice from National Poisons Information Service (NPIS) 0344 892 0111
- If there is **absolute certainty** that a single dose of paracetamol of <6 g and <75 mg/kg has been ingested, plasma paracetamol need not be measured and child requires no antidote

### Investigations

***Treatment with acetylcysteine interferes with the measurement of paracetamol causing falsely low results***

***Paracetamol measurements taken AFTER administration of acetylcysteine are not reliable and should not be used to decide on management***

- Plasma paracetamol 4–16 hr (but not outside this interval) is a reliable guide to the need for treatment after single overdose ingested over <60 min
- If patient presents >8 hr after single overdose; or after staggered overdose; request baseline:
  - FBC, INR
  - U&E, liver function, phosphate
  - acid-base (venous sample)

## IMMEDIATE TREATMENT

- If <150 mg/kg paracetamol ingested and delay >8 hr from ingestion to getting paracetamol level, then start treatment
- Compare plasma paracetamol with treatment graph (**Figure 1**)
- if above, or on, the 'treatment line', give IV acetylcysteine in glucose 5%
- Time interval is critical in assessing need for treatment. Detailed questioning essential

# PARACETAMOL POISONING • 2/5

*If there is doubt about timing or need for treatment, treat*

Acetylcysteine dosage (see BNFC\*) prescribe as mg acetylcysteine

<b>Weight &lt;20 kg (including neonates)</b>	<ul style="list-style-type: none"> <li>• <b>First phase:</b> 150 mg/kg IV in 3 mL/kg glucose 5% over 60 min, then</li> <li>• <b>Second phase:</b> 50 mg/kg IV in 7 mL/kg glucose 5% over 4 hr, then</li> <li>• <b>Third phase:</b> 100 mg/kg IV in 14 mL/kg glucose 5% over 16 hr</li> <li>• Then careful review at 16 hr, in case of need to continue third infusion phase</li> </ul>
<b>Weight 20–39 kg</b>	<ul style="list-style-type: none"> <li>• <b>First phase:</b> 150 mg/kg IV in 100 mL glucose 5% over 60 min, then</li> <li>• <b>Second phase:</b> 50 mg/kg IV in 250 mL glucose 5% over 4 hr, then</li> <li>• <b>Third phase:</b> 100 mg/kg IV in 500 mL glucose 5% over 16 hr</li> <li>• Then careful review at 16 hr, in case of need to continue third infusion phase</li> </ul>
<b>Weight ≥40 kg (dose capped at 110 kg body weight)</b>	<ul style="list-style-type: none"> <li>• <b>First phase:</b> 150 mg/kg IV (max 16.5 g) in 200 mL (remove 50 mL from 250 mL bag) glucose 5% over 60 min, then</li> <li>• <b>Second phase:</b> 50 mg/kg IV (max 5.5 g) in 500 mL glucose 5% over 4 hr, then</li> <li>• <b>Third phase:</b> 100 mg/kg IV (max 11 g) in 1000 mL glucose 5% over 16 hr</li> <li>• Then careful review at 16 hr, in case of need to continue third infusion phase</li> </ul>

\* BNFC dose calculation and prescription method is simple to prescribe and give.

Alternatively, the dosage calculation described in Toxbase yields the same drug dose but is prepared differently and prescribed by volumes

**Alternative dosage chart for body weight >40 kg**

- See **Adult acetylcysteine dose and administration** in the **BNF**

<b>Adult acetylcysteine prescription</b> (each ampoule = 200 mg/mL acetylcysteine)						
Regimen	First infusion		Second infusion		Third infusion	
<b>Infusion fluid</b>	200 mL glucose 5% or sodium chloride 0.9%		500 mL glucose 5% or sodium chloride 0.9%		1000 mL glucose 5% or sodium chloride 0.9%	
<b>Duration of infusion</b>	1 hr		4 hr		16 hr	
<b>Drug dose</b>	150 mg/kg acetylcysteine		50 mg/kg acetylcysteine		100 mg/kg acetylcysteine	
<b>Patient weight</b>	<b>Ampoule volume</b>	<b>Infusion rate</b>	<b>Ampoule volume</b>	<b>Infusion rate</b>	<b>Ampoule volume</b>	<b>Infusion rate</b>
	<b>kg</b>	<b>mL</b>	<b>mL/hr</b>	<b>mL</b>	<b>mL</b>	<b>mL/hr</b>
40–49	34	234	12	128	23	64
50–59	42	242	14	129	28	64
60–69	49	249	17	129	33	65
70–79	57	257	19	130	38	65
80–89	64	264	22	131	43	65
90–99	72	272	24	131	48	66
100–109	79	279	27	132	53	66
≥110	83	283	28	132	55	66

- If for any reason glucose 5% unsuitable, substitute sodium chloride 0.9%

**Prepare and check infusion bags carefully. Administration errors are common**

**Acetylcysteine can cause a pseudo-allergic reaction (wheezing, flushing, hypotension) that is usually relieved by stopping infusion but occasionally chlorphenamine and hydrocortisone are required. Once reaction has subsided, recommence infusion at lower rate of 50 mg/kg/hr to complete the 150 mg/kg (max 16.5 g), then start the second phase infusion of 50 mg/kg (max 5.5 g) over 4 hr**

# PARACETAMOL POISONING • 3/5

## MONITORING TREATMENT

- Severe liver damage in the context of paracetamol poisoning has been defined as a peak plasma ALT activity exceeding 1000 iu/L

Time of presentation after overdose (hr)	Monitoring/continued treatment	Discharge policy
<8	<ul style="list-style-type: none"> <li>INR, AST/ALT, creatinine, bicarbonate 21 hr after overdose or when antidote treatment complete</li> <li>if INR &gt;1.3 or creatinine raised, or patient acidotic, repeat third infusion phase until INR &lt;1.3</li> <li>recheck INR and U&amp;E 12-hrly until clearly falling</li> <li>Do NOT correct INR with vitamin K without prior discussion with tertiary liver unit, see below for management of life-threatening conditions including use of FFP</li> </ul>	<ul style="list-style-type: none"> <li>Discharge if INR ≤1.3, AST/ALT &lt;2x upper limit of normal (ULN) at 21 hr after overdose, or after antidote treatment complete, with warning to return if vomiting or abdominal pain occur</li> </ul>
8–15	<ul style="list-style-type: none"> <li>INR, AST/ALT, creatinine, bicarbonate and phosphate 21 hr after overdose or when antidote treatment complete</li> <li>if INR &gt;1.3 or creatinine raised, or patient acidotic, repeat third infusion phase until INR &lt;1.3</li> <li>recheck INR and U&amp;E 12-hrly until clearly falling</li> <li>discuss with NPIS</li> </ul>	<ul style="list-style-type: none"> <li>If INR ≤1.3, AST/ALT &lt;2x ULN:                             <ul style="list-style-type: none"> <li>discharge asymptomatic patients 12 hr after antidote treatment with warning to return if vomiting or abdominal pain occur</li> </ul> </li> <li>if INR &gt;1.3 and rises, and/or plasma creatinine raised after antidote treatment, monitor and observe until these indices are falling and INR &lt;2.0</li> </ul>
≥16	<ul style="list-style-type: none"> <li>Observe for signs of encephalopathy (mental confusion, drowsiness, spatial disorientation, asterixis)</li> <li>Urine output (maintain good flow<sup>†</sup>)</li> <li>Capillary blood glucose 4-hrly</li> <li>Blood gases and acid-base daily</li> <li>INR, AST/ALT, creatinine, bicarbonate and phosphate 21 hr after overdose or when antidote treatment complete</li> <li>if INR &gt;1.3 and rises, or creatinine raised, or patient acidotic, repeat third infusion phase until INR &lt;2.0</li> <li>recheck INR and U&amp;E 12-hrly until INR clearly falling and creatinine &lt;10% higher than start value</li> </ul>	<ul style="list-style-type: none"> <li>If INR ≤1.3, AST/ALT &lt;2x ULN:                             <ul style="list-style-type: none"> <li>discharge asymptomatic patients 12 hr after end of antidote treatment with warning to return if vomiting or abdominal pain occur</li> </ul> </li> <li>if INR &gt;1.3 and rises, and/or plasma creatinine raised after antidote treatment, monitor and observe until these indices are falling and INR &lt;2.0</li> <li>Patients presenting 24–36 hr after overdose can develop hepatic dysfunction after this time, even if INR, ALT and creatinine normal at time of presentation: repeat these indices 12 hr later</li> </ul>

### Life-threatening features

- A poor prognosis indicated by:
  - INR >3.0
  - serum creatinine >200 µmol/L
  - blood pH <7.3
  - signs of encephalopathy
- If any of these features are present after overdose, **seek advice from local tertiary liver unit**
- <sup>†</sup>insert urinary catheter to monitor urine flow and rehydrate to maintain urine output >2 mL/kg/hr or 100 mL/hr whichever is smaller
- if unresponsive to IV fluids, give furosemide and consider low-dose dopamine
- insert CVP line to monitor response to IV fluids only if INR normal
- Patients with incipient or established hepatic failure may be candidates for liver transplantation

# PARACETAMOL POISONING • 4/5

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- Treat haemorrhage with fresh frozen plasma
- Hypophosphataemia usually occurs after paracetamol poisoning and correlates well with degree of hepatic damage

## **Psychiatric review**

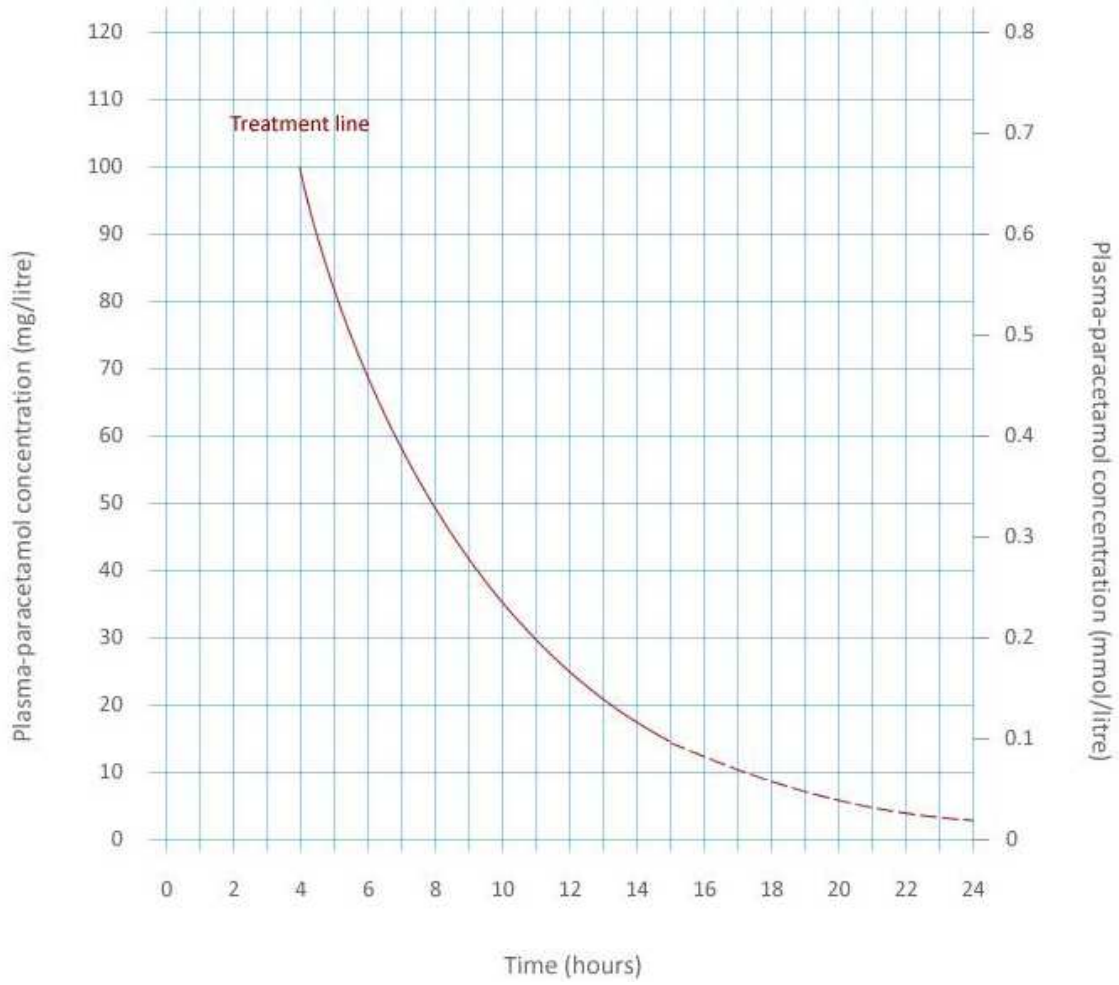
- Refer all patients admitted after acute self-poisoning or deliberate drug overdose to the psychiatric priority referral team within 24 hr of admission or regaining consciousness

## **DISCHARGE AND FOLLOW-UP**

- See **Poisoning and drug overdose** guideline
- Advise all patients to return to hospital if vomiting or abdominal pains develop or recur
- Provide all patients with a patient information sheet available from [www.toxbase.org](http://www.toxbase.org)

# PARACETAMOL POISONING • 5/5

Figure 1: Treatment graph for paracetamol overdose





# PHENOTHIAZINE POISONING • 1/1

*Always follow your local child safeguarding policies and procedures.  
The safety of children is everyone's responsibility.*

## RECOGNITION AND ASSESSMENT

### Signs and symptoms

- May be asymptomatic
- Drowsiness
- Confusion
- Hypotension
- Hypothermia
- Acute dystonic reactions (e.g. oculogyric crises, torticollis)
- Akathisia
- Convulsions
- Rarely:
  - respiratory depression
  - pulmonary oedema
  - rhabdomyolysis
  - renal failure
  - cardiac involvement e.g. arrhythmia

### Common preparations of phenothiazines and related drugs

- Chlorpromazine
- Perphenazine
- Prochlorperazine
- Trifluoperazine
- Droperidol
- Haloperidol
- Promazine
- Metoclopramide
- Domperidone

## IMMEDIATE MANAGEMENT

### Overdose/poisoning

- If presents within 1 hr of ingesting a potentially toxic dose, give activated charcoal 1 g/kg (max 50 g)
- Acute dystonia can be treated with antimuscarinics or diazepam
- Other treatment as indicated by clinical condition

### Very large overdose/poisoning – asymptomatic

- If presents within 1 hr of ingesting a potentially toxic dose, give activated charcoal 1 g/kg (max 50 g)
- Observe for ≥6 hr post ingestion
- Monitor pulse, BP, and temperature

### Very large overdose/poisoning – symptomatic

- Assess and manage airway and breathing
- If presents within 1 hr of ingesting potentially toxic dose, consider activated charcoal 1 g/kg (max 50 g)
- Correct hypotension (see **Poisoning and drug overdose** guideline)
- Actively warm if temperature <35.5°C
- Correct acid-base and metabolic disturbance with bicarbonate infusion (see **Salicylate poisoning** guideline)
- Control convulsions with IV lorazepam
- Acute dystonia can be treated with antimuscarinics OR diazepam

## SUBSEQUENT MANAGEMENT

- Follow additional guidance on [www.toxbase.org](http://www.toxbase.org)
- See **Poisoning and drug overdose** guideline
- If deliberate self-harm is suspected, follow local protocol for referral (also see **Self-harm** guideline)
- Information sharing with other agencies as relevant e.g. school nurse, social services
- Give advice to seek further medical assistance if symptoms develop after discharge (acute dystonia may occur 2–3 days after overdose)

# SALICYLATE POISONING • 1/3

*Always follow your local Child Safeguarding Policies and Procedures.  
The safety of children is everyone's responsibility*

## RECOGNITION

### Preparations

- Aspirin tablets
- Methyl salicylate (Oil of Wintergreen), very toxic
- Choline salicylate (dental gels)
- Numerous over-the-counter analgesics/antipyretics contain aspirin

### Symptoms and signs

#### Common features

- Vomiting
- Dehydration
- Tinnitus
- Vertigo
- Deafness
- Sweating
- Warm extremities with bounding pulse
- Increased respiratory rate
- Hyperventilation
- Acid-base disturbance:
  - aged >4 yr usually mixed respiratory alkalosis and metabolic acidosis with normal or high arterial pH
  - aged <4 yr usually a dominant metabolic acidosis with low arterial pH

#### Uncommon features

- Haematemesis
- Hyperpyrexia
- Hypoglycaemia
- Hypokalaemia
- Thrombocytopenia
- Increased INR/PTR
- Intravascular coagulation
- Acute kidney injury
- Non-cardiac pulmonary oedema
- Confusion
- Disorientation
- Coma
- Convulsions

## IMMEDIATE MANAGEMENT

- Ensure clear airway and adequate ventilation, consider airway adjunct or intubation if unconscious
- Give supplementary oxygen if indicated e.g. respiratory depression
- If ingested >125 mg/kg salicylate within previous hour, give oral activated charcoal 1 g/kg (maximum 50 g), mixed with soft drink/fruit juice if necessary to disguise taste
- Rehydrate orally (IV if vomiting)

### Assessment of severity

- Severity cannot be assessed from plasma salicylate concentrations alone
- Neurological features (e.g. confusion and impaired consciousness), metabolic acidosis, and high salicylate concentrations indicate severe poisoning
- Risk factors for death include:
  - aged <10 yr
  - CNS features
  - acidosis
  - hyperpyrexia
  - late presentation
  - pulmonary oedema
  - salicylate concentration >5.1 mmol/L

# SALICYLATE POISONING • 2/3

## Investigations

- U&E, creatinine
- INR
- PT and FBC
- Arterial blood gases
- ECG (QRS and QT interval prolongation)
- Blood glucose (capillary)
- In asymptomatic patients with a reliable history of ingestion of <125 mg/kg of aspirin, plasma salicylate concentration is not required
- In those who have ingested >125 mg/kg, measure plasma salicylate level
  - repeat level after 2 hours: if rising, repeat levels every 3 hours until the levels are falling
- If coincident paracetamol overdose, check salicylate level before administration of N-acetylcysteine
- Urine pH

## Interpretation of plasma salicylate concentrations

- Clinical presentation is most important factor
- Late presenting patient may have a subtoxic salicylate concentration, but serious acid-base or CNS disturbances
- **If levels still rising, repeat oral activated charcoal**
- Plasma salicylate <300 mg/L (2.2 mmol/L) and mild clinical effects:
  - continue maintenance management
- Plasma salicylate 300–700 mg/L (2.2–5.1 mmol/L) and moderate clinical effects:
  - continue maintenance management and start alkaline diuresis in children aged <5 yr
  - if plasma salicylate >500 mg/L (3.6 mmol/L) in children aged ≥5 yr start alkaline diuresis
- Plasma salicylate >700 mg/L (5.1 mmol/L) and severe clinical effects or metabolic acidosis or plasma salicylate >900 mg/L (6.4 mmol/L)
  - use **haemodialysis**

***Children aged <10 yr have an increased risk of salicylate toxicity and may require haemodialysis at an earlier stage***

## Alkaline diuresis

- Treat hypokalaemia urgently
- If serum potassium low, give potassium chloride 1 mmol/kg oral
  - if not tolerated orally, give sodium chloride 0.9%/glucose 5% with 20 mmol potassium in 500 mL IV at 100% maintenance
- If serum potassium within normal range, alkalise urine to enhance salicylate excretion (optimum urine pH 7.5–8.5)
  - give sodium bicarbonate 8.4% 1 mL/kg (1 mmol/kg) in 500 mL glucose 5% at 2–3 mL/kg/hr (max 1 mmol/min), and repeat if necessary to maintain urine pH 7.5–8.5
  - repeat salicylate levels and potassium level every 1–2 hr

***Do not use volumes of IV fluids above maintenance requirements (forced diuresis) – they do not increase salicylate elimination and can cause pulmonary oedema***

## Haemodialysis

Use in patients with severe poisoning

- Plasma concentrations >700 mg/L (5.1 mmol/L)
- Acute kidney injury
- Congestive cardiac failure
- Non-cardiogenic pulmonary oedema
- Convulsions
- CNS effects not resolved by correction of acidosis
- Persistently high salicylate concentrations unresponsive to urinary alkalisation
- Severe metabolic acidosis
- Children aged <10 yr who have an increased risk of salicylate toxicity

## SUBSEQUENT MANAGEMENT

- During alkaline diuresis, check U&E, blood glucose, acid-base hourly
- Repeat plasma salicylate 2-hrly until falling
- Continue therapy until patient improving and plasma salicylate falling
- Cooling with ice if temp  $>39^{\circ}\text{C}$
- Avoid sedation for agitation – try to nurse in dark and quiet environment with close relative present
- If required, most appropriate sedative is buccal midazolam
- 200–300 microgram/kg (max 8 mg) OR
- 50 microgram/kg over 2–3 minutes IV (can be topped up after 5–10 minutes if ineffective – see BNFc)
- maximum mg/course:
  - aged  $\geq 6$  yr = 10 mg
  - aged  $< 6$  yr = 6 mg
- Convulsions: single brief convulsions do not require treatment
- Control frequent/prolonged seizures with diazepam (300 microgram/kg) IV over 3–5 min [can be repeated after 10 min (max 10 mg)], lorazepam (100 microgram/kg) or midazolam (150–200 microgram/kg IV; although buccal preparations are easier to administer – dosing as per BNFc)
- Treat pulmonary oedema with CPAP or in severe cases IPPV AND PEEP
- See **Poisoning and drug overdose** guideline
- Follow additional guidance on [www.toxbase.org](http://www.toxbase.org) (password from A&E)
- Further advice from National Poisons Information Service (UK – 0344 892 0111 or Ireland 01 809 2566)
- If deliberate self-harm is suspected, follow local protocol for referral (see **Self harm** guideline)
- Information sharing with other agencies as relevant e.g. school nurse, social services
- Give advice to seek further medical assistance if symptoms develop after discharge

# TRICYCLIC POISONING • 1/2

*Always follow your local Child Safeguarding Policies and Procedures.  
The safety of children is everyone's responsibility*

## RECOGNITION

### Preparations

- Amitriptyline, dosulepin (highest risk fatality from overdose)
- Clomipramine, doxepin, imipramine, lofepramine, nortriptyline, trimipramine

### Symptoms and signs

#### *Early in poisoning*

- Anticholinergic effects (tachycardia, hot, dry skin, dry mouth and tongue, dilated pupils, urinary retention)
- Ataxia, nystagmus
- Drowsiness
- Metabolic acidosis
- Hypokalaemia

#### *Severe cases*

- Hypotension
- Increased tone, hyperreflexia
- Coma
- Seizures
- Respiratory depression
- Cardiac arrhythmias

## IMMEDIATE MANAGEMENT

*If a benzodiazepine has also been taken, do NOT give flumazenil*

### Investigations

- U&E
- Arterial blood gas
- 12-lead ECG, large doses cause prolongation of P-R and QRS intervals

### Management

- Ensure clear airway and adequate ventilation – consider airway adjunct or intubation if unconscious
- Give supplementary oxygen if indicated e.g. respiratory depression
- Correct any hypoxia
  - if PaCO<sub>2</sub> >6 kPa in respiratory failure arrange assisted ventilation
- If high dose see Toxbase for detail on individual drugs (e.g. amitriptyline >3 mg/kg) within previous hour, give activated charcoal 1 g/kg (max 50 g) either oral (mixed with soft drink/fruit juice if necessary to disguise taste) or, if drowsy or unconscious, by nasogastric tube (provided airway can be protected)
- Admit to HDU
- Treat arrhythmias by correction of hypoxia and acidosis
  - if presents with torsade de pointes, consider magnesium sulphate
  - sodium bicarbonate 8.4% diluted in an equal volume of glucose 5% and give a 'calculated' dose: dose (in mmol) = desired change in base deficit (current-target) x 0.3 x weight (kg) to a maximum of 50 mmol (ideally via central vein). For rapid correction administer over 20 min, otherwise administer at a rate of 1 mmol/min. **Caution required if solution to be given by peripheral venous line, as irritant to veins and can cause local necrosis in cases of extravasation**
  - if unresponsive discuss using lipid emulsion with National Poisons Information Service (NPIS) (0344 892 0111)
  - do not use arrhythmics
  - consult local paediatric cardiac team
- Hyperpyrexia (>39°C): treat with ice bags and sedation: if persists give dantrolene, discuss with NPIS

*Prolonged resuscitation (up to 1 hr) may be successful after cardiac arrest*

## SUBSEQUENT MANAGEMENT

- See **Poisoning and drug overdose** guideline
- Follow additional guidance on [www.toxbase.org](http://www.toxbase.org) (password from A&E)
- Further advice from UK National Poisons Information Service (NPIS) (0344 892 0111 )
- Cardiac monitoring should be continued for at least 6 hr afterwards
- asymptomatic patients with normal ECG after 6 hr are unlikely to develop late complications
- If modified release formulation was taken, or evidence of CNS/respiratory depression, a repeat dose of activated charcoal maybe considered. Contact NPIS for further advice
- In severe cases, correct hypotension by raising foot of bed or, if necessary, expanding intravascular volume
- Control convulsions with lorazepam IV
- If patient hypothermic, rewarm slowly using conventional means (e.g. Bair Hugger, blankets)
- Treat skin blisters as burns
- monitor for rhabdomyolysis (look for coca-cola coloured urine testing positive for blood, measure creatine kinase)
- Forced diuresis, haemodialysis or haemoperfusion **are of no value**
- Agitation and visual and auditory hallucinations are common during recovery and may require treatment with high doses of diazepam
- If deliberate self harm is suspected follow local protocol for referral (see **Self harm** guideline)
- Information sharing with other agencies as relevant e.g. school nurse, social services
- Give advice to seek further medical assistance if symptoms develop after discharge

# DIABETES AND FASTING FOR SURGERY • 1/5

## INTRODUCTION

Children with diabetes mellitus undergoing surgery are at risk of hypoglycaemia and hyperglycaemia

## DEFINITIONS

### Peri-operative management

- Dependent upon insulin regimen

### Minor surgery

- Short procedures (<30 min)
- With/without sedation or anaesthesia
- Rapid recovery anticipated
- Child expected to be able to eat by next meal
- Examples include:
  - endoscopic biopsies
  - myringotomy
  - incision and drainage

### Major surgery

- General anaesthesia lasting >30 min or a procedure likely to cause post-operative nausea, vomiting or inability to feed adequately
- If unsure about length of anaesthetic or risk of slow post-operative recovery from anaesthesia, discuss with anaesthetist

## ELECTIVE SURGERY

### Glycaemic targets

- If glycaemic control very poor [ $HbA_{1c} >75$  mmol/mol (9.0%)] postpone elective surgery
- If glycaemic control poor, consider admission to hospital before surgery for assessment and stabilisation
- if control remains problematic, cancel surgery and re-schedule

### Pre-operative assessment

- Surgeon to inform hospital, paediatric diabetes team and anaesthetist:
  - date and time of planned procedure (if possible child first on morning list)
  - type of procedure: major/minor
- Before surgery paediatric diabetes team to:
  - optimise glycaemic control
  - ensure parents have clear written instructions regarding management of child's diabetes (including any medication adjustments)
  - if surgery taking place in another hospital, local diabetes team must inform other hospital diabetes team

### Pre-operative fasting

- Before elective surgery
  - children: no solid food up to 6 hr
  - infants: breast milk up to 4 hr and other milks up to 6 hr
- Encourage to drink clear fluids (including water, low-sugar squash) >2 hr before elective surgery
- if not possible give IV fluid

### Peri-operative blood glucose targets

- 5–11.1 mmol/L
- Check at least hourly before, during and after surgery

## CHILDREN WHO ARE INSULIN TREATED

### Minor elective morning surgery

#### Day before surgery

- Advise normal insulin and diet

#### Morning of procedure

- Admit
- If possible child should be first on list

# DIABETES AND FASTING FOR SURGERY • 2/5

- Insert IV cannula
- Measure and record capillary blood glucose hourly pre-operatively, and half-hourly during operation

## **Basal bolus regime using multiple daily injection (MDI) regimens with stable blood glucose between 5–11.1 mmol/L**

- Omit rapid-acting insulin [e.g. insulin aspart, (NovoRapid®) insulin lispro (Humalog®), insulin glulisine (Apidra®)] in the morning until after procedure: give with late breakfast
- If basal insulin analogue [insulin glargine (Lantus®) or insulin detemir (Levemir®)] is usually given in the morning, continue as usual

## **Insulin pumps**

- Before surgery:
  - run pump at usual basal rate
  - check blood glucose hourly and ask parents to adjust basal rates to maintain blood glucose between 5–11.1 mmol/L
- During surgery
  - run pump on normal basal setting for duration of procedure
  - once nil-by-mouth check blood glucose hourly, and half-hourly during operation
  - basal rate can be suspended for 30 min to correct any episodes of mild hypoglycaemia
  - if pump stopped for 30–60 min, start on IV insulin and intravenous fluid – see **Maintenance fluid guide** and **Insulin infusion guide**

## **Premixed insulin in the morning (biphasic regimen)**

- Delay morning dose until after procedure, then give with late breakfast

## **All insulin regimens (peri-/post-operative)**

- Blood glucose <5 mmol/L
- glucose 10% 2 mL/kg IV bolus; recheck blood glucose 15 min later
- blood glucose >12 mmol/L
- start IV insulin infusion and IV fluids as per sliding scale – see **Maintenance fluid guide** and **Insulin infusion guide**
- if procedure delayed for further 2 hr, or child has had repeated low blood glucose, start on maintenance IV fluids – see **Maintenance fluid guide**

## **Minor elective afternoon surgery**

### **Day before surgery**

- Advise usual doses of insulin before procedure

### **Morning of procedure**

- Advise to have normal breakfast no later than 0730 hr
- breakfast insulin dose dependent on regimen

### **MDI regimen**

- FULL usual dose of rapid-acting insulin [e.g. insulin aspart (NovoRapid®), insulin lispro (Humalog®), insulin glulisine (Apidra®)] according to carbohydrate content of breakfast, as well as usual correction dose, depending on pre-meal blood glucose level
- If insulin glargine (Lantus®) or insulin detemir (Levemir®) given in the morning: give dose in FULL

### **Twice daily insulin regimen**

- Give half of rapid-acting component of morning dose as rapid-acting insulin  
**Example: if usual morning dose is 10 units of NovoMix® 30 or Humulin M3®, then the usual fast-acting component is:**  
 $3/10 \times 10 = 3$  units of rapid acting insulin [e.g. insulin aspart (NovoRapid®), lispro (Humalog®), glulisine (Apidra®)] give half of this i.e. 1.5 units

### **Insulin pumps**

- Run pump on normal basal setting
- Check blood glucose at least hourly
- Patient/carer to alter infusion rate accordingly



# DIABETES AND FASTING FOR SURGERY • 3/5

## ***Peri-operatively***

- Measure and record capillary blood glucose on arrival
- Insert IV cannula
- Child should be first on list
- Measure and record capillary blood glucose hourly (once nil-by-mouth), and half-hourly during operation
- Blood glucose <5 mmol/L:
  - give glucose 10% 2 mL/kg IV bolus
  - recheck blood glucose after 15 min
  - if procedure delayed for further 2 hr, or child is continuing to have low blood glucose, start on maintenance IV fluids – see **Maintenance fluid guide**
- Blood glucose ≥12 mmol/L:
  - start IV insulin infusion and IV fluids as per sliding scale – see **Maintenance fluid guide** and **Insulin infusion guide**
- Children on insulin pumps should continue as long as their blood glucose remains between 5–11.1 mmol/L
  - blood glucose should be checked hourly pre-operatively, and half-hourly during surgery
  - if blood glucose <5 mmol/L, suspend pump for 30 min and give glucose bolus (see above)
  - if pump stopped for >1 hr start IV insulin and intravenous fluid – see **Maintenance fluid guide** and **Insulin infusion guide**

## ***After procedure***

- Once eating, give usual dose rapid acting insulin generally taken with that meal
- If needing IV fluids and insulin infusion – see **How to restart subcutaneous insulin after being on intravenous insulin**
- Insulin pump regimen:
  - allow parents to re-start pump at usual basal rate once the child has recovered
  - discharge when eating and drinking, regardless of blood glucose level (in consultation with diabetes team); parent will control better at home

## **Major elective morning surgery**

### ***Day before surgery***

- Admit day before surgery
- Measure and record: weight, U&E, FBC, true blood glucose, urine or blood for ketones, pre-meal and bedtime capillary blood glucose
- Give usual insulin evening and night before surgery
- if using insulin pump continue as usual with parental management until surgery

### ***Morning of surgery***

- First on list
- Nil-by-mouth <6 hr before operation
- morning list patients should commence nil-by-mouth 0300 hr (can drink clear fluids >2 hr before operation)
- Omit rapid-acting insulin in the morning
- If insulin glargine (Lantus<sup>®</sup>) or insulin detemir (Levemir<sup>®</sup>) given in the morning, give usual FULL dose
- At 0630 hr start:
  - intravenous maintenance fluids at maintenance rate
  - intravenous insulin according to sliding scale
  - Maintain blood glucose level 5–11.1 mmol/L – see **Maintenance fluid guide** and **Insulin infusion guide**
  - Measure and record capillary blood glucose pre-theatre, and half-hourly during surgery
  - If on insulin pump, parents to continue with usual management until operation, then stop pump and commence IV infusion

### ***After surgery***

- Measure and record capillary blood glucose and ketones hourly
- Continue IV fluids and IV insulin infusion until ready to start eating
- Give basal insulin analogue [subcutaneous insulin glargine (Lantus<sup>®</sup>) or insulin detemir (Levemir<sup>®</sup>)] at usual time, (including if still on IV fluids and sliding scale of insulin)
- See **How to restart subcutaneous insulin after being on intravenous insulin**

## **Major elective afternoon surgery**

### ***Day before surgery***

- Admit to ward

# DIABETES AND FASTING FOR SURGERY • 4/5

- Measure and record: weight, U&E, FBC, true blood glucose, urine or blood for ketones, pre-meal and bedtime capillary blood glucose
- Give usual insulin evening and night before surgery
- Insulin pump: continue pump as usual with parental management until time of operation

## **Morning of surgery**

- Light breakfast at 0700 hr on morning of procedure, and then nil-by-mouth (check with anaesthetist for exact timing)
- Basal bolus (MDI): rapid-acting insulin – take at FULL usual dose according to carbohydrate content, as well as usual correction dose, depending on pre-meal blood glucose level
  - if basal insulin analogue [e.g. insulin glargine (Lantus<sup>®</sup>) or insulin detemir (Levemir<sup>®</sup>)] given in the morning, dose should also be given in FULL
- Biphasic insulin regimen: give half usual morning insulin dose
- Intravenous fluid infusions from 1200 hr and intravenous insulin infusion – see **Maintenance fluid guide** and **Insulin infusion guide**
- Measure capillary blood glucose pre-theatre and half-hourly during operation
- For those on insulin pumps continue pump as usual with parental management until time of operation

## **After surgery**

- Measure and record capillary blood glucose and ketones hourly including theatre
- Continue IV fluids and IV insulin infusion until ready to start eating
- See **How to restart subcutaneous insulin after being on intravenous insulin**

## **Emergency surgery**

### **Before surgery**

- Measure and record weight, capillary and plasma blood glucose, venous blood gases, blood ketones, electrolyte, urea and creatinine
- Inform diabetes team of admission
- If ketoacidotic:
  - see **Diabetic ketoacidosis** guideline
  - operate when rehydrated, blood pressure stable, blood glucose normal, and sodium and potassium in normal range
  - blood glucose levels should also be stable; ideally 5–11.1 mmol/L
    - may not be possible for some life-saving operations
- If not ketoacidotic
  - see **Major elective surgery**
  - start fluid maintenance and intravenous insulin – see **Maintenance fluid guide** and **Insulin infusion guide**
  - for those on insulin pump, stop pump once IV infusion started
  - always give basal insulin analogue [subcutaneous insulin glargine (Lantus<sup>®</sup>) or insulin detemir (Levemir<sup>®</sup>)] at usual time (including if still on IV fluids and sliding scale of insulin)

### **After surgery**

- Measure capillary blood glucose hourly and check for blood ketones on every sample (including whilst in theatre)
- Continue IV fluids and insulin infusion until ready to eat
- See **How to restart subcutaneous insulin after being on intravenous insulin**

## **MAINTENANCE FLUID GUIDE**

- Fluid of choice – sodium chloride 0.9% with glucose 5%

### **Glucose**

- Use glucose 5%
- if concern about hypoglycaemia, use 10 %
- If blood glucose >12 mmol/L, increase insulin supply – see **Insulin infusion guide**

### **Potassium**

- Monitor electrolytes
- Include potassium chloride 20 mmol/L in IV fluid

# DIABETES AND FASTING FOR SURGERY • 5/5

## Maintenance fluid calculation

	Body weight in kg	Fluid requirement in 24 hr
For each kg between	3–9 kg	100 mL/kg
For each kg between	10–20 kg	Add an additional 50 mL/kg
For each kg over	>20 kg	Add an additional 20 mL/kg

## INSULIN INFUSION GUIDE

- Dilute 50 units soluble insulin (Actrapid®) in sodium chloride 50 mL; 1 unit per mL

### Start infusion rate

Blood glucose	Rate	Dose
6–8	0.025 mL/kg/hr	0.025 units/kg/hr
8–12	0.05 mL/kg/hr	0.05 units/kg/hr
12–15	0.075 mL/kg/hr	0.075 units/kg/hr
>15	0.1 unit/kg/hr	0.1 units/kg/hr

- Monitor blood glucose hourly before surgery, half-hourly during operation, and until child recovers from anaesthesia. Adjust IV insulin accordingly
- If blood glucose <5 mmol/L:
  - stop IV insulin infusion for 10–15 min
  - give glucose 10% 2 mL/kg IV bolus
  - recheck blood glucose after 15 min

## HOW TO RESTART SUBCUTANEOUS INSULIN AFTER BEING ON INTRAVENOUS INSULIN

### If ready to eat at lunch give the following insulin:

- Biphasic injection regimen, NOT using long-acting basal insulin analogue e.g. glargine; allow to eat but continue IV insulin sliding scale until evening meal
- Patients using long-acting basal insulin analogues e.g. glargine: give rapid-acting insulin with lunch
- Check long-acting insulin has been carried on throughout stay. If missed dose, delay restarting subcutaneous insulin until had long-acting insulin
- For patients on insulin pump:
  - parents can restart insulin pump at usual basal rate once child feeling better and blood glucose levels are stable with no ketones
  - allow parents to manage according to their usual practice

### If ready to eat by evening meal give the following insulin:

- Biphasic injection regimen NOT using long-acting basal insulin analogue e.g. glargine: give usual dose of insulin with evening meal
- Multiple injection regimen with long-acting basal insulin analogue e.g. glargine: give rapid-acting insulin with evening meal and long-acting insulin analogue at usual time
- Always give dose of long-acting basal insulin analogue e.g. glargine at usual time, even if still on intravenous fluids and intravenous insulin overnight, to prevent rebound hyperglycaemia
- If child first given premixed insulin or long-acting basal insulin analogue dose, stop IV insulin 60 min after subcutaneous insulin has started
- If child is given a rapid acting insulin dose, stop IV insulin 10 min after subcutaneous insulin has started
- Insulin pump: parents can restart pump at usual basal rate once child feeling better and capillary blood glucose levels stable with no ketones
- allow parents to manage according to their usual practice

## ORAL MEDICATIONS

### Metformin

- Discontinue at least 24 hr before procedure for elective surgery
- in emergency surgery and when stopped <24 hr, ensure optimal hydration to prevent risk of lactic acidosis

### Other oral medications e.g. sulphonylureas/thiazolidinediones

- Stop on day of surgery

# DIABETIC KETOACIDOSIS • 1/6

## RECOGNITION AND ASSESSMENT

### Symptoms and signs

- Thirst
- Weight loss
- Polyuria
- Abdominal pain/vomiting
- Tachypnoea
- Sighing respiration (Kussmaul breathing)
- Odour of ketones
- Dehydration
- Drowsiness
- Coma
- Biochemical signs:
  - ketones in urine or blood
  - elevated blood glucose (>11 mmol/L)
  - acidaemia (pH <7.3)

### Assessment

- Airway, breathing, circulation
  - record respiratory rate, heart rate, BP, peripheral pulse volume
- Conscious level: look for signs of cerebral oedema (see **Glasgow coma score** guideline)
- Headache, confusion, irritability, abnormal movements, slow pulse, high BP, papilloedema, small and irregular pupils
- Infection
- Height, weight
- Dehydration:
  - pH >7.1 = mild/moderate (5%)
  - pH <7.1 = severe (10%)

### Investigations

- Insert IV cannula (as large as appropriate for child)

### All cases

- Capillary blood glucose
- FBC
- Blood glucose
- Blood gas
- Haemoglobin A<sub>1c</sub>
- Blood osmolality, sodium, potassium, urea, bicarbonate, creatinine, pH
- Urine ketones on urinalysis
- Blood ketones
- Infection screen: blood and urine culture; if meningism consider lumbar puncture

### Severe cases

- Liver function tests and amylase
- Group and save

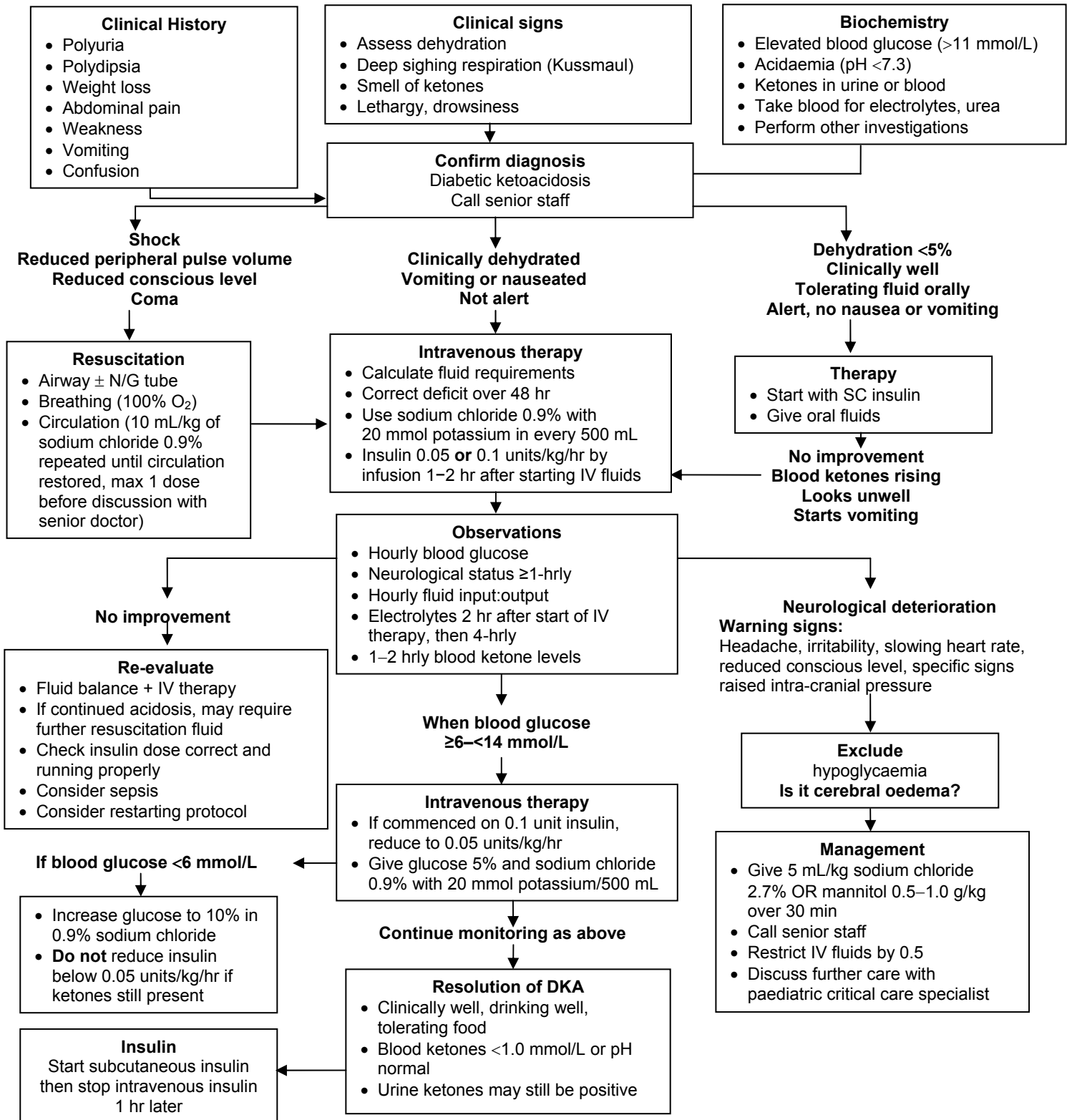
### Newly diagnosed case

- Thyroid and coeliac disease antibody screen
- Islet cell antibodies
- GAD antibodies
- Thyroid function tests, TSH, Free T4
- Immunoglobulin A

# DIABETIC KETOACIDOSIS • 2/6

## ALGORITHM (cross-referenced to text)

- Remember paediatric type 2 patients can present in DKA



# DIABETIC KETOACIDOSIS • 3/6

## IMMEDIATE TREATMENT

*Inform senior staff*

### Admission

- If alert and not shocked, admit to ward/HDU
- If shock or GCS <8, admit to PICU
- Discuss with PICU if:
  - pH <7.1 and marked hyperventilation
  - aged <2 yr

### General

- Nil-by-mouth for first 8–12 hr
- if vomiting, abdominal pain, no bowel sounds or decreased GCS, insert nasogastric tube
- Place on weigh-bed (if available)
- Strict fluid balance: consider catheterisation of children requiring HDU or PICU
- Start flow-sheet to record biochemistry and blood gases
- Monitor ECG for T wave changes
- Initiate IV fluids and insulin (see below)

### Shock and resuscitation

- Patient is shocked (very rare in DKA):
  - poor peripheral pulses
  - poor capillary refill
  - tachycardia
  - with or without hypotension
- Give sodium chloride 0.9% 10 mL/kg as bolus
- do not give >1 bolus IV without discussion with responsible senior paediatrician
- If child cannot protect airway: seek urgent anaesthetic review and discuss with paediatric critical care specialist
- If in hypotensive shock: discuss use of inotropes with paediatric critical care specialist
- When no longer shocked and circulated blood volume has been restored, calculate volume of fluid required (see below)

## INTRAVENOUS FLUIDS

- See <http://www.bsped.org.uk/clinical/docs/DKACalculator.pdf>

### Volume of fluid

- Total fluid requirement is the addition of 4 categories:
  - fluid to re-expand circulating volume if shocked
  - maintenance fluids
  - deficit
  - continuing losses, do not include continuing urinary losses at this stage

### Maintenance fluids

- Patient will be nil-by-mouth and will need normal fluid requirement IV

Weight (kg)	Rate
0–9	2 mL/kg/hr
10–39	1 mL/kg/hr
≥40	40 mL/hr

### Fluid deficit

- Estimated amount of fluid patient has lost (dehydration)
- Deficit in mL = % dehydration × body weight (kg) × 10 (e.g. for a 10 kg child with 5% dehydration, the deficit is  $5 \times 10 \times 10 = 500$  mL)

# DIABETIC KETOACIDOSIS • 4/6

## Total Amount

- Hourly rate of fluid replacement = (48 hr maintenance requirements + deficit – resuscitation fluid already given (>20 mL/kg)/48 (see **Example** below)
- Weight should rise gradually with rehydration
- If available use weigh-bed to record weight hourly to obtain accurate assessment

### Example:

A 60 kg girl aged 16 yr with a pH of 6.9, who was given sodium chloride 0.9% 30 mL/kg for circulatory collapse will require:

deficit 10% x 60 kg	= 6000 mL
- 10mL/kg (excess over 20 mL/kg) resuscitation fluid (-600)	= 5400 mL
÷ over 48 hr	= 113 mL/hr
plus maintenance fixed rate	= 40 mL/hr
<b>Total</b>	<b>= 153 mL/hr</b>

## Type of fluid

- Initially use sodium chloride 0.9% with potassium chloride dependent on serum potassium as described in **Table 1**. Use **commercially premixed bag**
- Maximum rate potassium 0.2 mmol/kg/hr (ward)
- If femoral line used prescribe dalteparin 100 units/kg/day (max 5000 units) SC

Table 1

K <sup>+</sup> <3.5	K <sup>+</sup> 3.5–5.5	K <sup>+</sup> >5.5
500 mL sodium chloride 0.9% with potassium chloride 0.6% (40 mmol/500 mL) via <b>central line</b>	Sodium chloride 0.9% with potassium chloride 0.3% (40 mmol/L)	Sodium chloride 0.9%

***If serum potassium <2.5 mmol/L, transfer to PICU. Discuss with consultant whether to give potassium chloride 0.2 mmol/kg in sodium chloride 0.9% by separate infusion over 1 hr. Before infusing bag containing potassium, connect patient to cardiac monitor.***  
***If possible, use commercially premixed bag. Only in exceptional circumstances (with consultant agreement and 2 doctors checking procedure) should potassium chloride be added on the ward to a bag of sodium chloride 0.9% (mix well)***

- Further fluid and K<sup>+</sup> as dictated by the patient's condition and serum K<sup>+</sup> (**Table 1**), repeated until glucose fallen to 14 mmol/L, then move to **Subsequent management**

## Fluid losses

- If a massive diuresis continues for several hours fluid input may need to be increased
- If large volumes of gastric aspirate continue, these will need to be replaced with sodium chloride 0.45% with potassium chloride

## Oral fluids

- If receiving intravenous fluids for DKA **do not** give oral fluids until ketosis is resolving and there is no nausea/vomiting
- In the case of gastric paresis a nasogastric tube may be necessary
- If oral fluids given before 48 hr rehydration period completed, reduce IV infusion to take account of oral intake

***Do not give intravenous sodium bicarbonate to children and young people with DKA***

## Insulin infusion

- Start 1–2 hr after IV fluids**
- Soluble insulin (e.g. Actrapid<sup>®</sup>) infusion 1 unit/mL in sodium chloride 0.9% via IV syringe pump at 0.05–0.1 units/kg/hr (according to local policy)
- If no fall in glucose after 2 hr (very unusual, check pump and patency of IV cannula), increase by 20%. If no fall after 4 hr, increase to 0.1 unit/kg/hr and re-evaluate (e.g. sepsis, insulin errors)
- If blood glucose falls exceeds 5 mmol/L/hr, reduce insulin infusion rate to 0.05 unit/kg/hr initially then adjust if necessary
- Do **not** stop insulin infusion. Check capillary glucose in 1 hr
- If IV fluids and insulin given through same cannula use anti-reflux valve

# DIABETIC KETOACIDOSIS • 5/6

**Do not give insulin bolus. Do not add insulin directly to fluid bags**

## Other insulin management

### **Continuous subcutaneous insulin infusion (CSII) pump therapy**

- Stop pump when starting intravenous insulin

### **Long-acting insulin [especially insulin glargine (Lantus®)]**

- Usual dose/time may be continued throughout DKA treatment in addition to IV insulin infusion, in order to shorten length of stay after recovery from DKA

## MONITORING TREATMENT

- Hourly capillary blood gas and glucose
- Check U&E, glucose, osmolality pH and capillary ketones 2-hrly until improving, then 4-hrly
- Neurological status, heart rate and blood pressure hourly (half hourly if aged <2 yr)
- Complete DKA summary sheets
- If complaining of headache: for medical review

## Medical reviews

- At 2 hr after starting treatment, and then ≥4-hrly, carry out and record results of:
  - glucose (laboratory measurement)
  - blood pH and pCO<sub>2</sub>
  - plasma sodium, potassium and urea
  - blood ketones (beta-hydroxybutyrate)
- Doctor to carry out face-to-face review at start of treatment, and then 4-hrly, and more frequently if:
  - aged <2 yr
  - severe DKA (blood pH <7.1)
  - any other reasons for special concern
- At each face-to-face review assess following:
  - clinical status (including vital signs and neurological status)
  - blood investigation results
  - ECG trace
  - cumulative fluid balance record

## SUBSEQUENT MANAGEMENT

**When blood glucose falls below 14 mmol/L use a glucose containing fluid**

- Maintenance fluid dependent on, glucose and potassium

**Table 2: Glucose**

Blood glucose	Fluid: sodium chloride 0.9% with potassium chloride (see Table 1) and
0–6.0	Glucose 10%
6.1–14.0	Glucose 5%
>14	No glucose

- If pH >7.3 reduce insulin infusion rate to 0.05 units/kg/hr (if on 0.1 units/kg/hr)
- Blood glucose may rise as a result, **but do not revert to sodium chloride 0.9% unless plasma pH falls**
  - if pH falls, reassess fluid deficit and regimen
- If glucose falls below 4 mmol/L, give 2 mL/kg glucose 10% IV. Reduce insulin infusion rate by 20%. Check capillary glucose in 1 hr
- To make glucose 10% with sodium chloride 0.9% (with or without potassium): remove 50 mL from 500 mL bag of glucose 5%, sodium chloride 0.9% (with or without potassium) and add 50 mL of glucose 50%
- Continue with IV fluids and insulin infusion until blood ketones <0.5 and child tolerating oral fluids and food
- Start subcutaneous insulin ≥30 min before stopping intravenous insulin
- If using insulin pump therapy:



# DIABETIC KETOACIDOSIS • 6/6

- restart pump  $\geq 60$  min before stopping intravenous insulin
- change insulin cartridge and infusions set
- insert cannula into new subcutaneous site

## If acidosis not improving, consider:

- Insufficient insulin to switch off ketones
- Inadequate resuscitation
- Sepsis
- Hyperchloraemic acidosis
- Salicylate or other prescription or recreational drugs

## Cerebral oedema

- Observe for headache, any change in symptoms, pH  $< 7.2$ , or persistently low serum sodium as glucose corrects
- Exclude hypoglycaemia
- If cerebral oedema suspected, inform consultant immediately
- Give 5 mL/kg of sodium chloride 2.7% over 10–15 min
- if not available give mannitol 0.5 g/kg (2.5 mL/kg of 20%) over 15 min, repeat mannitol after 2 hr if required
- restrict IV fluid intake to half maintenance and replace deficit over 72 hr
- if patient unconscious, insert urethral catheter
- admit to PICU
- consider CT scan/MR scan

## Converting to SC insulin

- Inform diabetes team (consultant, diabetes nurse and dietitian)
- Children usually require insulin 0.5–1.0 units/kg/day (pre-pubertal usually 0.5–0.6 units/kg/day; higher in puberty)
- **If converting to multiple daily dose regimen:**
  - give 40% as long-acting insulin at night
  - 20% short-acting insulin with each of the 3 main meals
  - Adjust ratio if necessary, depending on child's eating patterns
  - Start subcutaneous insulin  $\geq 30$  min before stopping intravenous insulin
  - If using insulin pump therapy:
    - restart pump  $\geq 60$  min before stopping intravenous insulin
    - change insulin cartridge and infusions set
    - insert cannula into new subcutaneous site

## DISCHARGE AND FOLLOW-UP

- Prescribe following as TTO for all new patients (according to local policy):
  - brand and strength of regular long-acting insulin, specify if pre-filled pen or cartridges
  - brand of soluble short-acting insulin, specify if pre-filled pen or cartridges
  - needles 4 or 5 mm
  - 1 pack hypostop triple pack
  - 1 packet glucose tablets
  - 1 box lancets (e.g. Micro-Fine™ plus)
  - GlucaGen® HypoKit (glucagon) 1 kit 500 microgram  $< 25$  kg, 1 mg  $\geq 25$  kg
  - 1 box blood glucose strips appropriate to blood glucose monitor
  - 1 box Ketostix® (ketones in urine)
  - 1 box blood ketone testing strips
- Organise out-patient follow-up

# DIABETES NEW (NON-KETOTIC) • 1/2

*Any child or young person presenting to GP or A&E with symptoms suggestive of diabetes should be referred (by phone) immediately to paediatric diabetes team/paediatric assessment unit*

## RECOGNITION AND ASSESSMENT

### Definition

Elevated blood glucose with no ketonuria/blood ketones

- Random plasma glucose  $\geq 11$  mmol/L
- Or symptoms + fasting plasma glucose  $\geq 7$  mmol/L

### Symptoms and signs

- Change in school performance
- Thirst
- Weight loss
- Thrush
- Polyuria
- Nocturia
- Tiredness
- If obese, no ketonuria or evidence of insulin resistance (e.g. acanthosis nigricans), consider type 2 diabetes

### Investigations

- Height and weight
- Blood:
  - glucose
  - electrolytes
  - pH
  - ketones
- haemoglobin A<sub>1c</sub>
- FBC
- cholesterol and triglycerides
- TSH and FT4
- immunoglobulins G, A and M
- autoantibody screen for thyroid, coeliac, GAD and islet cell antibodies

*Do not arrange a fasting blood glucose or glucose tolerance test*

## IMMEDIATE TREATMENT

- Admit under admitting consultant of day/week
- Inform diabetes team, consultant or diabetes nurse specialist
- Start on SC insulin, total daily dose of 0.5 units/kg:1 unit/kg
- **If starting on multiple daily dose regimen:**
  - give 40% as long-acting insulin at night
  - 20% short-acting insulin with each of the 3 main meals
- Adjust ratio if necessary, depending on child's eating patterns

## SUBSEQUENT MANAGEMENT

- If tolerating food, allow patient to eat according to appetite for first 24–48 hr
- Adjust insulin according to child's eating habits
- Refer to dietitians

## MONITORING TREATMENT

- Glucose stick monitoring pre-meals and at 0000 and 0400 hr

## DISCHARGE AND FOLLOW-UP

- Out-patient appointment to see consultant 1–2 weeks after discharge
- Prescribe as TTO (dependent on local policy):
  - brand and strength of regular (long-acting) insulin, specify if pre-filled pen or cartridges

## DIABETES NEW (NON-KETOTIC) • 2/2

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- brand of soluble (short-acting) insulin, specify if pre-filled pen or cartridges
- needles 4 or 5 mm
- 1 pack glucogel triple pack
- 1 packet glucose tablets
- 1 box lancets (e.g. Microfine plus)
- GlucaGen hypoKit (glucagon) 1 kit 500 microgram <25 kg, 1 mg  $\geq$ 25 kg
- 1 box blood glucose sticks appropriate to blood glucose monitor
- 1 box ketostix (ketones in urine)
- 1 box blood ketone testing strips

# HYPOGLYCAEMIA • 1/5

## Management of unexplained and prolonged hypoglycaemia

### RECOGNITION AND ASSESSMENT

#### Definition

- For the purposes of this guideline, hypoglycaemia defined as a blood glucose <2.6 mmol/L in child aged >1 month

#### Symptoms and signs

- Lethargy
- Tremulousness
- Loss of consciousness
- Seizure
- Autonomic effects
  - sweating
  - shaking
  - tachycardia
  - anxiety
  - hunger

#### Previous history

- Ask about:
  - antenatal history (e.g. small-for-dates)
  - prematurity
  - history of hypoglycaemia on the neonatal unit
  - early or prolonged jaundice
  - family history of sudden death (MCAD, LCAD)
  - development, especially developmental regression
  - medication
  - access to glycopenic agents (e.g. metformin)
  - oral hypoglycaemics
  - nutritional intake

#### Investigations

***Certain pointers to cause of unexplained hypoglycaemia are detectable only during episode. Take blood samples BEFORE correcting blood glucose***

#### Immediate samples

- Before treating hypoglycaemia, take venous blood for assay using correct blood bottles (**Table 1**)
- once samples have been obtained, correct hypoglycaemia. See **Immediate treatment**
- inform laboratory immediately so samples arrive as quickly as possible (within 20 min)
- **Ensure first voided urine specimen after hypoglycaemia episode is obtained (minimum 10 mL) to test for ketone bodies, organic/amino acid metabolites and reducing substances. Check with laboratory**

**Table 1: Total blood requirement (5 mL minimum)**

Fluoride	1.3 mL (1 bottle)
Lithium heparin	2.6 mL (2 bottles)
Clotted	2.6 mL (2 bottles)

# HYPOGLYCAEMIA • 2/5

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## ***Investigations***

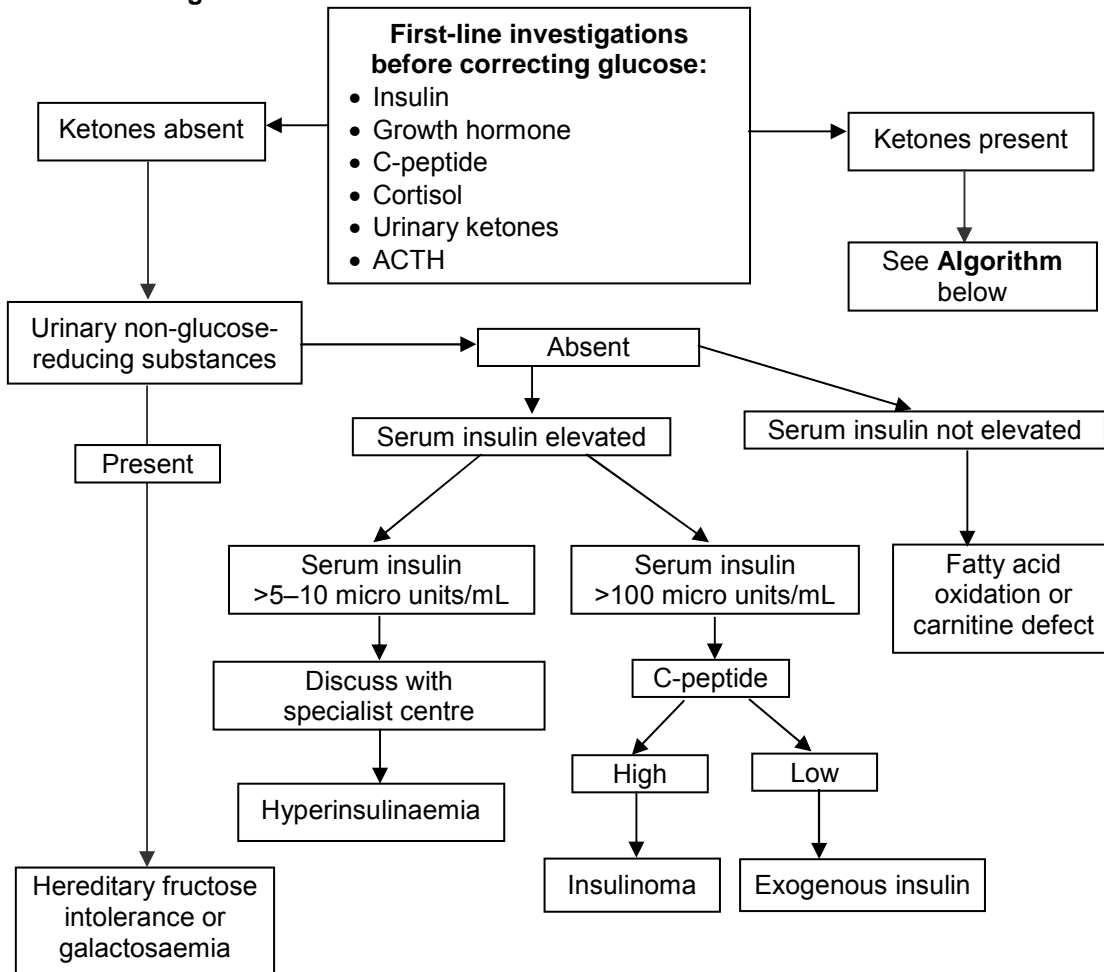
- In all prolonged unexplained hypoglycaemia:
  - glucose – point of care
  - capillary blood gas
  - laboratory glucose
  - lactate
  - ACTH
  - growth hormone
  - insulin (clotted sample – send in ice)
  - C-peptide (clotted sample – send in ice)
  - cortisol
  - urea and electrolytes
  - urinary ketones
  - 17 O HP in infant if hyponatraemia present
- Store blood and urine for these investigations depending on above results:
  - IGF1
  - beta-hydroxybutyrate
  - free fatty acids
  - carnitine
  - urinary-reducing substances
  - organic and amino acids

## ***Physical examination***

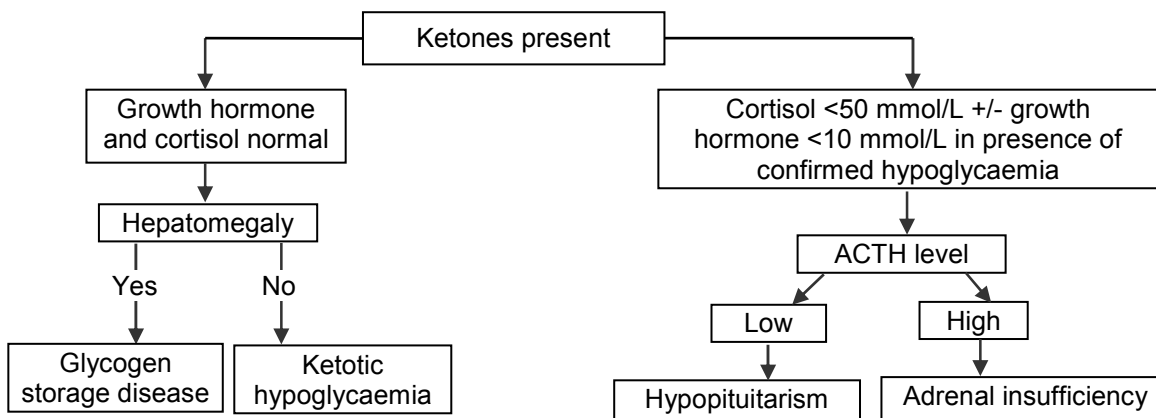
- Height and weight
- Midline defects, micropenis, optic nerve hypoplasia (pituitary disorder)
- Dysmorphic features: macroglossia, macrosomia, ear lobe crease (Beckwith-Wiedemann)
- Skin hyperpigmentation (adrenal insufficiency)
- Hepatomegaly (glycogen storage disorder)

# HYPOGLYCAEMIA • 3/5

## Differential diagnosis

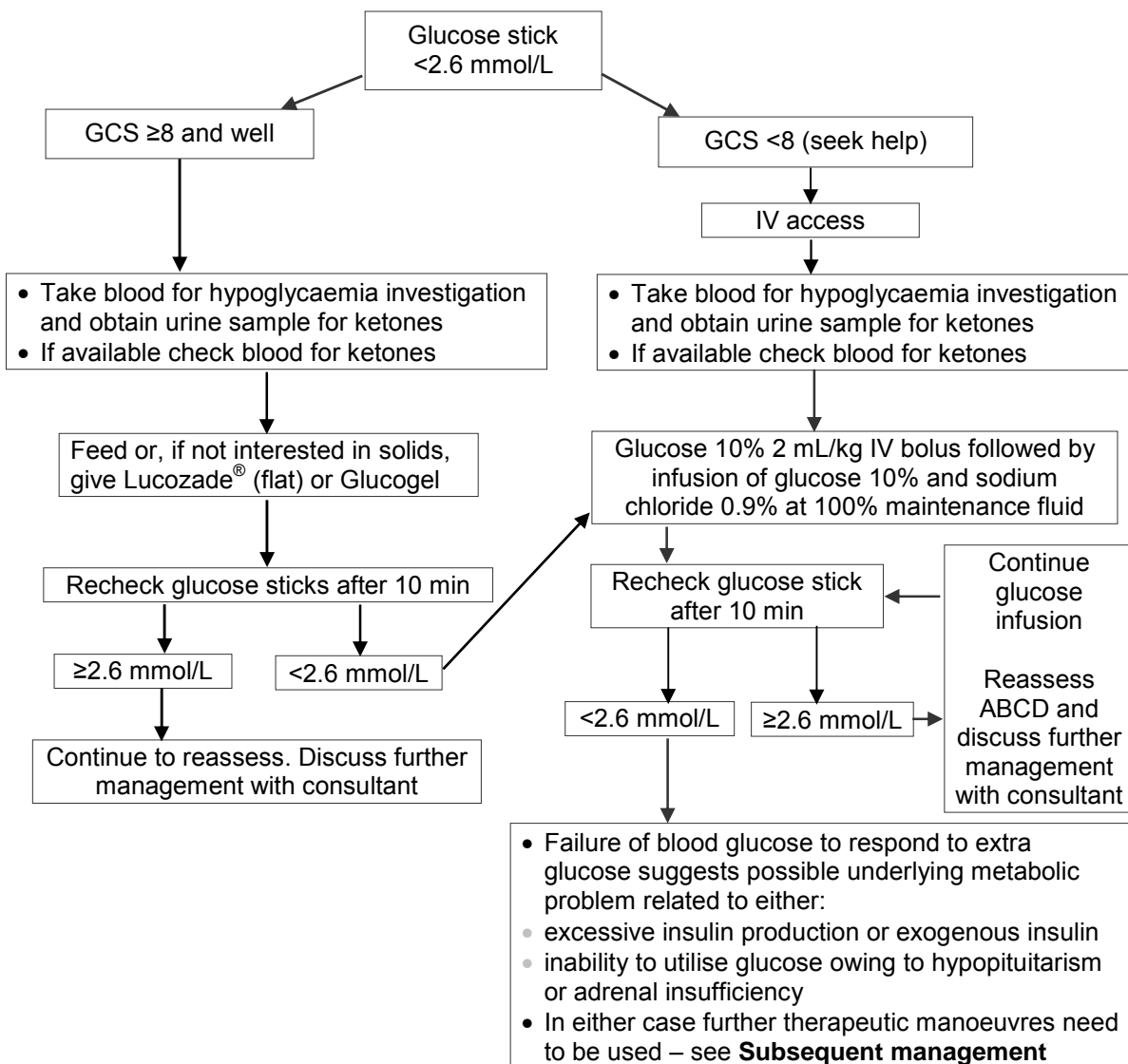


## Algorithm: Ketones present



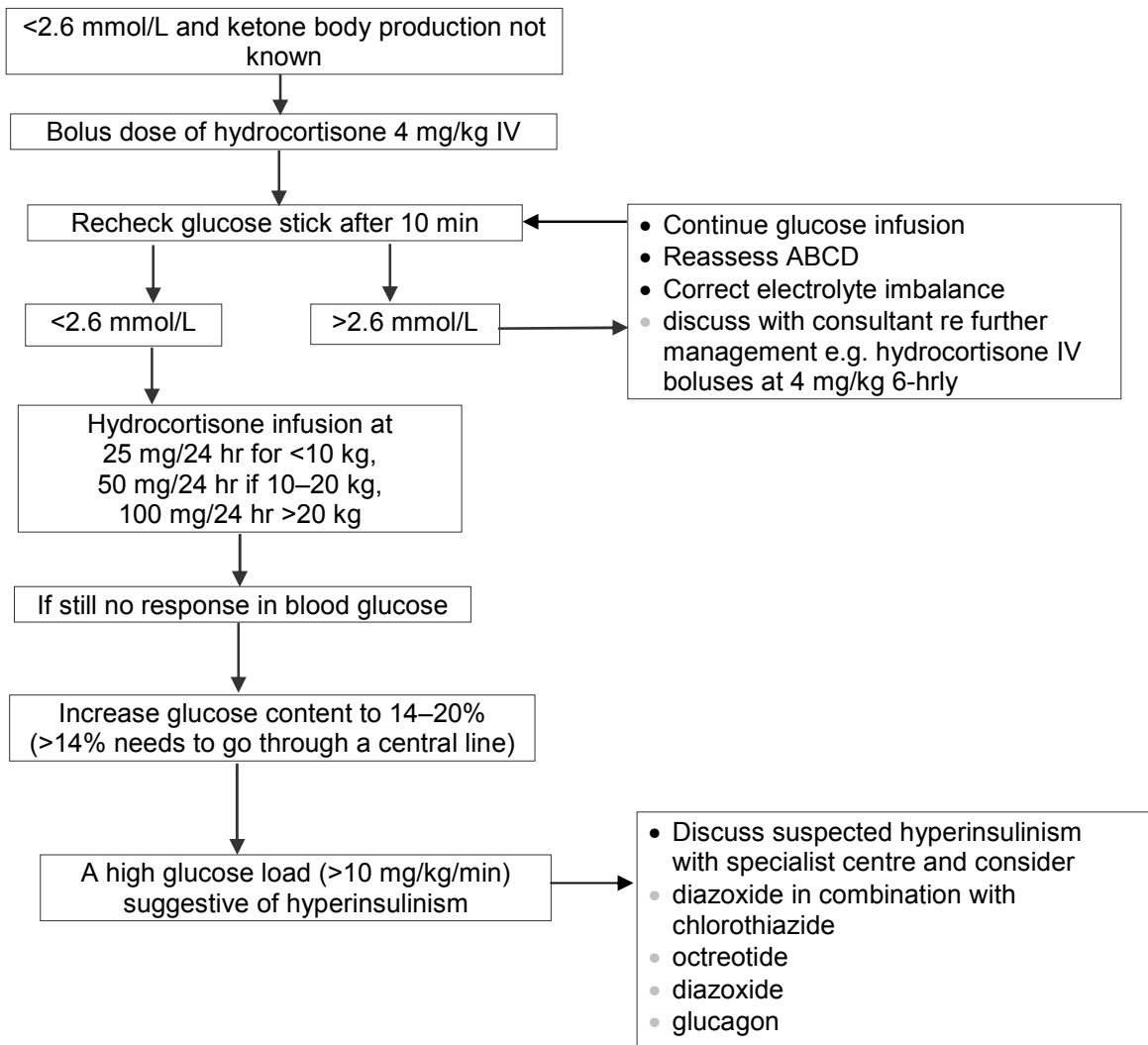
# HYPOGLYCAEMIA • 4/5

## IMMEDIATE TREATMENT



# HYPOGLYCAEMIA • 5/5

## SUBSEQUENT MANAGEMENT



To calculate the amount of glucose/kg/min:  $\frac{\% \text{ glucose} \times 10 \times \text{volume/hr}}{60 \times \text{wt (kg)}}$



# KETONE MONITORING • 1/2

Blood ketone monitoring for all subcutaneous insulin regimes and insulin pump therapy

Negative ketones <0.6 mmol/L	Small to moderate ketones 0.6–1.5 mmol/L	Moderate to large ketones >1.5 mmol/L
Give correction dose (CD) to correct high blood glucose (BG) in addition to normal bolus for carbohydrates eaten	Give: <ul style="list-style-type: none"> <li>• 10% of total daily dose (TDD) of insulin as additional fast acting insulin</li> </ul> OR <ul style="list-style-type: none"> <li>• 0.1 units/kg body weight as additional fast acting insulin</li> </ul>	Give: <ul style="list-style-type: none"> <li>• 20% of total daily dose (TDD) of insulin as additional fast acting insulin</li> </ul> OR <ul style="list-style-type: none"> <li>• 0.2 units/kg body weight as additional fast acting insulin</li> </ul>
Then: <ul style="list-style-type: none"> <li>• Re-check BG and ketones in 2 hr</li> </ul>	Then: <ul style="list-style-type: none"> <li>• Monitor fluid intake and ensure remains well-hydrated</li> <li>• Re-check BG and ketones in 2 hr (see below)</li> </ul>	Then: <ul style="list-style-type: none"> <li>• Monitor fluid intake and ensure remains well-hydrated</li> <li>• Re-check BG and ketones in 2 hr (see below)</li> </ul>
If BG is going down that is a good sign but monitor closely throughout the day  <b>If BG increasing but ketones &lt;0.6 mmol/L:</b> <ul style="list-style-type: none"> <li>• Give another correction dose using pen</li> </ul> If ketones 0.5–1.5 mmol/L, follow <b>small/mod</b> column advice  If ketones >1.5 mmol/L, follow <b>mod/large</b> column advice	If ketone negative follow <b>negative</b> column advice  <b>If BG increasing but ketones still 0.6–1.5 mmol/L:</b> <ul style="list-style-type: none"> <li>• Continue to give 10% of TDD <b>or</b> 0.1 unit/kg as additional fast acting insulin every 2 hr using pen</li> <li>• Give usual boluses for food</li> <li>• Re-check BG and ketones every 2 hr, including through the night</li> </ul> If ketones increase to >1.5 mmol/L follow <b>mod/large</b> column advice	If ketones negative follow <b>negative</b> column advice  <b>If BG increasing but ketones have reduced to 0.6–1.5 mmol/L follow <b>small/mod</b> column advice:</b>  If ketones still >1.5 mmol/L: <ul style="list-style-type: none"> <li>• Give another 20% TDD <b>or</b> 0.2 units/kg as additional fast acting insulin every 2 hr using pen</li> <li>• Give usual boluses for food</li> <li>• Once vomiting with high ketones, have low threshold for admission to hospital</li> </ul>

## SICK DAY DOSES

### Insulin pumps

- When unwell if blood glucose levels are high carry out standard checks on pump for:
  - occlusions
  - disconnection
  - battery failures
- Blood ketone level:
  - <0.6 mmol/L: give correction dose through pump
  - >0.6 mmol/L: give additional fast acting insulin using pen
- If 1 correction dose via pump has no effect in 1 hr, repeat correction dose with insulin pen
- Monitor blood glucose regularly
- If blood glucose levels rising in unwell child needing frequent additional insulin doses, consider using higher temporary basal rates – up to 200% of normal basal rates may be needed in some patients

## PRE-ADMISSION MANAGEMENT OF INFECTIONS USUALLY ASSOCIATED WITH HYPOGLYCAEMIA (E.G. GASTROENTERITIS)

- Encourage regular small sips of sugar-containing drinks (**not** diet drinks)
- Monitor blood glucose  $\geq 2$ -hrly
- If oral intake reduced and BG in normal/low range: decrease usual fast acting insulin whilst illness persists
- BG:
  - 10–14 mmol/L: give usual fast acting dose of insulin
  - >14 mmol/L: see above for extra insulin doses

## KETONE MONITORING • 2/2

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- Once oral intake is tolerated again, give normal dose of insulin
- If not tolerating anything orally and BG are  $<4$  mmol/L: advise attend hospital
- If drowsy or reduced conscious level advise give glucagon IM as follows and dial 999:
  - if aged  $>1$  month and  $<25$  kg give 500 microgram glucagon IM
  - if  $\geq 25$  kg give 1 mg glucagon IM
- if then able to tolerate oral intake and BG  $<4$  mmol/L can go home
- If not tolerating anything orally or BG still  $<4$  mmol/L admit for observation and intravenous glucose if necessary
- If child has been vomiting and not eating they may have ketones with normal BG (starvation ketones)
- Monitor BG frequently and encourage fluids containing sugar
- If BG  $>14$  mmol/L with ketones and vomiting, this is DKA: advise attend hospital urgently

# STEROID DEPENDENCE • 1/2

## Pituitary-adrenal axis impairment

### RECOGNITION AND ASSESSMENT

#### Definition

Children with the following conditions are corticosteroid-dependent with a depressed or absent pituitary-adrenal axis:

- hypopituitarism
- adrenal insufficiency
- congenital adrenal hyperplasia
- growth hormone insufficiency
- prolonged oral corticosteroid use for more than 2 months

***When shocked or stressed corticosteroid-dependent children cannot mount an appropriate adrenal response***

Corticosteroid-dependent children are encountered in a number of ways:

- at presentation and first diagnosis
- for elective surgical and investigative procedures
- for emergency surgery or when acutely unwell
- with hyponatraemia, hyperkalaemia +/- hypoglycaemia and hypotension

### MANAGEMENT

#### Elective surgical and investigative procedures

- Check whether pre-operative discussion of endocrine management has taken place
- if no plan for corticosteroid treatment, prescribe hydrocortisone 2–4 mg/kg IV at induction then 6-hrly until child capable of taking oral medication, then give double usual daily maintenance dosage of hydrocortisone for subsequent 48 hr
- Continue usual medication with:
  - fludrocortisone
  - growth hormone
  - levothyroxine
  - desmopressin

#### Acute illness

- During illness, corticosteroid-dependent children can usually be managed at home
- Moderate illness with temperature  $\leq 38^{\circ}\text{C}$  give double hydrocortisone dose, if temperature  $>38^{\circ}\text{C}$  give treble hydrocortisone dose
- if unable to take oral corticosteroids (e.g. vomiting or acute collapse), parents to administer IM hydrocortisone 2 mg/kg or aged  $<1$  yr 25 mg, 1–5 yr 50 mg, 100 mg thereafter
- If IM hydrocortisone required, hospital assessment necessary
- If IM hydrocortisone not available and child is too unwell to take oral corticosteroids call 999
- Continue usual dose of other medication
- Patients must carry a steroid card

#### Management of unwell corticosteroid-dependent children requiring hospital assessment

- Resuscitate (ABC)
- Monitor BP and GCS
- Obtain IV access
- Take blood for glucose stick, FBC, blood culture, U&E, bicarbonate and blood gas
- If glucose stick  $<2.5$  mmol/L: give bolus of glucose 10% 2 mL/kg and monitor blood glucose
- glucose 10% can be made by removing 50 mL from 500 mL bag of glucose 5% with sodium chloride 0.9% or 0.45% and adding 50 mL glucose 50%
- If shock give sodium chloride 0.9% 20 mL/kg
- do not wait for low BP
- do not give for cold hands in winter
- Give hydrocortisone 4 mg/kg IV bolus
- Commence IV maintenance with sodium chloride 0.9% and glucose 5% at maintenance rate (extra if dehydrated)
- add potassium depending on electrolyte result

## STEROID DEPENDENCE • 2/2

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- Severely ill patients: commence hydrocortisone infusion or 2–4 mg/kg 6-hrly bolus IV
- Regularly monitor BP and blood glucose
- titrate infusion accordingly, i.e. low BP and/or glucose stick, then increase infusion rate
- Once able to tolerate oral fluids, convert to oral corticosteroids (at double normal daily dose) for 2–3 days
- consider treble usual corticosteroid dose initially
- for simplicity, double patient's highest dose of the day (as may be different doses throughout day)
- Continue double/triple normal daily dose of corticosteroid until 2–3 days after recovery from acute episode

# ABDOMINAL PAIN • 1/4

## RECOGNITION AND ASSESSMENT

### Symptoms and signs

- Pain may be localised or generalised
- Vomiting
- Anorexia
- Fever
- Crying and irritability

### Typical features of some important causes of acute abdominal pain in children

#### **Appendicitis**

- History of localised pain with increased severity on RIF
- On examination:
  - low grade fever
  - mid-abdominal pain migrating to RIF
  - guarding and rebound tenderness
  - pain on percussion
- Young children
  - may not have typical features e.g. irritability, grunting, diarrhoea, vomiting, limp, right hip pain

#### **Intussusception**

- Typical age at presentation: 2 months–2 yr
- History of intermittent colicky abdominal pain 2–3 times/hr initially with increasing frequency
- Looks pale with pain
- Lethargic between episodes of pain
- Vomiting prominent feature
- Diarrhoea common
- Passage of blood and/or mucus *per rectum* (redcurrant jelly stools) late sign
- Follows respiratory or diarrhoeal illness
- Clinical features of intestinal obstruction
- On examination:
  - a sausage-shaped mass crossing midline in the right upper quadrant, epigastrium or behind umbilicus may be palpable
  - may be associated with Henoch-Schönlein purpura (children can be aged <2 yr)
  - abdominal distension and hypovolaemic shock are late signs

#### **Mid-gut volvulus**

- Presents mainly in neonatal period
- History of:
  - bowel obstruction
  - abdominal pain
  - distension
  - bilious vomiting (green bile)
- On examination
  - abdominal distension, tenderness

#### **Pneumonia and empyema**

- History of fever and cough
- On examination:
  - tachypnoea
  - recession +/- focal signs at one base
  - decreased breath sounds and dullness to percussion

### Differential diagnosis

#### **Surgical problems**

- Acute appendicitis
- Intussusception
- Intestinal obstruction
- Torsion of ovary or testis
- Meckel's diverticulitis

# ABDOMINAL PAIN • 2/4

- Renal pelvis-ureteric junction hydronephrosis obstruction
- Renal or biliary calculus
- Enterocolitis secondary to Hirschprung's disease

## **Medical problems – relatively common**

- Mesenteric adenitis (history of sore throat)
- Constipation
- Gastroenteritis
- Inflammatory bowel disease
- Lower lobe pneumonia
- Acute pyelonephritis
- Henoch-Schönlein purpura
- Hepatitis
- Acute cholecystitis
- Gastritis/peptic ulcer
- Coeliac disease (chronic history)

## **Medical problems – rare but important**

- Lead poisoning
- Diabetes
- Sickle cell crisis
- Acute porphyria
- Pancreatitis
- Primary peritonitis
- Non-accidental injury

## **Gynaecological problems**

- Ectopic pregnancy
- Torsion of ovarian cyst
- Miscarriage
- Pelvic inflammatory disease (PID)
- Mittelschmerz pain (mid menstrual cycle)
- Imperforate hymen

## **INVESTIGATIONS**

Only urinalysis is essential, other tests as appropriate for differentials above:

- Normal WBC and CRP do not rule out appendicitis
- Urine testing and analysis
- FBC, ESR
- Blood and stool culture
- CRP, U&E, amylase, glucose, LFT
- TTG and IgA if chronic history
- Consider group and save
- Consider pregnancy test in adolescent females (inform patient)

## **Imaging**

- Only if bowel obstruction or perforation suspected: **abdominal X-ray**
- If child stable and suspect appendicitis, intussusception, torsion of ovary or testis, renal problems, pancreatitis or cholecystitis: **ultrasound scan of abdomen**
  - if USS by skilled operator not available CT abdomen can be useful for same conditions, but involves radiation
- If respiratory symptoms: **CXR**
- Do not delay surgical review awaiting scans if acute surgical problem suspected (e.g. torsion of testis, intussusception)

## **MANAGEMENT**

- If present, treat hypotension and shock
- Stop feeding if you suspect surgical problem

## ABDOMINAL PAIN • 3/4

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- If appendicitis suspected, can have clear fluids whilst awaiting surgical review
- Peritonitic: nil-by-mouth
- IV access if surgical cause likely
- Nasogastric tube free drainage if bowel obstruction
- IV antibiotics if perforation (e.g. cefuroxime and metronidazole)

### Indications for surgical review

- Localised right iliac fossa pain
- Rebound tenderness/pain on percussion
- Migration of pain
- Redcurrant jelly stools and bleeding *per rectum*
- Bile-stained vomiting
- Marked abdominal distension
- Inguino-scrotal pain or swelling
- Increasing abdominal pain with progressive signs of deterioration
- If in doubt, discuss with senior colleague

### Observation

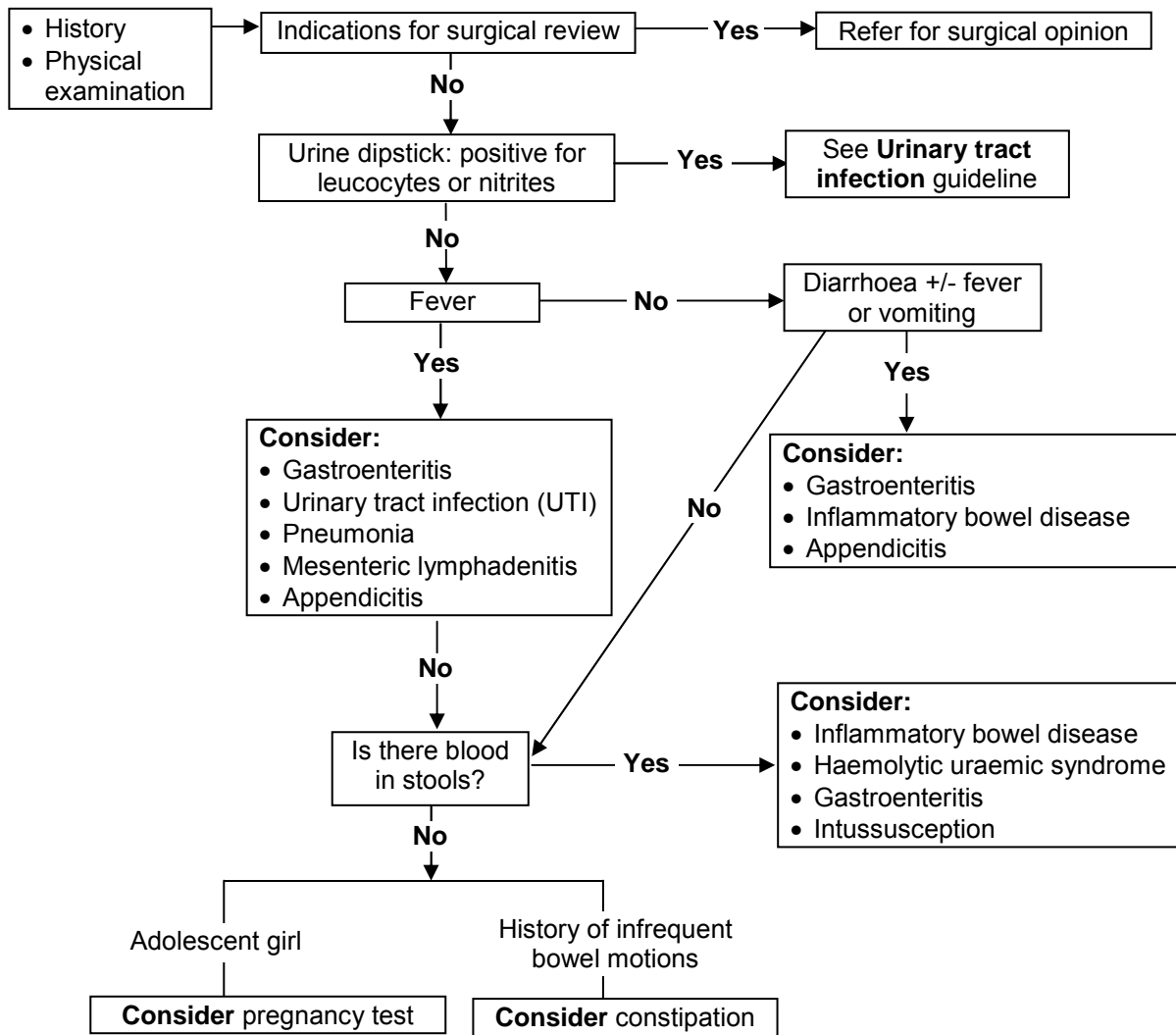
- If stable, period of observation may be useful to make diagnosis

### Analgesia

- Do not withhold analgesia pending surgical review: opioids may be necessary (see **Analgesia** guideline)

# ABDOMINAL PAIN • 4/4

## Management of acute abdominal pain



## DISCHARGE AND FOLLOW-UP

- Discharge usually within 24 hr of symptoms improving (e.g. fever, abdominal pain)
- Follow-up usually appropriate in primary care/GP



# CONSTIPATION • 1/5

## RECOGNITION AND ASSESSMENT

### Definition

- **Constipation:** infrequent bowel evacuation of hard faeces or difficult/painful defecation for  $\geq 1$  month
- **Faecal soiling** (overflow as a result of faecal impaction): passage of loose and offensive stools in child's underwear over which child has no control
- **Encopresis** (functional non-retentive soiling): inappropriate passage of normal stools in inappropriate places. Often associated with behavioural problems
- **Faecal incontinence:** soiling in the presence of an anatomical or organic lesion
- **Faecal impaction:** hard faecal mass in lower abdomen, a dilated rectum impacted with stool or excessive stool in the colon identified radiologically

## KEY POINTS IN HISTORY

- Frequency, volume and type of stool using Bristol stool chart
- Overflow soiling in older children
- Distress and/or straining on opening bowels
- Holding behaviour (crossing legs, back arching or tiptoeing)
- Time of passing meconium after birth
- Bleeding *per rectum*
- Any trigger factors i.e. diet change, infection, potty training or starting nursery/school

## KEY POINTS IN PHYSICAL EXAMINATION

- Weight and height
- Abdominal examination to look for abdominal distension, faecal loading
- Lower limb neuromuscular examination in long standing cases
- Spinal examination
- Inspection of perianal area for appearance, position of anus or evidence of streptococcal infections

### Symptoms and signs suggestive of organic constipation (red flags)

- Early onset of constipation (first few weeks of life)
- Failure to thrive/growth failure
- Neuropathic bowel:
  - lack of lumbosacral curve
  - pilonidal dimple or tuft of hair
  - sacral agenesis
  - flat buttocks
  - patulous anus
  - absent cremasteric reflex/absent anal wink
  - decreased lower extremity tone and/or strength
  - absence or delay in relaxation phase of lower extremity deep tendon reflex
  - urinary symptoms
- Hirschsprung's disease
  - delayed passage of meconium for more than 24 hr after birth in a term baby
  - abdominal distension
  - tight empty rectum in presence of palpable faecal mass
  - gush of liquid stool and air from rectum on withdrawal of finger
  - rarely causes soiling
- Anteriorly displaced anus
- Anal stenosis:
  - tightness or stricture felt when *per rectum* digital examination done using lubricated fifth finger in newborn and infants up to 6 months
- Delayed cow's milk protein allergy in first 3 yr of life

## DIFFERENTIAL DIAGNOSIS

- Idiopathic functional constipation (90–95%). Most common cause of constipation beyond neonatal period

### Organic constipation (suspected in presence of red flags)

- Constipation secondary to anal anatomic malformation (ano-rectal examination required)

# CONSTIPATION • 2/5

- Neurogenic constipation due to spinal cord anomalies or trauma, neurofibromatosis and tethered cord (lower limb neurological examination required)
- Constipation secondary to endocrine/metabolic disorders (hypothyroidism, hypercalcaemia, hypokalaemia, CF)
- Constipation induced by drugs (opioids)
- Coeliac disease

## INVESTIGATIONS

- Most children with chronic constipation require minimal investigation:
  - careful history and physical examination will help determine appropriate investigation
- In cases of refractory constipation (consider earlier if faltering growth/short stature):
  - thyroid function tests
  - coeliac panel
- If delayed passage of meconium:
  - sweat test

### Abdominal X-ray

- Has little or no value in the diagnosis of idiopathic constipation
- lower spine X-ray may be useful in encopresis if no faecal masses on abdominal and rectal examination

### When to consider referral for rectal biopsy

- History of delayed passage of meconium
- Constipation since neonatal period
- History of abdominal distension and vomiting
- Failure to thrive or faltering growth
- Family history of Hirschprung's

## MANAGEMENT OF FUNCTIONAL CONSTIPATION

- See **Constipation management flowchart**

### Principles of treatment

- Education
- Diet and lifestyle
- Behavioural management
- Medication
- Supporting child and family

### Education

- Give parents clear explanation of pathophysiology of constipation and soiling

### Diet and lifestyle

- Use in combination with laxatives
- Ensure adequate fluid intake
- High fibre diet is recommended
- Encourage physical activities

### Behavioural management

- Use of behavioural management in combination with medications decreases time to remission
  - regular toileting: unhurried time on the toilet after meals
  - correct toilet position
  - maintain diaries of stool frequency combined with reward system
  - regular review and positive reinforcement
  - discourage negative responses to soiling from family
  - encourage older children to take responsibility
- May need counselling or a psychology referral in case of motivational or behavioural problems

### Medication

- Disimpaction in the presence of impacted stools

# CONSTIPATION • 3/5

## DISIMPACTION

1. A macrogol laxative [polyethylene glycol (e.g. Movicol<sup>®</sup> paediatric plain)]; faecal impaction dose, see below up to a maximum of 7 days
2. Use stimulant laxative, senna or sodium picosulphate (Picolax<sup>®</sup>) if no result with macrogol or if not tolerated
3. Review all children within/after one week of disimpaction (in hospital or by GP)

### Disimpaction dosage

Age (yr)	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Number of Movicol paediatric plain sachets daily divided into 2–3 doses							
1–5	2	4	4	6	6	8	8
5–11	4	6	8	10	12	12	12
Number of adult Movicol preparation for children aged >12 yr							
12–18	4	6	8	8	8	8	8

### Rectal disimpaction (only if oral disimpaction fails)

- Sodium citrate micro-enemas
- Small volume sodium citrate enemas preferable to large volume phosphate enemas
- Phosphate enemas (only if oral medications and sodium citrate enemas failed). Use only under specialist supervision. Consider sedation if child is distressed

### Manual evacuation

- If all above have failed, consider manual evacuation under general anaesthetic. Consult with paediatric gastroenterologist or paediatric surgeon

## MAINTENANCE THERAPY

- After disimpaction, or if child had no impaction, focus treatment on prevention of recurrence and establishment of a regular bowel habit to allow bowel to regain normal tone and sensation
- Continue maintenance therapy for 4–6 months then reduce dosage gradually
- half the disimpaction dose of Movicol<sup>®</sup> is a useful guide for initial maintenance dose

### Laxatives

- Use macrogols as first line maintenance treatment (½–1 sachet daily in children aged <1 yr)
- If not improved within a month or to prevent recurrence of impaction, add a stimulant laxative such as senna, bisacodyl or sodium picosulphate syrup. Using stimulants is recommended only for short periods of time and intermittently. Use with faecal softener e.g. sodium docusate and/or fibre
- Aim for soft/loose stools initially daily
- High doses (up to 4–6 sachets daily of macrogols) may be required and doses may need frequent adjustment by child and parent to maintain a regular bowel action. Advise parents to reduce doses gradually and to increase again if no bowel action in 3 days
- If macrogols not tolerated, use sodium docusate or lactulose
- Aged <6 months:
  - give infant glycerol suppository once/day
  - change milk to hydrolysed formula if delayed cow's milk allergy suspected

### Supporting child and family

- Organise review within a week then regular and frequent local contact and by telephone to prevent re-impaction
- Provide a contact telephone number for parents if available
- discuss timing of doses for convenience with bowel action
- emphasise need for good compliance
- Use outreach nursing support if available
- Liaise with the child's health visitor, community paediatric nurse and/or school nurse. Send copies of consultations with parental agreement to help provide a unified approach
- Child psychology support when available is invaluable

### Withdrawal of laxatives

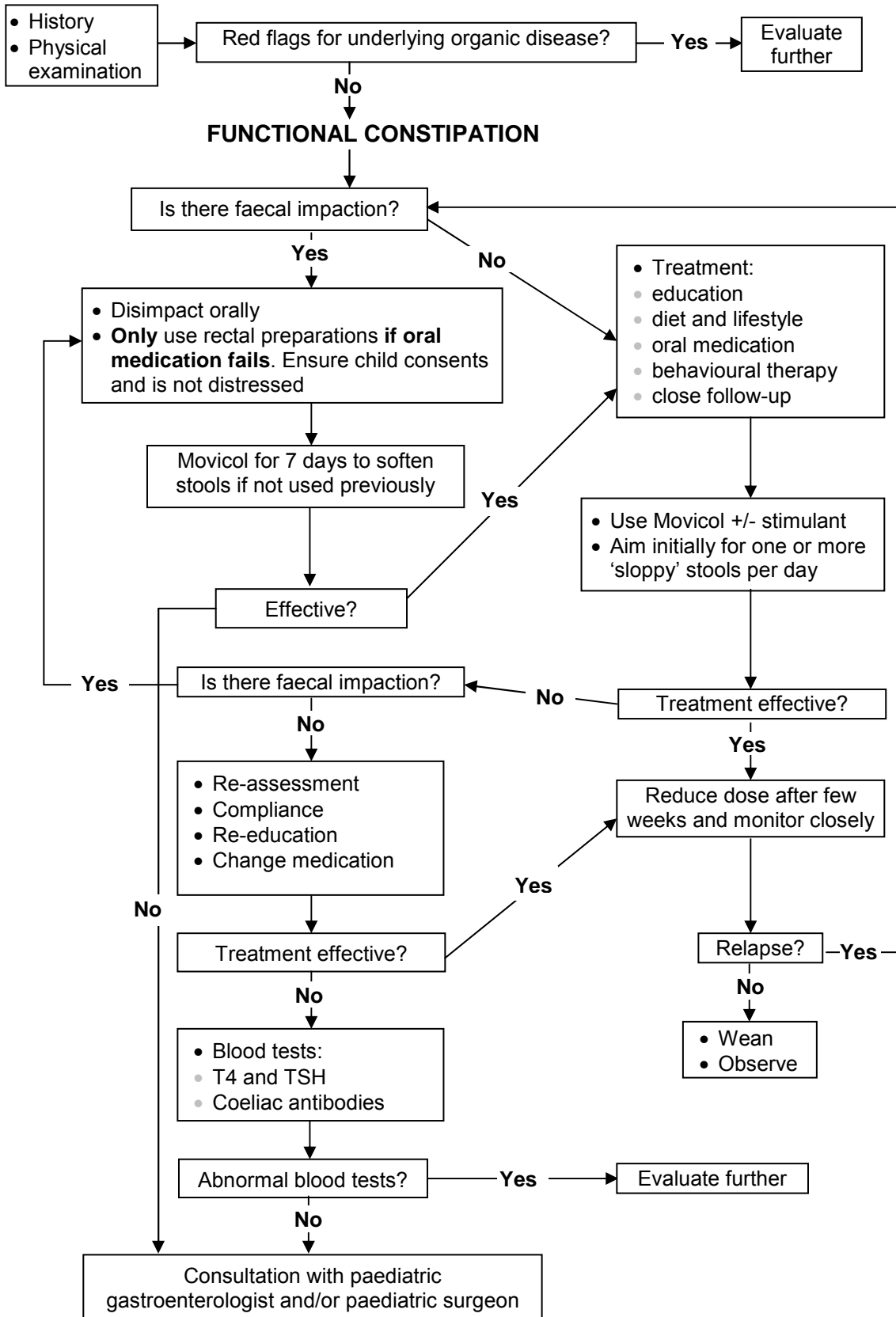
- Once regular bowel habit has been established for a few months, and child has good sensation to pass stools, gradually withdraw laxatives over a period of months

### **INDICATIONS FOR SEEKING ADVICE OF PAEDIATRIC GASTROENTEROLOGIST**

- Organic cause of constipation suspected
- Disimpaction orally/rectally unsuccessful
- Soiling/abdominal pain continues despite treatment
- Children aged <1 yr with faecal impaction or not responding to maintenance therapy

# CONSTIPATION • 5/5

## CONSTIPATION MANAGEMENT



# DIARRHOEA AND VOMITING • 1/5

## RECOGNITION AND ASSESSMENT

### Definition of diarrhoea

- Passage of loose watery stools at least three-times in 24 hr
- Most common cause is acute infective gastroenteritis

*Diarrhoea and vomiting in infants may be a sign of sepsis*

### Symptoms and signs

- Sudden onset of diarrhoea (D) or vomiting (V), or both (D&V)
- Fever, malaise, lethargy
- Abdominal cramps
- Loss of appetite

### Patient history

- Ask about:
  - duration of illness
  - frequency of stools and associated vomiting (>6 stools more likely to become dehydrated)
  - colour of vomit (if green bilious vomit, consider obstruction)
  - nature of stools, including presence of blood in stool
  - feeds (fluid and food intake)
  - urine output (number of wet nappies)
  - contacts/exposure to infection
  - recent travel abroad
  - recent antibiotic use
- symptoms of other causes of D&V (e.g. high pyrexia, shortness of breath, severe/localised abdominal pain or tenderness, symptoms of meningitis/septicaemia)
- weight loss
- underlying problems e.g. low birth-weight, malnutrition, neuro-disability

*Inform public health if outbreak of gastroenteritis suspected or reportable pathogen*

### Assessment

- Weight, including any previous recent weight
- Temperature, pulse, respiratory rate
- Degree of dehydration (see **Table 1**) and/or calculate from weight deficit
- Complete systemic examination to rule out other causes of D&V
- Children aged <1 yr are at increased risk of dehydration

### Calculating fluid deficit over 24 hr

- Deficit in mL = % dehydration x weight (kg) x 10
- e.g. for a 10 kg child with 5% dehydration deficit is 5 x 10 x 10 = 500 mL

### Calculating maintenance fluids

Weight (kg)	Fluid volume
<10	100 mL/kg/day
10–20	1000 mL + 50 mL/kg/day for each kg >10 kg
>20	1500 mL + 20 mL/kg/day for each kg >20 kg

# DIARRHOEA AND VOMITING • 2/5

Table 1: Assessment of degree of dehydration

		Increasing severity of dehydration		
		No clinically detectable dehydration (<5%)	Clinical dehydration 5–10% dehydrated	Clinical shock >10% dehydration
Symptoms (remote and face-to-face assessment)	Appears well	–	■ Appears to be unwell or deteriorating	–
	Alert and responsive	–	■ Altered responsiveness (e.g. irritable, lethargic)	Decreased level of consciousness
	Normal urine output	–	Decreased urine output	–
	Skin colour unchanged	–	Skin colour unchanged	Pale or mottled skin
	Warm extremities	–	Warm extremities	Cold extremities
Signs (face-to-face assessment)	Alert and responsive	–	■ Altered responsiveness (e.g. irritable, lethargic)	Decreased level of consciousness
	Skin colour unchanged	–	Skin colour unchanged	Pale or mottled skin
	Warm extremities	–	Warm extremities	Cold extremities
	Eyes not sunken	–	■ Sunken eyes	–
	Moist mucous membranes (except for 'mouth breather')	–	Dry mucous membranes (except after a drink)	–
	Normal heart rate	–	■ Tachycardia	Tachycardia
	Normal breathing pattern	–	■ Tachypnoea	Tachypnoea
	Normal peripheral pulses	–	Normal peripheral pulses	Weak peripheral pulses
	Normal capillary refill time	–	Normal capillary refill time	Prolonged capillary refill time
	Normal skin turgor	–	■ Reduced skin turgor	–
	Normal blood pressure	–	Normal blood pressure	Hypotension (decompensated shock)

## Investigations

- If vomiting a major feature or vomiting alone, or if baby aged <3 months: urine for MC&S
- If septicaemia suspected, child immunocompromised, or if stools bloody, mucous or chronic diarrhoea present, send stools for MC&S and virology
- If recent antibiotics and aged >2 yr send stool for *Clostridium difficile* toxin
- If severe dehydration, possible hypernatraemic dehydration (see **Hypernatraemic dehydration** below) or diagnosis in doubt:
  - FBC, U&E, chloride, glucose, blood and urine cultures. Blood gas or venous bicarbonate
  - if decreased level of consciousness consider lumbar puncture, especially in babies

## IMMEDIATE TREATMENT

See **Flowchart – Management of acute gastroenteritis in young children (aged <4 yr)**

### General advice to parents

- Adequate hydration important
- Encourage use of oral rehydration solution (ORS)
- 'clear fluids' (water alone/homemade solutions of sugar and fruit) lack adequate sodium content and are inappropriate
- sugar, fruit juices and cola have a high osmolar load and little sodium, and can worsen diarrhoea
- Recommend early re-feeding with resumption of normal diet (without restriction of lactose intake) after 4 hr rehydration
- Do not use opioid anti-diarrhoeal agents. The enkephalinase inhibitor racecadotril can be used to reduce diarrhoeal stools
- Anti-emetics can be given for vomiting

**Continue breastfeeding throughout episode of illness, ORS can be given in addition**

### Treatment of dehydration

- Admit if:

# DIARRHOEA AND VOMITING • 3/5

- patient  $\geq 10\%$  dehydrated
- failure of treatment (e.g. worsening diarrhoea and/or dehydration)
- other concerns (e.g. diagnosis uncertain, child aged  $< 3$  months, irritable, drowsy, potential for surgical cause)

## **Step 1: Mild dehydration (<5%)**

- Can be managed at home
- Emphasise to parents importance of adequate hydration
- Rehydrate orally using ORS (prescribe sachets and give clear instructions: if genuinely not tolerated, parents may substitute with diluted sugar containing juice)
- calculate fluid deficit and replace over 4 hr with frequent small volumes (5 mL every 1–2 min)
- continue to supplement with ORS for each watery stool/vomit (10 mL/kg per watery stool)
- Do not withhold food unless vomiting
- full feeding appropriate for age well tolerated with no adverse effects

## **Step 2: Moderate dehydration (6–10%)**

- If improving after 4 hr observation, can be managed at home provided social circumstances are appropriate/parents are happy. Otherwise, admit
- Calculate deficit and aim to replace with ORS 50 mL/kg oral over 4 hr
- Give small frequent volumes (5 mL every 1–2 min)
- If not tolerating oral rehydration (refuses, vomits, takes insufficient volume), use NG tube
- Review after 4 hr
- when rehydrated start a normal diet, and continue maintenance fluids and supplementary ORS for each watery stool or vomit (10 mL/kg per watery stool)
- if dehydration persists, continue the same regimen but replace fluid deficit with ORS over the next 4 hr
- if this fails, e.g. vomiting ORS, consider IV rehydration (see below)
- If improving move to **Step 1**

## **Step 3: Severe dehydration (>10%) – see flowchart**

**Beware hypernatraemic dehydration. See Hypernatraemic dehydration section**

- If child in shock, first resuscitate with sodium chloride 0.9% (20 mL/kg) and reassess
- If  $> 10\%$  dehydration, obtain IV access, especially if child drowsy
- Calculate deficit using recent normal weight if available
- If alert, rehydrate orally with ORS, replacing deficit (plus maintenance requirement) over 4 hr
- Use NG tube if necessary
- If oral/NG rehydration not possible, replace deficit with isotonic fluid e.g. sodium chloride 0.9% or sodium chloride 0.9% with glucose 5% and potassium as excess gastrointestinal losses are usually high in potassium – see **IV fluid therapy** guideline
- if hypoglycaemic or at risk of hypoglycaemia use sodium chloride 0.9% with glucose 5% and potassium chloride
- start normal diet as soon as tolerated
- continue to replace ongoing losses with ORS for each watery stool or vomit (5 mL/kg per watery stool)
- when improves move to **Step 2**

## **Hypernatraemic dehydration (Na $> 150$ mmol/L)**

- In hypernatraemic dehydration, there are fewer signs of dehydration
- skin feels warm and doughy, child lethargic and irritable/jittery with hypertonia and hyperreflexic. They may have seizures
- if in shock, resuscitate with sodium chloride 0.9% 20 mL/kg bolus
- if Na  $> 170$  mmol/L, contact PICU
- if child has passed urine, give IV fluid bags containing potassium – initially at 10 mmol/500 mL, adjust according to blood results when available

**In hypernatraemic dehydration, aim to reduce sodium by no more than 10 mmol/L in 24 hr**

- After initial resuscitation, give ORS: (maintenance) +replace deficit over 48 hr – via NG if necessary
- Check U&E after 1 hr

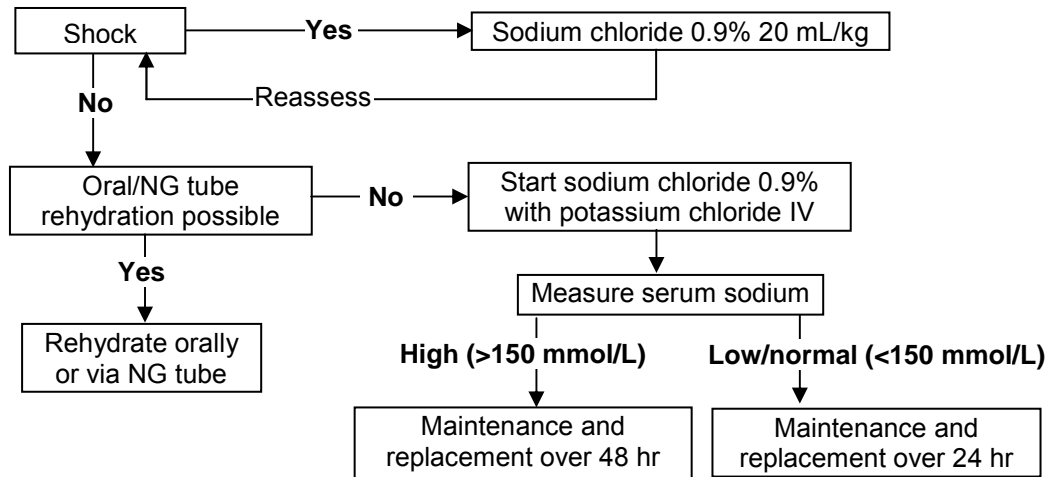


# DIARRHOEA AND VOMITING • 4/5

- If ORS not tolerated or sodium drops  $>0.5$  mmol/L/hr, start IV rehydration with sodium chloride 0.9%, (maintenance) +replacing deficit over 48 hr
- Recheck U&E after 1–4 hr (depending on rate of drop of serum sodium and starting value)
- If sodium dropping by  $>0.5$  mmol/L/hr, reduce rate by 20%
- Once rehydrated, start normal diet including maintenance fluids orally

**Hyponatraemia** (see IV fluid therapy guideline)

## MANAGEMENT OF SEVERE DEHYDRATION

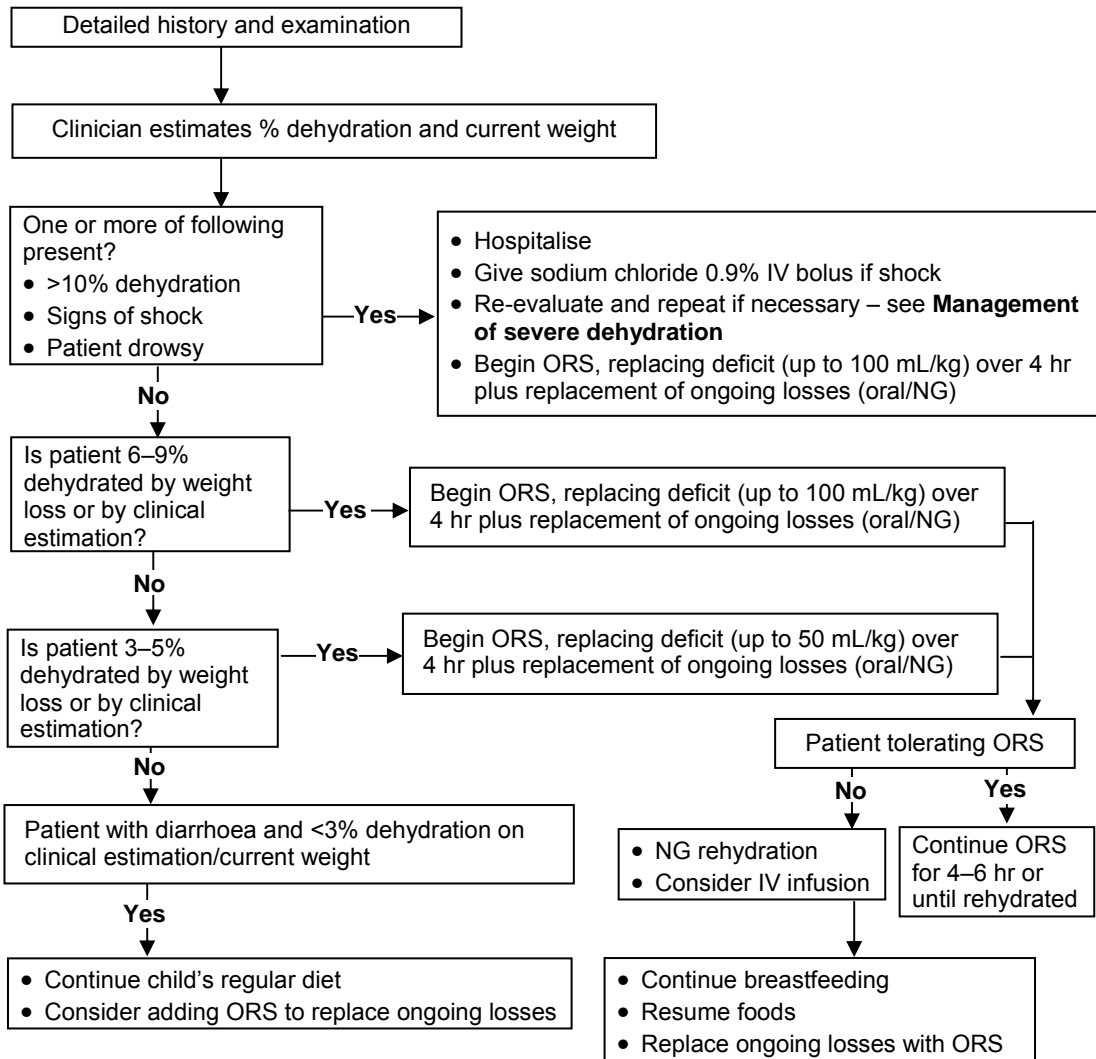


## DISCHARGE AND FOLLOW-UP

- If dehydration was  $>5\%$ , ensure child has taken and tolerated 2 breast or bottle feeds, or at least 1 beaker of fluid
- Check child has passed urine
- Tell parents diagnosis and advise on management and diet
- Explain nature of illness, signs of dehydration, and how to assess and deal with continuing D&V (explain flagged symptoms in table of dehydration)
- Emphasise importance of adequate hydration. If dehydration recurs will need further rehydration
- If symptoms persisting, aged  $<1$  yr or low birth weight, continue to supplement with ORS at 5 mL/kg per watery stool or vomit
- Do not withhold food, (especially breast milk), full feeding appropriate for age if well tolerated after initial rehydration
- Advise parents how to prevent transmission to other family members and contacts
  - patient should not share towels with others
  - hand-washing with soap and warm water after using toilet or changing nappy. Dry hands properly
- Exclude from school/nursery until 48 hr from last episode of diarrhoea or vomiting
- Exclude from swimming for 2 weeks following last episode of diarrhoea
- Give open access if appropriate, ensure parents aware of how to seek help if needed
- If diarrhoea persists for  $>10$  days, advise to return for medical reassessment

# DIARRHOEA AND VOMITING • 5/5

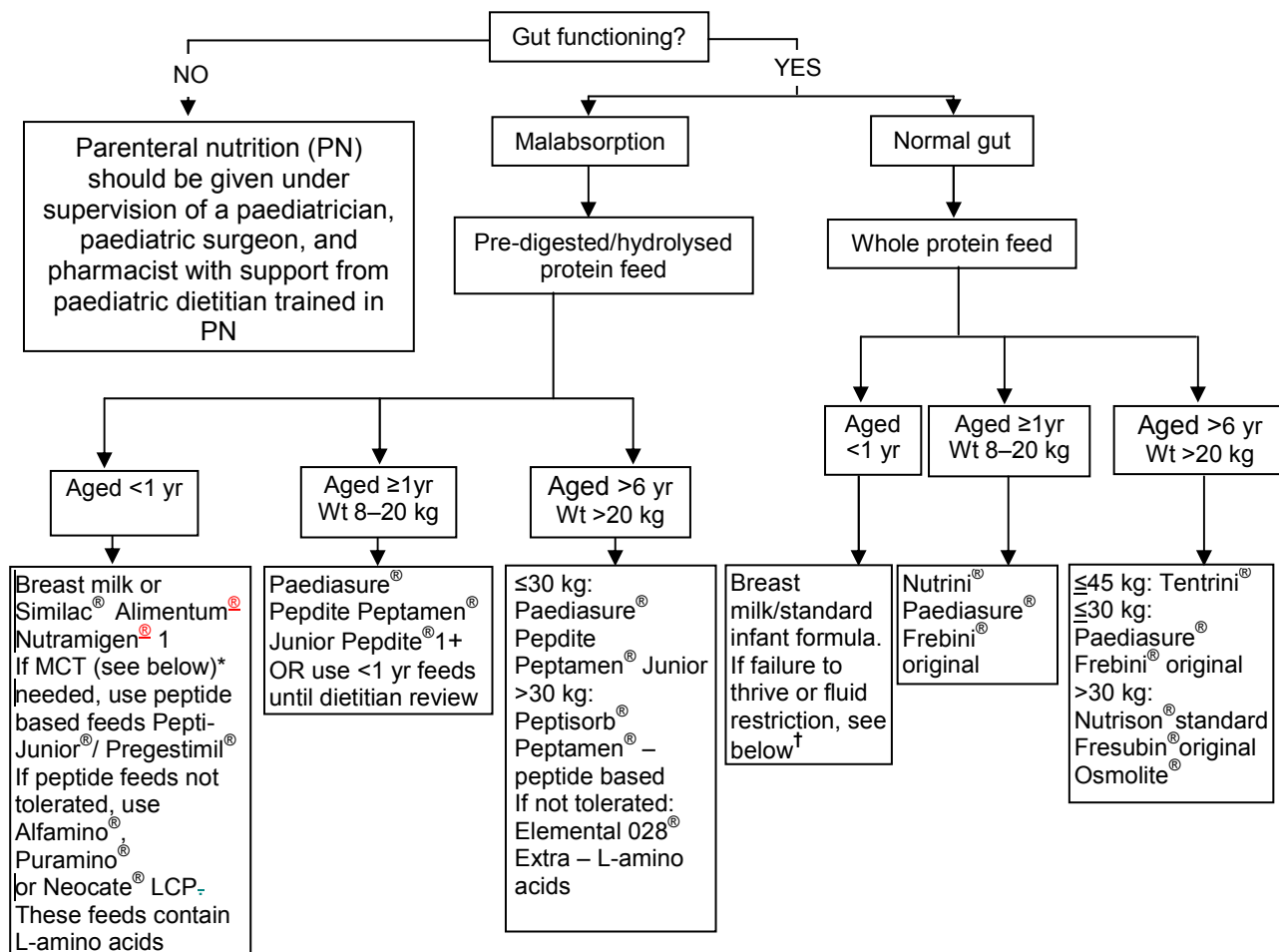
## MANAGEMENT OF ACUTE GASTROENTERITIS IN YOUNG CHILDREN (AGED <4 YR)



# NUTRITIONAL FIRST LINE ADVICE • 1/2

Initial guide to feeding when child not able to eat normally and dietitian not available

**If patient nil-by-mouth see IV fluid therapy guideline before starting total parenteral nutrition (TPN) to ensure hypotonic fluids are not used if contraindicated**



- For suspected cow's milk allergy both IgE and non IgE use an extensively hydrolysed formula or amino acid formula i.e. **Similac**, **Alimentum**, **Nutramigen 1**, **Pepti-Junior**, **Pregestimil**, **Alfamino**, **Puraminio**, **Neocate LCP** and **Elemental 028**

- Contact dietitian to assess individual requirements and appropriate feed at the first available opportunity Monday–Friday check telephone or bleep number via hospital intranet or switch board
- Feeds in **bold** must be prescribed
- Hospital pharmacy will advise which feed is used locally (all similar composition for ages but different manufacturer)
- See **Table 1** for daily fluid and nutritional requirements

\* Indications for medium chain triglycerides (MCT): problems with digestion, absorption or transport of long chain fats e.g. cholestasis, short gut, pancreatic insufficiency

† If failure to thrive or fluid restricted:

- If using breast milk, dietitian to advise on fortification of breast milk
- If using standard infant formula, change to **Similac High Energy** or **Infatrini**

- Nutritional composition of milks – see BNFC

**Table 1: Fluid and energy requirements**

Age	Fluid* mL/kg per day	Energy † Kcal/kg/day
0–3 months	150	104
4–6 months	130	88
7–9 months	120	72
10–12 months	110	72
1–3 yr	95	81
4–6 yr	90	78
7–10 yr	75	64
11–14 yr	55	55
15–18 yr	50	46

\* Department of Health Report No 41, Dietary Reference Values 1991

† Scientific Advisory Committee on Nutrition (SACN) 2011

### How to calculate energy requirements for tube feeds

- Choose appropriate feed for age. **If very underweight for age**, use appropriate feed for **actual bodyweight** – see **Initial guide to feeding when child not able to eat normally and dietitian not available**
- Calculate amount of feed to use in 24 hr based on:
  - Kcal/kg in children
- Calculate fluid requirement; if restricted, continue to use feeds above until reviewed by dietitian
  - if extra fluid required, give water
- Feeding method depends on clinical condition of child:
  - if child at risk of re-feeding syndrome (e.g. anorexia nervosa, Crohn's), introduce feed slowly over 3–4 days starting at 25% of Kcal intake day 1. Increase daily by 25% until full feeds at day 4. Only increase feeds if bloods are normal
  - Bolus feed can be given 1, 2, 3, 4 hrly intervals depending on tolerance
  - If on continuous feeds (i.e. over 24 hr), start feed at a quarter of final hourly requirement. Increase to half requirement, three-quarters, and full every 4–6 hr as tolerated. When full feeds tolerated, aim to give full requirement over 20 hr

### Monitoring

- Check plasma electrolytes daily with particular reference to phosphate, potassium, magnesium, calcium and sodium: correct accordingly. Stop once clinical condition stable
- Re-feeding syndrome may occur in the first few days of re-feeding but can occur up to 2 weeks after. Continue daily biochemical monitoring for 2 weeks or until electrolyte parameters are stable

# OBESITY • 1/3

## RECOGNITION AND ASSESSMENT

### Definition

- Body mass index (BMI)  $\geq 98^{\text{th}}$  centile

### Symptoms and signs

- Age of onset
  - peripubertal common
  - infancy onset rare and may suggest a syndrome
- Bullying
- Low self-esteem
- Depressed mood
- Acanthosis nigricans – thickened velvety darkened skin in neck and flexures suggestive of insulin resistance

### Significant features

- Osmotic symptoms suggestive of diabetes mellitus:
  - thirst
  - nocturia
- Obstructive sleep apnoea
  - night-time snoring with daytime somnolence
- Signs of steroid excess
  - growth failure
  - recent onset purple striae
  - hypertension
  - hirsutism
- Early onset associated with vision/hearing problems/learning difficulties/hypogonadism – suggest a genetic syndrome
- Non-alcoholic steato-hepatitis
  - hepatomegaly
- Polycystic ovarian syndrome

### Causes

- Primary
  - imbalance between calories consumed and calories expended
- Secondary genetic
  - chromosomal: Prader Willi/Down's syndrome
  - autosomal dominant: Biemond syndrome
  - autosomal recessive: Bardet Biedl/Alstrom/Carpenter/Cohen syndrome
  - mutations in leptin pathway: melanocortin 4, prohormone convertase 1, leptin or receptor
- Secondary endocrine/metabolic:
  - Cushing's syndrome
  - autoimmune hypothyroidism
  - hypothalamic obesity

### To be seen in secondary care:

- Extreme obesity [BMI  $>3.5$  standard deviations above mean (99.6<sup>th</sup> centile)]
- BMI  $>98^{\text{th}}$  centile plus possible secondary cause of obesity. Look for:
  - short stature in relation to expected for parental height
  - dysmorphic features
  - learning difficulties
- Obesity with significant co-morbidities/high risk for co-morbidities

### Investigations

#### All

- Urinalysis (albumin creatinine ratio)
- Blood pressure
- Pubertal assessment
- Thyroid function
- Random glucose, glycated haemoglobin, (HbA<sub>1c</sub>)

# OBESITY • 2/3

- Lipid profile (total and HDL-cholesterol, triglycerides)
- Liver function

## Second-line investigations (if indicated by presence of significant features – see above)

- Genetic studies, including chromosome studies
  - all children with extreme obesity
  - children with obesity and dysmorphic features and/or learning difficulties
- 24-hr ambulatory blood pressure monitoring
- Calcium and phosphate (pseudohypoparathyroidism)
- 24-hr urinary free cortisol (growth failure, hirsutism, hypertension)
- Oral glucose tolerance test
- If suspecting polycystic ovarian syndrome measure:
  - LH
  - FSH
  - serum testosterone
  - 17-hydroxy-progesterone
  - sex hormone binding globulin
  - prolactin
  - pelvic ultrasound
- Sleep study (usually overnight pulse oximetry recording in first instance)

## TREATMENT

- Lifestyle, diet and exercise advice – reduce calorie intake, increase calorie expenditure
- Management of co-morbidities

### Type 2 diabetes

- Involve paediatric diabetes team immediately
- Initial pharmacological treatment with metformin 500 mg oral once a day (aged >10 yr), increasing over 4–6 weeks to max dose of 1000 mg 12-hrly
- metabolically unstable patients (glycated haemoglobin  $\geq 8.5\%$  and/or osmotic symptoms) will need insulin

### Microalbuminuria

- Defined as albumin/creatinine ratio  $\geq 3.5$  mg/mmol (female) or 2.5 mg/mmol (male) in early morning urine sample, on 2 out of 3 samples
- Involve paediatric nephrologist for commencement of angiotensin receptor antagonist

### Hypertension

- Defined as average systolic or diastolic blood pressure  $>95^{\text{th}}$  percentile for age, sex, and height percentiles
- confirm on ambulatory blood pressure monitoring
- First-line treatment: diet and exercise advice, limitation of dietary salt
- Second-line treatment: pharmacological treatment angiotensin receptor antagonist

### Dyslipidaemia

- Definitions: LDL-cholesterol  $\geq 2.5$  mmol/L; HDL-cholesterol  $\leq 0.91$  mmol/L; triglycerides  $\geq 1.7$  mmol/L
- confirm on fasting samples
- First-line treatment: dietetic advice
- Pharmacologic therapy with statin (usually reserved for familial hypercholesterolaemia)

### Non-alcoholic fatty liver disease

- First-line treatment: diet and exercise advice
- Hepatic transaminases  $>2x$  upper limit of normal is a surrogate marker for fatty liver disease – refer to paediatric hepatologist

### Polycystic ovarian syndrome

- Defined by 2 out of 3 of following criteria:
  - oligo- or an-ovulation
  - hyperandrogenism
  - multiple ovarian cysts on ultrasound scan
- First-line treatment: consider metformin as above for type 2 diabetes

## **Obstructive sleep apnoea**

- Oxygen desaturation while sleeping, diagnosed on oximetry monitoring
- consider screening & @!^} who complain of snoring at night, and daytime somnolence
- First-line treatment: refer to ENT for possible adeno-tonsillectomy

## **Depression**

- Low self esteem
- Disordered body image
- Have a low threshold for referring to child and adolescent mental health services for assessment

## **MONITORING TREATMENT**

- Regular follow-up and assessment
- best delivered in community rather than secondary care
- Principles include:
  - setting realistic, achievable targets
  - regular contact
  - non-judgemental approach
- Complications i.e. type 2 diabetes require 3-monthly follow-up
- Other complications require subspecialty-specific follow-up

## **SUBSEQUENT MANAGEMENT**

- Primary obesity
- annual screen for complications
- Most secondary causes of obesity are chronic conditions that require specific management

## **FOLLOW-UP**

- Children with:
  - extreme obesity (BMI >99.6th centile for age and sex)
  - secondary obesity

## **DISCHARGE**

- GP follow-up once secondary obesity excluded
- If secondary obesity – transition to young adult care

# FALTERING GROWTH • 1/3

*Always follow the Child Safeguarding Policy and Procedures in your Trust.  
It is everyone's responsibility*

## RECOGNITION AND ASSESSMENT

- An infant or older child who fails to gain weight as expected without an apparent cause
- Growth below the 2<sup>nd</sup> percentile or a change in growth that has crossed downwards 2 major growth percentiles in a short time (approximately 4 months, or longer period in older child)
- Associated features include:
  - developmental delay
  - apathy
  - misery

### Symptoms and signs

- Gastrointestinal problems
  - vomiting
  - voracious appetite
  - anorexia
  - diarrhoea
- Full physical examination
  - dysmorphic features
  - heart murmurs
  - abdominal distension
  - wasting
  - bruising
  - examine mouth for cleft palate

### Patient and family history

#### **Child**

- Take a full feeding history
  - type of milk given (breast milk, formula milk, cow's milk)
  - volume given at each feed
  - frequency of feeding
  - method of making up feeds (correct strength)
  - introduction of solids: age and type of solid
  - any difficulty with feeding process (e.g. breathless, uncomfortable)
- Perform direct observation of child at mealtimes:
  - oral, motor, co-ordination, behaviour (e.g. crying, tantrums), appetite, family interaction

#### **Family**

- Family history of siblings/children with unexplained growth faltering or early onset diarrhoea
- Ask about socio-emotional factors
  - family composition (other children, age?)
  - ask parental ages, health, educational status
    - were either parents in care during childhood?
    - do parents have a history of psychiatric illness or depression (including post-natal depression) or had learning disability?
    - parents with inadequate social or problem solving skills?
  - has the family any support network (e.g. grandparents)?
  - social isolation?
  - is there a lack of money in the home or unemployment?
  - other sources of stress (e.g. divorce)?
  - substance abuse?
  - domestic violence?

### Measurements

Measurements must be carried out properly and checked if there is doubt

- Record birth weight and gestation
- some 'light-for-dates' infants fail to catch up, and grow parallel but below the 2<sup>nd</sup> percentile
- Measure and plot



## FALTERING GROWTH • 2/3

- weight (unclothed)
- head circumference
- length or height
- body mass index and plot on appropriate chart (useful if height or weight below 0.4<sup>th</sup> centile)
- Infant may be a small, normal child growing below but parallel to the 2<sup>nd</sup> percentile
- parents are often also small
- record height of parents and grandparents
- calculating midparental height, height velocity can be helpful – see **Fact sheet: UK 2-18 years Growth Chart** available at: [www.rcpch.ac.uk/child-health/research-projects/uk-who-growth-charts/uk-growth-chart-resources-2-18-years/school-age%232-18](http://www.rcpch.ac.uk/child-health/research-projects/uk-who-growth-charts/uk-growth-chart-resources-2-18-years/school-age%232-18)
- review 'Red book' growth charts for more information
- pubertal staging is helpful for teenagers

***Single set of measurements of limited value and does not justify complex investigations.  
Serial measurements of more value and should be plotted on percentile charts***

### Investigations

#### ***First line tests (as indicated) where cause of poor growth is not obvious***

- Blood gas
- Faeces: culture and sensitivity, microscopy for ova, cysts and parasites (if diarrhoea)
- Urinalysis for protein, nitrites and blood
- Haemoglobin, blood film (for signs of iron deficiency), WBC and ESR
- Biochemical profile including U&E, liver and bone profile, CRP, B12/folate, ferritin, thyroid function, creatinine, bicarbonate, calcium and albumin
- Coeliac screen (anti-tTG and IgA)

#### ***Further tests***

- If underlying pathology indicated by history, clinical examination or results of routine investigations, request further tests, such as:
  - CXR
  - bone age (X-ray of non-dominant hand and wrist)
  - if head size is increasing, ultrasound of head before aged 6 months
  - Vitamin A, D, E, trace metals, faecal elastase
  - sweat test/cystic fibrosis (CF) gene
- Further gastrointestinal investigation or management of malabsorption disorders should be undertaken by referral to specialist gastroenterology team as appropriate:
  - endoscopy
  - gastrointestinal imaging

### Differential diagnosis

- Low genetic growth potential:
  - familial
  - 'light-for-dates' baby
  - genetic syndrome
- Social factors:
  - maternal depression
  - poor parenting skills
  - abuse
- Malabsorption:
  - pancreatic insufficiency: CF, Swachman-Diamond syndrome
  - enteropathy: coeliac, cow's milk protein allergy
  - inflammatory bowel disease (IBD)
  - infective: Giardia, bacterial overgrowth
  - others (rarer): abetalipoproteinaemia, lymphangiectasia
- Vomiting/severe regurgitation
- Any chronic underlying disorder:
  - renal failure
  - liver disease
  - congenital heart disease

## FALTERING GROWTH • 3/3

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- severe asthma
- immunodeficiency
- other rare conditions e.g. endocrine, chromosomal or metabolic conditions if dysmorphic features present

### MANAGEMENT

- Most patients can be managed as an out-patient
- record height and weight at each visit
- seek dietitian opinion
- if treatable cause identified, treat appropriately
- If social problems responsible, consider:
  - admission to ward to demonstrate good weight gain out of home environment
  - significant weight gain after admission (>180 g/week in infant) supports parenting issues as cause
  - health visitor support
  - social work support
- child psychology consultation, referral and/or intervention (evaluation of: child's cognitive development, food refusal etc; parents' perception of the child; family/child disturbances of affect expression and family dynamics)
- day care and nursery provision
- case conference
- care proceedings

# GASTRO-OESOPHAEGEAL REFLUX • 1/3

## RECOGNITION AND ASSESSMENT

### Definition

- Gastro-oesophageal reflux (GOR)
- passive physiological passage of gastric contents into oesophagus
- Gastro-oesophageal reflux disease (GORD): GOR causing symptoms needing treatment or leading to complications
- Vomiting/emesis:– active retrograde passage of gastric contents associated with retching, pallor and sweating

*It is very important to distinguish between vomiting and GOR*

### Key points in history

#### Infants

- Preterm/term
- Breast/bottle feeds
- Volume and number of feeds – overfeeding
- Vomiting
  - episodes >4
  - volume expelled
  - vomiting versus possetting
  - colour of posset/vomit
    - white
    - bile stained
    - blood
  - projectile/non-projectile
- Choking/gagging whilst feeding
- Excessive crying/unsettled after feeds
- Faltering growth
- Associated diarrhoea/constipation
- Blood in stools
- Family history of atopy
- Chronic cough/recurrent chest infections/pneumonia
- Sandifer's syndrome:– episodic torticollis with neck extension and rotation
- Neurodisability

#### Older children

- Abdominal pain, heartburn, epigastric pain
- Halitosis
- Dental enamel problems
- Hoarseness
- School absenteeism

### Examination

- Hydration
- Perfusion
- Abdomen – masses/tenderness
- Hernial sites
- Growth
- Document episode personally
- Parental mobile phone recording

### Red flags

- Projectile vomiting: pyloric stenosis, raised intracranial pressure
- Bilious vomiting: intestinal obstruction
- Abdominal distension/tenderness/palpable mass: intestinal obstruction, constipation
- Hematemesis: gastritis, esophagitis
- Dysphagia
- Late onset [>6 months or persistent after aged 1 yr; consider urinary tract infection (UTI)]
- Blood in stools: infection, cow's milk protein allergy (CMPA), surgical cause

# GASTRO-OESOPHAGEAL REFLUX • 2/3

- Fever: UTI, meningitis, encephalitis, pneumonia
- Dysuria: UTI
- Bulging fontanelle: raised intracranial pressure
- Rapidly increasing head circumference: raised intracranial pressure
- Persistent/early morning headaches: intracranial pathology
- Altered sensorium/irritability: meningitis, encephalitis
- Family history of atopy: CMPA

## ADVICE TO PARENTS

- GOR is physiological and common (40%)
- Usually begins aged <8 weeks
- 90% of infants improve by aged 1 yr
- Majority need reassurance, no investigations and treatment
- Inform about red flags

## HIGH RISK GROUP

- Preterm
- Neurodisability
- Family history
- Obesity
- Hiatus hernia
- Operated congenital diaphragmatic hernia
- Operated oesophageal atresia

## REFER FOR SPECIALIST OPINION

- Red flags
- Unexplained feeding difficulties
- Unexplained distressed behaviour
- Persistent faltering growth
- Feeding aversion with regurgitation
- No improvement after aged 1 yr
- Chronic cough with overt regurgitation
- Recurrent pneumonia (>1) with overt regurgitation
- Sandifer's syndrome
- Recurrent otitis media
- Dental enamel defects in a child with neurodisability

## NON-PHARMACOLOGICAL TREATMENT

- Review feeding history
- Reduce feed volume if excessive for current weight
- Small and frequent feeds
- Slightly propped position whilst feeding
- Trial of thickened formula
  - rice starch
  - corn starch
  - Thick & Easy™
  - Carobel
  - Nutrilis®
- Family history of atopy
  - trial of extensively hydrolysed formula for 4 weeks
- Obese patient
  - weight management
  - healthy life style choices

## PHARMACOLOGICAL TREATMENT

- Treat symptoms
- Does not reduce number of reflux episodes:

# GASTRO-OESOPHAEGEAL REFLUX • 3/3

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- trial of alginate (Gaviscon<sup>®</sup>) therapy for 2 weeks
- H<sub>2</sub>-receptor antagonists (ranitidine) – easy to administer for 4 weeks
- Proton pump inhibitors (PPIs) for 4 weeks
  - omeprazole
  - lansoprazole
  - esomeprazole
- Refer if no response to treatment or recurrence on stopping treatment
- Domperidone
- see Medicines and Healthcare products Regulatory Agency (MHRA) guidelines on use of domperidone

## INVESTIGATIONS

- Requested by specialist
- 24 hr pH study – detects acid reflux episodes
- 24 hr pH and impedance study – detects both acid and non-acid reflux episodes
- Upper gastrointestinal contrast study or barium swallow – detects anatomical defects, hiatus hernia, malrotation and pre-surgery
- flexible upper gastrointestinal endoscopy and biopsies – inflammation

## SURGICAL TREATMENT

- Refractory patients
- fundoplication
- surgical jejunostomy

# JAUNDICE IN NEONATES • 1/3

Jaundice in neonates aged >7 days old (aged <7 days old see **Neonatal** guidelines)

## RECOGNITION AND ASSESSMENT

### Symptoms and signs

- Any visible yellow colouration of skin in any infant
- Yellow conjunctivae in dark-skinned infants
- In an infant aged >14 days (or >21 days preterm infants <37/40)

### Assess for red flags

- Stools (pale and/or chalky; refer to CLDF stool colour chart) and urine colour (yellow or orange is abnormal and suggests conjugated hyperbilirubinaemia. Most infants have colourless urine)
- Pallor (haemolysis)
- Poor feeding, drowsiness (neurotoxicity)
- Weight gain (plot on centile chart, is growth satisfactory and has infant regained birth weight?)
- Hepatosplenomegaly (blood-group incompatibility or cytomegalovirus, liver disease)
- Splenomegaly (e.g. haemolytic anaemia, spherocytosis)
- Dysmorphic features

### Causes of persistent jaundice >14 days in term infants and >21 days in preterm

- Physiological/breast milk jaundice
- Prematurity
- Increased bilirubin load (e.g. bruising, blood group incompatibility)
- G6PD deficiency and other red cell enzyme deficiencies
- congenital spherocytosis
- cephalohaematoma
- Rarely infection (e.g. UTI, congenital infection)
- Metabolic disorder (e.g. galactosaemia, tyrosinaemia)
- Endocrine disorders (e.g. hypothyroidism, hypopituitarism)
- Biliary atresia
- Liver disease (e.g. neonatal hepatitis, alpha-1-antitrypsin deficiency)
- TPN-induced cholestasis

### Investigations

#### All

- Total bilirubin
- Conjugated bilirubin on all babies aged >14 days. Can wait until next working day in the absence of red flags (as above)
- Document stool and urine colour
- Check routine metabolic screening has been performed (serum and urine organic acid)
- Blood glucose if baby is unwell

### Second line investigations if indicated by presence of red flags above

- If conjugated bilirubin >20% of total bilirubin, seek advice of specialist liver unit as infant may require further investigations
- If conjugated bilirubin >20% of total bilirubin perform following:
  - Save stool sample for senior review
  - U&Es and bicarbonate
  - LFTs (ALT/AST, alkaline phosphatase, gamma GT, albumin)
  - Pre-feed blood glucose, perform for at least first 24 hr of admission
  - FBC, retics and blood film
  - Blood group and direct Coombs' test
  - Coagulation screen including PT and/or INR [give 300 microgram/kg phytomenadione IV (vitamin K) if prolonged and repeat after 12 hr]
  - G6PD screen in African, Asian or Mediterranean patients
  - Thyroid function tests: ask for 'FT4 priority and then TSH'
  - Congenital infection screen:
    - CMV PCR: in urine first 2 weeks life, later test newborn blood spot card
    - toxoplasma ISAGA-IgM and
    - HSV PCR
  - Metabolic investigations:

## JAUNDICE IN NEONATES • 2/3

- blood galactose-1-phosphate uridyl transferase
- urine dipstick for protein
- urine for reducing substances
- urine for amino acid and organic acid
- alpha-1-antitrypsin level and phenotype
- cortisol
- cholesterol and triglycerides
- immunoreactive trypsinogen (IRT)

### Third line investigations that may be recommended by paediatric gastroenterologist or hepatologist

- Liver and abdominal ultrasound
- DESIDA or HIDA radionucleotide scan
- Lactate, ammonia and pyruvate
- Very long chain fatty acids
- Urine and serum bile acids
- Acyl carnitine
- Isoelectric focussing of transferrin
- Ferritin and transferrin saturation
- Muscle biopsy
- Bone marrow for storage disorders
- Skin biopsy for fibroblast culture
- Liver biopsy
- If Alagilles syndrome suspected: CXR to look for butterfly vertebrae
- Syphilis serology
- Ophthalmological examination (for Alagilles' syndrome and panhypopituitarism)

**If conjugated bilirubin elevated at any age (>20% of total bilirubin), discuss with consultant urgently**

### Limits (micromol/L) for phototherapy and exchange transfusion for infants $\geq 38$ weeks' gestation

Age (hours)	Repeat transcutaneous bilirubin/serum bilirubin (6–12 hours)*	Consider phototherapy <sup>#</sup>	Phototherapy	Exchange transfusion
0			>100	>100
6	>100	>112	>125	>150
12	>100	>125	>150	>200
18	>100	>137	>175	>250
24	>100	>150	>200	>300
30	>112	>162	>212	>350
36	>125	>175	>225	>400
42	>137	>187	>237	>450
48	>150	>200	>250	>450
54	>162	>212	>262	>450
60	>175	>225	>275	>450
66	>187	>237	>287	>450
72	>200	>250	>300	>450
78	>212	>262	>312	>450
84	>225	>275	>325	>450
90	>237	>287	>337	>450
96+	>250	>300	>350	>450

\* Result in this category repeat transcutaneous measurement in 6–12 hr

<sup>#</sup> Result in this category repeat serum bilirubin measurement in 6 hr whether or not phototherapy started

- For other gestations see **Neonatal** guidelines

# JAUNDICE IN NEONATES • 3/3

## TREATMENT OF UNCONJUGATED JAUNDICE

- Adequate fluid and energy intake
- Phototherapy

### Phototherapy

- If bilirubin near exchange threshold or still rising:
  - increase power number of lights
  - increase area exposed (e.g. biliblanket and overhead)

### Exchange transfusion

- See **Exchange transfusion** in **Neonatal** guidelines

### IVIG

- For dose information see [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/216671/dh\\_131107.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/216671/dh_131107.pdf) for dose information
- Use as an adjunct to multiple phototherapy in rhesus disease when bilirubin continues to rise by >8.5 micromol/L/hr

## MONITORING TREATMENT

- If haemolysis present, check bilirubin 4–6 hrly until rate of rise flattens
- If bilirubin concentration approaching threshold for exchange transfusion, or rising rapidly (>10 micromol/hr), check 4-hrly

## SUBSEQUENT MANAGEMENT

- When bilirubin concentration has fallen below threshold for phototherapy (see above), discontinue phototherapy
- If jaundice persists after 14 days of age, review and treat cause

## TREATMENT OF CONJUGATED JAUNDICE

- Fat soluble vitamins (A,D,E and K)
- Ursodeoxycholic acid (after discussions with liver unit)

## FOLLOW-UP

### Conjugated Jaundice

- Conjugated bilirubin <20% of total bilirubin in a well baby without red flags
  - discharge to routine community care
  - advise parents to look out for 'worrying features'
- Conjugated fraction >20%
  - discuss with consultant as this will depend on cause and severity of conjugated jaundice

### Unconjugated Jaundice

- GP follow-up with routine examination at 6–8 weeks
- If exchange transfusion necessary or considered, request development follow-up and hearing test
- In babies with positive Coombs test who require phototherapy, check haemoglobin at 2 and 4 weeks of age because of risk of continuing haemolysis and give folic acid daily



# VITAMIN D DEFICIENCY • 1/2

*Routine screening is not recommended*

## RECOGNITION AND ASSESSMENT

### Symptoms and signs

#### **Rickets**

- Progressive bowing of legs (bowing of legs can be a normal finding in toddlers)
- Progressive knock knees
- Wrist swelling
- Rachitic rosary (swelling of the costochondral junctions)
- Craniotables (skull softening with frontal bossing and delayed fontanelle closure)
- Delayed tooth eruption and enamel hypoplasia

#### **Other symptoms or conditions associated with vitamin D deficiency**

- Long-standing (>3 months), unexplained bone pain
- Muscular weakness (e.g. difficulty climbing stairs, waddling gait, difficulty rising from a chair or delayed walking)
- Tetany due to low serum calcium
- Seizures due to low serum calcium (usually in infancy)
- Infantile cardiomyopathy

#### **Abnormal investigations**

- Low serum calcium or phosphate, high alkaline phosphatase ( $\geq$ local age-appropriate reference range)
- Radiographs; showing osteopenia, rickets or pathological fractures

#### **Chronic disease that may increase risk of vitamin D deficiency**

- Chronic renal disease, chronic liver disease
- Malabsorption syndromes (e.g. coeliac disease, Crohn's disease, cystic fibrosis)

#### **Bone diseases in children where correcting vitamin D deficiency prior to specific treatment indicated**

- Osteogenesis imperfecta
- Idiopathic juvenile osteoporosis
- Osteoporosis secondary to glucocorticoids, inflammatory disorders, immobility and other metabolic bone conditions

## INDICATIONS FOR REFERRAL TO SECONDARY CARE

- Repeated low serum calcium concentration with/without symptoms (irritability, brisk reflexes, tetany, seizures or other neurological abnormalities)
- Symptomatic: requires immediate referral to A&E if outpatient
- Asymptomatic: discuss treatment with paediatrician
- Underlying complex medical disorders (e.g. liver disease, intestinal malabsorption)
- Deformities or abnormalities probably related to rickets
- Poor response to treatment despite good adherence (level of 25(OH)D <50 nmol/L after 8–12 weeks of adherent therapy)
- Persisting low serum phosphate or low/high alkaline phosphatase

Serum 25-OHD nmol/L	ug/L	Vitamin D status	Manifestation	Management
<25	<10	Deficient	Rickets Osteomalacia	Treat with high-dose vitamin D
25–50	10–20	Insufficient	Associated with disease risk	Vitamin D supplementation
50–75	20–30	Adequate	Healthy	Lifestyle advice
>75	>30	Optimal	Healthy	None

#### **Dose of colecalciferol (units)**

- Give as divided doses for 6 weeks
- Single high dose can be used if compliance concerns

## VITAMIN D DEFICIENCY • 2/2

Insufficient 25–50 nmol/L (10–20 ug/L)			
Age			
	<1 month	1 month–12 yr	>12 yr
Daily	300–400	400–1000	800–1000
Monthly	-	-	20,000
Once	-	-	160,000
Deficient <25 nmol/L (<10 ug/L)			
Age			
	1–6 months	6 months–12 yr	>12 yr
Daily	3000	6000	10,000
2 weekly	-	-	20,000
Once	-	-	300,000
Maintenance			
	Premature infant	1 month–12 yr	>12 yr
Daily	400	600	
6 weekly	-	-	20,000

### Administration

- All children who can swallow normal food can take the small colecalciferol capsules
- Children who have swallowing difficulties (aged <1 yr or disabled) a liquid preparation may be used but is unpalatable
- Colecalciferol and ergocalciferol liquid preparation doses are equivalent

### MONITORING

- At end of treatment: bone profile, vitamin D (if patient has rickets/hypocalcaemia: PTH test)
- If 25(OH)D >50 nmol/L bone profile normal:
  - give advice on safe sun exposure and diet
  - advise multivitamin containing vitamin D 400–600 IU/day (continued unless there is significant lifestyle change to improve vitamin D status)
- If 25(OH)D <50 nmol/L:
  - consider poor compliance, drug interactions and underlying disease e.g. renal disease, liver disease and malabsorption
  - if poor compliance suspected, consider high-dose treatment if aged 12–18 yr (e.g. 300,000 IU as single or divided dose)
- **If unimproved symptoms/signs despite satisfactory 25(OH)D concentration: unlikely to be related to vitamin D deficiency**
- If recommended nutritional intake of 400 IU/day (10 microgram/day) unlikely to be met, give daily vitamin D 400 IU/day:
  - breast fed infants
  - not spending substantial time outdoors
  - wearing concealing clothing
  - dark skin

# BLOOD AND PLATELET TRANSFUSIONS • 1/2

*Always check front sheet in oncology patient notes before prescribing any blood product*

## Before transfusion

- Explain indications for blood products to parents
- Document indications and verbal consent
- If previous reactions to blood products have occurred, pre-medicate with chlorphenamine (oral or IV), if severe with hydrocortisone 4 mg/kg IV

## BLOOD TRANSFUSION

### When to transfuse

#### *Oncology children*

- If haemoglobin  $\leq 70$  g/L or if  $>70$  g/L and symptomatic or unstable, transfuse
- If having radiotherapy, transfuse if Hb  $<110$  g/L
- If oncology patient has potential to require a bone marrow transplant give hepatitis E –ve leucodepleted blood, unless already identified as requiring irradiated products

#### *PICU patients*

- Hb transfusion trigger of 70 g/L in stable critically ill children
- If symptomatic anaemia or impaired cardiorespiratory function, transfuse at higher threshold

#### *Non-oncology children*

- If haemoglobin  $<60$  g/L or  $>60$  g/L and symptomatic

### Target Hb and volume to be transfused

- Aim for target haemoglobin of 120 g/L or for 100 g/L if initial haemoglobin  $<60$  g/L
- In newly diagnosed patients with leukaemia/profound anaemia, aim for target Hb 80–90 g/L
- Calculate volume to be given as: (round to nearest unit)

$$[\text{Target Hb} - \text{actual Hb (g/L)}] \times \text{weight (kg)} \times 0.4 \text{ mL}$$

- **Total volume should not exceed 20 mL/kg**

### Rate of infusion

- Give **total** over 3–4 hr. **Max rate 5 mL/kg/hr**
- If Hb  $<60$  g/L, give blood over 4–8 hr (each unit must be used **within 4 hr** once removed from fridge)
- If concerns regarding fluid overload give furosemide 1 mg/kg oral if tolerated, or IV half-way through

### Use irradiated blood if

- Allogenic bone marrow transplant (BMT) from start of conditioning regimen
- Allogenic BMT donors
- If  $<7$  days pre-harvest for autologous BMT and stem cell transplant patients (e.g. stage IV neuroblastoma)
- Hodgkin's disease or if patient has received fludarabine
- Children with severe immunodeficiency (e.g. SCID)
- HLA-matched platelets
- For high risk neonates e.g. post intrauterine transfusion

### Leucodepleted blood

- All packed cells are leucodepleted

### CMV negative blood

- All the packed cells are leucodepleted and therefore CMV negative
- For neonates aged  $<28$  days post expected date of delivery and for intrauterine transfusions CMV serology negative blood requested

## PLATELET TRANSFUSION IN ONCOLOGY CHILDREN

### Transfuse platelets if platelet level

- $<10 \times 10^9$ /L oncology children except brain tumour
- $<20 \times 10^9$ /L oncology children except brain tumour and unwell
- $<30 \times 10^9$ /L brain tumour
- $<50 \times 10^9$ /L brain tumour and unwell
- $<50 \times 10^9$ /L for lumbar puncture

# BLOOD AND PLATELET TRANSFUSIONS● 2/2

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## Dosage and rate

- <15 kg: 15 mL/kg round off the nearest unit
- ≥15 kg: one pack
- Transfuse within 15–30 min

***Immune thrombocytopenic purpura (ITP) – transfuse platelets only if bleeding and see Immune thrombocytopenic purpura (ITP) guideline***

## FRESH FROZEN PLASMA

- For bleeding in disseminated intravascular coagulopathy (DIC) when INR >1.7
- 12–15 mL/kg
- 10–20 mL/kg/hr

## CRYOPRECIPITATE

- For bleeding with DIC with fibrinogen <1.5 g/L

# FEBRILE NEUTROPENIA • 1/3

*Frequent clinical re-assessment of patients is a vital part of effective management of febrile neutropenia in children*

## RECOGNITION AND ASSESSMENT

### Definition

- Temperature  $\geq 38^{\circ}\text{C}$  at any time
- Neutrophils  $\leq 0.5 \times 10^9$  cells/L

## IMMEDIATE TREATMENT

See **Figure 1** (see BNFC for dose reduction in renal impairment)

### ALL PATIENTS – with central venous access

- Culture both lumens/Port-a-cath. Take FBC, group and save, U&E, LFTs, CRP. If septic also do a coagulation screen
- Urinalysis in all children
- CXR only if respiratory signs i.e. increased respiratory rate, auscultatory signs
- Respiratory viral screen if coryzal and/or cough
- **Do not wait for results, administer antibiotics**
- 'Door to needle time' must be within 1 hr
- Follow individual trust antibiotic policy or individual patient plan if resistant organisms

### No haemodynamic compromise and NOT on chemotherapy block containing IV methotrexate

- Start piperacillin with tazobactam (Tazocin<sup>®</sup>) 90 mg/kg 6-hrly (maximum single dose 4.5 g) administered over 30 min

### No haemodynamic compromise and on chemotherapy block containing IV methotrexate, penicillin allergic or previous Tazocin<sup>®</sup> resistant gram negative infection:

- Use meropenem 20 mg/kg 8-hrly over 5 min (maximum single dose 1 g)
- If previous documented MRSA infection, **add** either teicoplanin 10 mg/kg 12-hrly for 3 doses, then 10 mg/kg once daily, OR vancomycin 15 mg/kg 8-hrly given over at least 60 min, max 10 mg/min for doses above 600 mg (max initial single dose 700 mg until levels available). Target trough level 10–15 mg/L
- Pre-dose vancomycin level before third dose, and no post-dose sample required
- Adjust dose as follows dependent on pre-dose concentration (mg/L):
  - <10 give 6-hrly and recheck level before dose 4 or 5
  - 10–15 continue current dose and recheck concentration in 3–5 days
  - 15–20 reduce a dose by 10–20% and recheck level before dose 4 or 5 (unless higher levels advised by microbiology)
  - >20 and <25 extend interval to 12-hrly. Recheck level at 12 hr and give dose without waiting for result
  - >25 stop vancomycin and recheck level after 24 hr to see if therapy can be restarted and to determine interval

### Haemodynamic compromise

- Check A, B, C and initiate appropriate resuscitation
- Give sodium chloride 0.9% 20 mL/kg bolus
- Start meropenem 20 mg/kg 8-hrly over 5 min

### LOW RISK PATIENTS

- **No** central access **and**
- Neutrophils  $> 0.5 \times 10^9$  cells/L **and**
- Clinically well
- consider discharge on oral antibiotics after discussion with oncology team/on call consultant

## SUBSEQUENT TREATMENT

- Reassess at 24 hr and chase blood cultures
- **Positive cultures:** discuss patients with positive blood cultures with microbiologist or paediatric oncology team for advice on appropriate treatment. Where blood cultures positive for yeast in presence of suspected line infection, remove lines promptly
- Give culture-positive patients at least 7 days treatment intravenously

## FEBRILE NEUTROPENIA • 2/3

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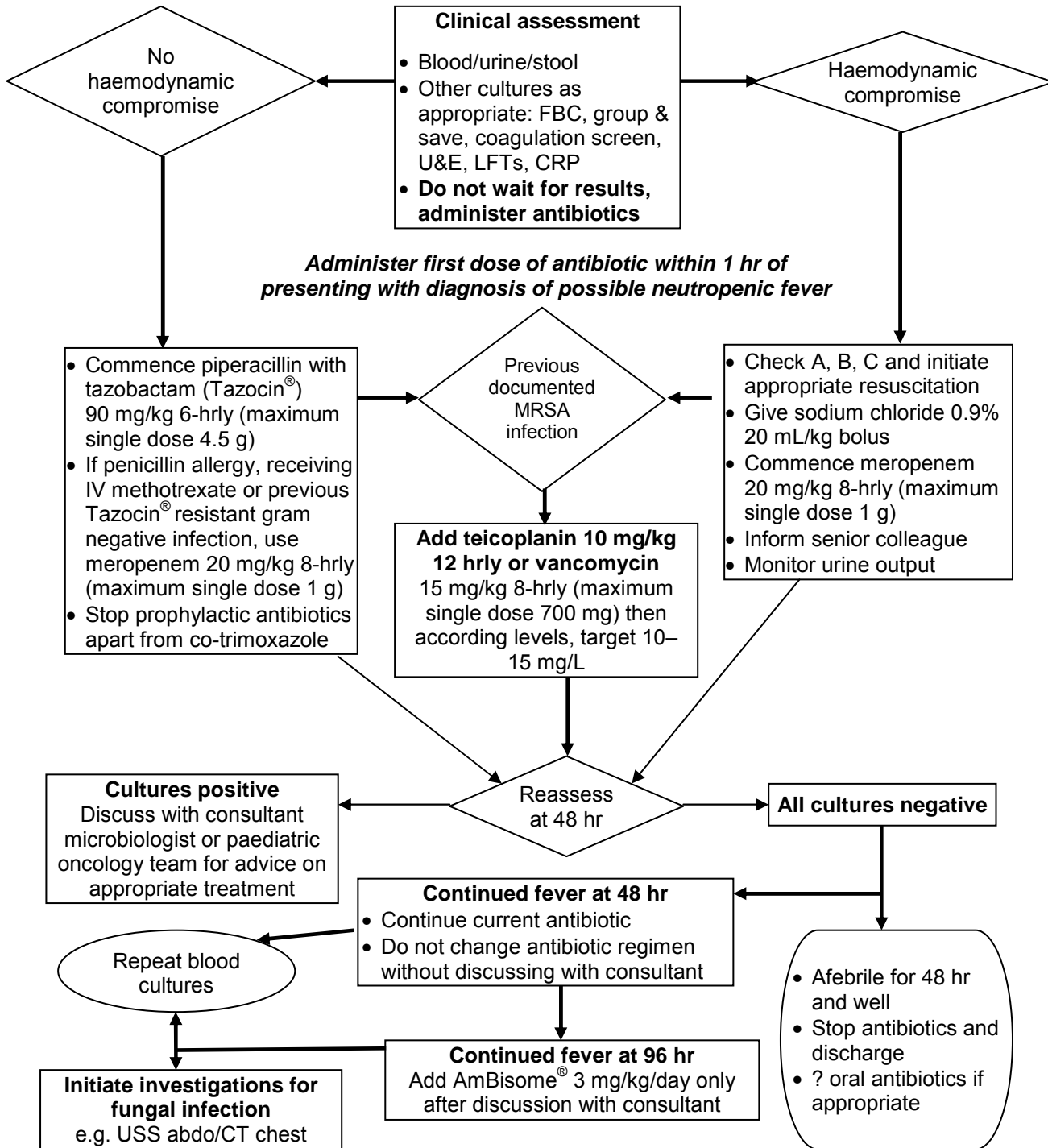
- **Negative cultures:** do not switch initial empiric antibiotics in patients with unresponsive fever unless there is clinical deterioration or a microbiological indication
- If febrile after 48 hr:
  - repeat blood cultures and discuss with on-call consultant/paediatric oncology team
- Initiate investigations for fungal infection e.g. US abdo/CXR/CT chest
- If febrile after 96 hr or clinically unstable between 48 and 96 hr:
  - repeat blood cultures
  - add **liposomal amphotericin** (AmBisome<sup>®</sup>) **3 mg/kg/day** (give test dose 100 microgram/kg (max 1 mg)
  - if profoundly neutropenic and after discussion with oncology team consider G-CSF 5 microgram/kg subcutaneously once daily

### **When to discharge**

- If clinically well and afebrile for 48 hr, and no growth in blood cultures after 48 hr:
  - stop antibiotics
  - no need for routine in-patient observation after stopping antibiotics

# FEBRILE NEUTROPENIA • 3/3

Figure 1: Management of fever in neutropenic/immunocompromised child



# HENOCH-SCHÖLEIN PURPURA • 1/2

## RECOGNITION AND ASSESSMENT

- Vasculitic condition of unknown aetiology
- Typical age group 2–8 yrs old

### Symptoms and signs

#### **Rash**

- Purpuric, raised on extensor surfaces of legs, buttocks and arms, with surrounding erythema

#### **Gastrointestinal tract**

- Abdominal pain mostly idiopathic, typically resolves in 72 hr
- if severe or persistent, exclude intussusception, testicular torsion or pancreatitis (rare)
- Nausea and vomiting
- Intestinal haemorrhage: haematemesis, melaena, bloody stools (rare)

#### **Joints**

- Arthralgia and swelling of large joints, especially ankles and knees. Pain typically resolves in 24–48 hr

#### **Renal**

- Microscopic haematuria (common)
- Proteinuria can present 4–6 weeks after initial presentation
- Hypertension
- Nephritic syndrome: haematuria with at least one of following:
  - raised urea and creatinine
  - hypertension
  - oliguria
- Nephrotic syndrome: proteinuria +/- oedema and hypoalbuminaemia
- Oedema of hands, feet, sacrum and scrotum

#### **Neurological**

- Headache (common)
- Seizures, paresis, coma (rare)

### Differential diagnosis

- Purpuric rash:
  - meningococcaemia – clinical diagnosis
  - thrombocytopenia – FBC (rash looks different, ITP not vasculitic)
  - rarer vasculitides – more difficult to exclude; differentiation requires review over a period of time
  - pancreatitis – suspect in abdominal pain lasting >3 days

### Investigations

All patients

- BP
- Urine dipstick
  - if proteinuria, send urine for early morning protein:creatinine ratio
  - if haematuria, send urine for microscopy

#### **Additional investigations**

Blood tests if urinalysis abnormal or diagnosis uncertain

- FBC + film
- U&E
- Albumin
- If fever, blood culture and ASO titre
- Coagulation
- Throat swab

## IMMEDIATE TREATMENT/SUBSEQUENT MANAGEMENT

### Indications for admission

- Orchitis
- Moderate or severe abdominal pain



# HENOCH-SCHÖLEIN PURPURA • 2/2

- Arthritis involving >2 joints
- Proteinuria
- Clear evidence of gastrointestinal bleeding
- Inability to ambulate

## Joint pain

- NSAIDs (ibuprofen 1<sup>st</sup> line. Use with caution if renal involvement or patient asthmatic)

## Abdominal pain

- Give prednisolone 1 mg/kg/day for 2 weeks
- Renal involvement not a contraindication
- If severe and persists, exclude pancreatitis, intussusception or spontaneous bowel perforation

## MONITORING

### Uncomplicated HSP (e.g. urine analysis $\leq 1+$ blood and protein, and normal BP)

- No hospital follow-up required but GP to follow-up as below

### HSP with haematuria or proteinuria >1+ and normal renal function

- GP follow-up in 1–2 weeks. Monthly BP for 6 months and weekly urine dipsticks at home until urine clear
- If blood or protein >1+, routine follow-up in children's outpatients

### Refer to nephrologist if

- Urinalysis blood or early morning protein >1+ after 6 months
- Macroscopic haematuria or heavy proteinuria at presentation
- Hypertension (see **Hypertension** guideline)
- Significant proteinuria (early morning urine protein:creatinine ratio >100 g/mmol or 3+ proteinuria for 3 days)
- Impaired renal function

### Refer to rheumatologist if

- Atypical or rapidly evolving rash

## DISCHARGE AND FOLLOW-UP

- Inform parents condition may fluctuate for several months but recurrence rare once settled properly
- Very rare risk of renal failure, hence importance of monitoring urine
- Seek medical advice if child develops headache, PR bleeding or severe abdominal pain

### Uncomplicated HSP

- GP follow-up in 1–2 weeks. Monthly BP for 6 months and weekly urine dipsticks at home until urine clear

### Discharge from GP follow-up

- If urine analysis is normal **and**
- If BP normal at 6 months of symptoms onset

# IMMUNE THROMBOCYTOPENIC PURPURA (ITP)

## ● 1/2

### RECOGNITION AND ASSESSMENT

#### Definition

- Platelets  $<100 \times 10^9/L$ , usually  $<20 \times 10^9/L$
- Self-limiting disease with shortened platelet survival and increased megakaryocytes
- Good prognosis
- Acute 0–3 months
- Persistent 3–12 months
- Chronic  $>12$  months

#### Symptoms and signs

- Acute onset bruising, purpura and petechiae
- serious mucosal bleeding unusual, look for other causes
- Preceding infection
- Absence of:
  - hepatosplenomegaly
  - lymphadenopathy
  - evidence of serious cause/chronic underlying illness

#### Investigations

- FBC, blood film and clotting
- Blood group
- If ITP low platelets, headache and/or neurological signs, urgent CT scan of head
- Bone marrow aspiration unnecessary unless:
  - neutropenia or severe anaemia
  - hepatosplenomegaly
  - lymphadenopathy
  - pallor and lassitude
  - pain limb/abdomen/back
  - limp
- CMV and EBV IgM
- If risk factors: HIV, Hepatitis B and C

### IMMEDIATE TREATMENT

- None regardless of platelet count, unless life-threatening owing to significant bleeding
- If **significant bleeding** (e.g. uncontrollable epistaxis, GI haemorrhage, intracranial bleed), give:
  - platelets (see **Blood and platelet transfusions** guideline). Result will be short lived
  - methylprednisolone 30 mg/kg/day by intravenous infusion max 1g per dose for 3 days
  - Immunoglobulin 0.8–1 g/kg (see local policy) can be repeated once within 3 days if required – red indication in the Demand Management Programme for Immunoglobulin
- If **moderate bleeding** e.g. prolonged mucosal bleeds, give prednisolone 2 mg/kg daily for 14 days then taper over 21 days OR
  - prednisolone 4 mg/kg for 4 days OR
  - immunoglobulin 0.8 g/kg IV single dose
- Consider tranexamic acid for small bleeds
- Avoid NSAIDs e.g. ibuprofen
- Reassure parents
- Discuss newly diagnosed ITP with paediatric haematologist/paediatric consultant with a haematology interest
- Discuss treatment with platelets with paediatric haematologist in event of:
  - essential operations
  - emergency dental extractions

### SUBSEQUENT MANAGEMENT

- 75–80% resolve in 6 months
- favourable outcome irrespective of treatment
- Avoid contact sports
- impossible to prevent fighting/rigorous knockabout games at home
- Parents can find additional information from ITP support association: [www.itpsupport.org.uk](http://www.itpsupport.org.uk)

# IMMUNE THROMBOCYTOPENIC PURPURA (ITP)

● 2/2

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## MONITORING TREATMENT

- FBC and film monthly until diagnosis clear or recovery
- Repeat sooner if bleeding or increased bruising

## DISCHARGE AND FOLLOW-UP

- Discharge from long-term follow-up when platelets  $>100 \times 10^9/L$  and asymptomatic
- Advise of risk of relapse (20%)
- Note that mothers with history of ITP (even if they have normal platelet counts) can give birth to thrombocytopenic babies

## CHRONIC IMMUNE THROMBOCYTOPENIC PURPURA

- Avoid NSAIDs
- Avoid contact sports
- Investigate for autoimmune disease (ANA antinuclear antibody; APLA antiphospholipid antibodies; ACA, anticardiolipin antibody; and LAC, lupus anticoagulant) and immune deficiency (HIV, IgG, IgA, IgM)
- Treat only:
  - profound thrombocytopenia ( $<10 \times 10^9/L$ ) with repeated mucosal bleeding
  - older girls with menorrhagia
  - trauma
  - acute neurological signs
- If treatment indicated, give prednisolone 2 mg/kg/day 14 days, then taper over 21 days OR dexamethasone 0.6 mg/kg/day (max 40 mg) orally for 4 days if ongoing bleeding
- must have bone marrow aspirate before treatment
- If unresponsive, discuss with paediatric haematologist about treatment with rituximab or thrombopoietin receptor agonists
- Splenectomy reserved for those with persistent/significant bleeding non-responsive or intolerant of other therapies

# BLEEDING DISORDERS IN CHILDREN • 1/4

## INTRODUCTION

- All patients with a bleeding disorder must have open access and possess a medical card identifying their condition. Conditions include:
  - haemophilia A (factor VIII deficiency)
  - haemophilia B (factor IX deficiency)
  - von Willebrand's disease
  - platelet defects
  - deficiency of other coagulation factors (rare)
- Normal levels of factor VIII and IX = 50–150%
- Mild haemophilia >5% – muscle and joint bleeds, usually following trauma
- Moderate haemophilia 1–5% – muscle and joint bleeds, usually following trauma
- Severe haemophilia <1% – spontaneous joint and muscle bleeds
- Unless major trauma or major head injury (which should attend A&E), patient to attend children's assessment unit (CAU) and be treated within 30 min of arrival – open access folder in CAU available with patient details of condition and treatment
- Minor bleeds usually present with pain and slight restriction of movement, with minimal or no joint swelling
- Major bleeds present with severe pain/tenderness with marked swelling and restricted movement of joint
- Do not request inappropriate blood tests, venepuncture can cause bleeding. FBC only if large bleed, coagulation screen not required on a known patient. Discuss with consultant whether pre and post treatment factor levels required
- Patients presenting will be registered with the local designated haemophilia unit
- If condition severe, patient may be registered locally and also with comprehensive care centre

## INDICATIONS FOR ADMISSION

- Bleeding in mouth, neck, respiratory passages or gastro-intestinal tract
- Suspected internal bleeding (intracranial, intra-thoracic or intra-abdominal)
- Haemorrhage endangering a nerve (e.g. carpal tunnel – median nerve, iliopsoas – femoral nerve) or other vital structure
- Requiring surgical treatment, including dental surgery
- Haemarthrosis, especially weight-bearing joints (e.g. hips and knees)
- Any lesion requiring 12-hrly or more frequent replacement therapy

## MANAGEMENT OF ACUTE BLEEDING

- Patients present for treatment, particularly when developing a haemarthrosis before any physical signs are present
- If suspected intracranial bleed: arrange scans **but treat IMMEDIATELY – do not wait for results**
- Give **immediate** replacement therapy for joint bleeds as haemarthroses are very painful and any delay may increase severity of bleed and risk of joint damage
- When requesting any factor inform blood bank that it is required immediately; (use same brand factor named in each child's open access information)
- Prescribe analgesia (do not use ibuprofen or other NSAID– risk of bleeding), do not administer IM medications
- Contact haemophilia nurse (Mon–Fri) or out of hours on-call paediatric consultant requesting they liaise with haematologist

### Replacement therapy dosage

- When deciding dose, consider:
  - type of lesion
  - time of onset of symptoms
  - factor level required to sustain haemostasis
  - half-life of therapy (varies with each concentrate)

# BLEEDING DISORDERS IN CHILDREN • 2/4

Type of lesion	Level of factor desired
<ul style="list-style-type: none"> <li>Uncomplicated bleeding into joints and muscles</li> </ul>	<ul style="list-style-type: none"> <li>Non weight bearing joint 30%</li> <li>Weight bearing joint 50% (may need twice daily infusion)</li> </ul>
<ul style="list-style-type: none"> <li>Haematoma in potentially serious situations:               <ul style="list-style-type: none"> <li>bleeding in mouth</li> <li>neck</li> <li>respiratory passages</li> <li>endangering nerves</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>30–50%</li> </ul>
<ul style="list-style-type: none"> <li>Pre-dental extraction</li> </ul>	<ul style="list-style-type: none"> <li>50%</li> </ul>
<ul style="list-style-type: none"> <li>Major surgery</li> <li>Serious accident</li> <li>Head injury</li> </ul>	<ul style="list-style-type: none"> <li>80–100%</li> </ul>

## Calculation of replacement factor

- Give patient same brand of concentrate each time treatment is required

### Step 1 Calculate factor (%)

Increase required = desired factor percentage - baseline factor percentage of patient

### Step 2 Calculate dose of specific factor required

- For factor VIII concentrate (Advate<sup>®</sup>, ReFacto AF<sup>®</sup>): dose required (units) = body weight (kg) x factor (%) increase required divided by 2
  - For factor IX concentrate (BeneFix): dose required (units) = body weight (kg) x factor (%) increase required x 1.2
  - For VW factor concentrate (Haemate<sup>®</sup> P): dose required (units) = weight (kg) x Ricof (%) increase required divided by 3
- For any other Factor concentrate, contact on-call haematologist to discuss treatment and ascertain correct recovery constant

## Other treatment

- On advice of consultant haematologist for those with inhibitors to factors VIII or IX
- Factor VIIa (recombinant: Novoseven) or FEIBA (factor VIII inhibitor bypass agent)

## Administration of factor concentrate

- Always wear gloves**
- Most factor concentrates are provided in packs with concentrate, diluent in syringe, vial adapter for transfer, infusion set
- Read instructions carefully (picture guides included in each pack) before reconstituting factor-incorrect reconstitution may result in wastage of expensive concentrate. If in doubt seek advice from haemophilia nurse or consultant on-call
- Transfer the diluent into the dried concentrate vial via a needleless adapter
- Give intravenously, via butterfly if one dose required, use cannula if admitting for several doses. Rate to be given by slow bolus over no more than 3 mL per min – or as specified
- Factor IX infusion may cause reaction, observe patient carefully post infusion
- Vials available in 250–3000 units for factor VIII and IX
  - adverse reactions rare but include anaphylactic shock
- During prolonged treatment screen for inhibitors every 5 doses
- Half-life of factor VIII is 8–12 hr, half-life of factor IX is 18 hr (maybe shorter in young children). Initial levels can be assessed 15 min post infusion, blood tests to assess factor level are advisable post infusion under guidance of haematologist

## Duration of treatment

- Decided by local on-call haematologist or designated tertiary haemophilia unit (on-call haematologist). **If in doubt, ask**

# BLEEDING DISORDERS IN CHILDREN • 3/4

## DESMOPRESSIN IN MILD HAEMOPHILIA A AND VON WILLEBRAND'S DISEASE

- Subcutaneous or IV
- may be used to raise Factor VIII and Von Willebrand factor levels
- response usually fourfold rise (IV/sub cut) or twofold rise (intranasal) in Factor VIII and von Willebrand's antigen concentration – peak response is seen approx. 60 minutes after administration sub cut /IV

### Patient selection

- Consider **only** in mild (**NOT** severe) haemophilia A
- **Not** appropriate in Factor IX deficiency (haemophilia B)
- Check notes for outcome of previous desmopressin challenge
- Do not use in:
  - aged <2 yr
  - cardiac conditions
  - epilepsy
  - renal impairment

### Administration of desmopressin

- Desmopressin 0.3 microgram/kg, either 15 microgram in 1 mL vials for SC/IV or 4 microgram vials for IV only). **Be vigilant with dose prescribing and preparation choice** (lower dose preparation used in other medical conditions)
- **SC:** 0.3 microgram/kg (vials of 1 mL=15 microgram/mL) or, less preferably **IV:** 0.3 microgram/kg IV in sodium chloride 0.9% 30 -50 mL over 20 min. May be repeated after 12 hr
- **Side effects** include hypertension, headache, flushed face, nausea
  - measure pulse and BP every 5 min during IV infusion. If either rises unacceptably, reduce rate of infusion
- Blood samples may be taken before and after infusion to measure Factor VIII/vW level and ensure therapeutic level reached if requested by consultant
- tachyphylaxis can occur with depletion of stored Factor VIII with consecutive days. After 3 days there may be an inadequate rise of Factor VIII
- Monitor patient's fluid intake over the following 24 hr

## VON WILLEBRAND'S DISEASE

- More common than haemophilia
- caused by deficiency (qualitative or quantitative) of vWF protein, which binds to Factor VIII (prolonging half-life) and platelets
- Can present with acute episodes of mucosal bleeding, helping to form initial clot
- Before treatment, consider:
  - von Willebrand's disease (vWD) sub-type
  - bleeding history, including previous response to any treatment
  - nature of haemostatic challenge
- Treatment is often a combination of tranexamic acid and desmopressin or Haemate<sup>®</sup> P

### Tranexamic acid

- Anti-fibrinolytic agent
- Contraindicated in presence of frank haematuria (>2+blood)
- Decrease dose in renal failure
- Oral tranexamic acid alone can be used to treat minor problems such as recurrent epistaxis, but main use is in combination with desmopressin if appropriate
  - oral dose 15–25 mg/kg 8-hrly (max dose 1.5 g tds) for max 5 days (oral suspension available but pharmacy may need to order in or manufacture on site)
- Intravenous tranexamic acid 10 mg/kg (max 1 g) 8-hrly over 10 min

### Desmopressin

- Treatment of choice in responsive patients for spontaneous bleeding, trauma and minor surgery
- For administration – see **Administration of desmopressin**

## BLEEDING DISORDERS IN CHILDREN • 4/4

vWD Type	Advice
Type 1	<ul style="list-style-type: none"><li>• Most patients responsive</li></ul>
Type 2A	<ul style="list-style-type: none"><li>• Some patients responsive</li><li>• ask about previous challenge</li></ul>
Type 2B	<ul style="list-style-type: none"><li>• DO NOT GIVE desmopressin</li><li>• it causes platelet agglutination and thrombocytopenia</li></ul>
Type 3	<ul style="list-style-type: none"><li>• Not all responsive and some can be severe</li><li>• ask about previous challenge</li></ul>

### Haemate<sup>®</sup> P (blood product)

- Avoid if at all possible
- Use in patients not responsive to, or unsuitable for, desmopressin (e.g. aged <2 yr)

# ANTIBIOTICS • 1/1

## EMPIRICAL ANTIBIOTICS

See full guideline for each condition for indications, investigations and other management

Once organism identified, change antibiotic to narrowest spectrum appropriate for site of infection

**Oral** unless unavailable or IV stipulated; if not tolerating oral fluids use same antibiotic IV

	Mild/Moderate	Severe respiratory distress
<b>Pneumonia: 1<sup>st</sup> line (community acquired) 2<sup>nd</sup> line</b>	Amoxicillin 7 days (vomiting: benzylpenicillin IV) Amoxicillin 7 days <b>and</b> azithromycin 3 days	Co-amoxiclav IV – then oral (total 10 days) + azithromycin 3 days Piperacillin/tazobactam + azithromycin 10 days
<b>Flu</b>	Oseltamivir 5 days	Oseltamivir 5 days + co-amoxiclav 10 days
<b>Empyema</b>	Co-amoxiclav IV + clindamycin, when afebrile co-amoxiclav oral total 2–4 weeks	
<b>Hospital acquired</b>	Piperacillin/tazobactam 7 days	
<b>Allergy:</b> azithromycin instead of amoxicillin; clindamycin instead of co-amoxiclav or piperacillin/tazobactam		
		Penicillin allergy
<b>Meningitis</b> Meningococcus: 7 days Haemophilus*: 10 days Pneumo/GBS*: 14 days Gram –ve: 21 days	Cefotaxime or ceftriaxone (high dose) + amoxicillin IV (high dose)(aged <3 months) + vancomycin IV (multiple antibiotics in last 3 months or recent travel outside UK) *+/- dexamethasone – see <b>Meningitis</b> guideline	Cefotaxime or ceftriaxone IV  If confirmed immediate hypersensitivity chloramphenicol IV or teicoplanin + gentamicin
<b>Sepsis: Community Hospital</b>	Cefotaxime or ceftriaxone (high dose) 5 days + amoxicillin IV (high dose)(aged <3 months) Piperacillin/tazobactam 5 days minimum	
<b>Epiglottitis</b>	Ceftriaxone IV (high dose)	
<b>Encephalitis</b>	Aciclovir IV (high dose)	
<b>UTI aged &lt;3 months:</b> aged >3 months: Cystitis Pyelonephritis	Cefotaxime/ceftriaxone; when afebrile co-amoxiclav total 7 days Cefalexin 3 days Co-amoxiclav IV when afebrile oral total 7 days	Gentamicin  Co-trimoxazole
<b>Osteomyelitis and septic arthritis</b>	Cefotaxime or ceftriaxone aged <5 yr Flucloxacillin (high dose) IV aged ≥5 yr 4–6 weeks (discuss with ID and orthopaedics)	Cefotaxime or ceftriaxone Clindamycin
<b>GI surgical prophylaxis</b>	Co-amoxiclav IV (single dose 30 min pre-op)	Gentamicin + metronidazole
<b>Peritonitis</b>	Piperacillin/tazobactam 5–10 days	
<b>Tonsillitis</b>	Penicillin V 10 days (if not tolerated give amoxicillin)	Azithromycin 5 days
<b>Otitis media</b>	Amoxicillin (1 <sup>st</sup> line) 5 days Co-amoxiclav (2 <sup>nd</sup> line) 5 days	Azithromycin 5 days
<b>Otitis externa</b>	Flucloxacillin (if can swallow capsules) 5 days OR Co-amoxiclav (suspension) 5 days	Azithromycin
<b>Impetigo</b>	Fusidic acid 2% ointment 7 days Flucloxacillin if widespread	Azithromycin
<b>Erysipelas</b>	Co-amoxiclav 7 days	Azithromycin
<b>Cellulitis</b>	Co-amoxiclav 7 days Flucloxacillin IV (high dose if severe) 7 days	Clindamycin
<b>Periorbital cellulitis</b>	Co-amoxiclav 5 days	Azithromycin
<b>Orbital cellulitis</b>	Cefotaxime or ceftriaxone add clindamycin if severe when afebrile co-amoxiclav 2 weeks (6 if bone involvement)	Ciprofloxacin + clindamycin IV
<b>Sinusitis</b>	Amoxicillin 7 days If no response 48 hr co-amoxiclav (IV if severe)	Azithromycin
<b>Quinsy (peritonsillar abscess)</b>	Co-amoxiclav IV Change to oral when afebrile total 10 days	Clindamycin
<b>Mastoiditis</b>	Co-amoxiclav IV Ceftriaxone if bone erosions + aged <5 yr (see <b>Osteomyelitis</b> ) When afebrile co-amoxiclav total 10 days	Clindamycin



# CUTS AND BITES • 1/2

Prevention of infection after bites from humans and other animals

## PROPHYLACTIC ANTIBIOTICS

Give to:

- All human bite wounds ≤72 hr old, even if no sign of infection
- Animal bite wounds if wound ≤48 hr old and risk of infection high as follows:
  - bites to hand, foot, and face; puncture wounds; wounds requiring surgical debridement; crush wounds with devitalised tissue; wounds in genital areas; wounds with associated oedema; wounds involving joints, tendons, ligaments, or suspected fractures
  - wounds that have undergone primary closure
  - patients at risk of serious wound infection (e.g. immunosuppressed)
  - asplenic patients, even after trivial animal bites
  - patients with prosthetic implants e.g. heart valve, VP shunt
- antibiotics are not generally needed if wound ≥2 days old and no sign of local or systemic infection
- Advise patient and carers of signs of developing infection and to attend urgently for review should this happen. Do not give antibiotics for insect bites
- Send swab for bacterial culture and blood culture if systemically unwell
- Co-amoxiclav (if penicillin allergy – clindamycin and cotrimoxazole) for 5 days

## TETANUS-PRONE WOUND

- Wounds
  - that require surgical intervention that is delayed for >6 hr
  - that show a significant degree of devitalised tissue or a puncture-type injury particularly where there has been contact with soil or manure
  - containing foreign bodies
  - in patients who have systemic sepsis
- Compound fractures

Immunisation status	Clean wound	Tetanus-prone wound	
	Vaccine	Vaccine	Human tetanus immunoglobulin
Fully immunised, i.e. has received a total of 5 doses of vaccine at appropriate intervals	None required	None required	Only if high risk*
Primary immunisation complete, boosters incomplete but up to date	None required (unless next dose due soon and convenient to give now)	None required (unless next dose due soon and convenient to give now)	Only if high risk*
Primary immunisation incomplete or boosters not up to date	A reinforcing dose of vaccine and further doses as required to complete recommended schedule (to ensure future immunity)	A reinforcing dose of vaccine and further doses as required to complete recommended schedule (to ensure future immunity)	Yes: give one dose of human tetanus immunoglobulin in a different site
Not immunised or immunisation status not known or uncertain	An immediate dose of vaccine followed, if records confirm the need, by completion of a full 5 dose course to ensure future immunity	An immediate dose of vaccine followed, if records confirm the need, by completion of a full 5 dose course to ensure future immunity	Yes: give one dose of human tetanus immunoglobulin in a different site

\* High risk: heavy contamination with material likely to contain tetanus spores and/or extensive devitalised tissue

Tetanus vaccine [e.g. combined diphtheria (low dose), tetanus, and poliomyelitis] and immunoglobulin if indicated – see **Department of Health, Immunisation against infectious diseases:**

[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/148506/Green-Book-Chapter-30-dh\\_103982.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/148506/Green-Book-Chapter-30-dh_103982.pdf)

## RABIES

- Take history of:
  - patient name, date of birth, age and address

## CUTS AND BITES● 2/2

---

- date of exposure
- species and current health status of animal involved
- country of exposure
- type of exposure
- site of exposure
- any previous rabies vaccinations
- Seek advice from consultant microbiologist or consultant in infectious diseases

# CERVICAL LYMPHADENOPATHY • 1/3

Enlargement of cervical lymph nodes >2 cm

## Acute lymphadenitis

- Short history (usually <2 weeks)
- Neck mass with features of acute inflammation

## Subacute lymphadenopathy

- History variable
- Often non-tender but with overlying erythema

## Chronic lymphadenopathy

- Longer history (usually >6 weeks)
- No feature of acute inflammation

## HISTORY

### Symptoms

- Duration
- Symptoms of URTI
- Fever
- Weight loss
- Night sweats
- Eczema/skin infection
- Bruising
- Pallor
- Bone pain
- Pruritis

### Social

- Contact with TB or cats
- Travel or place of birth/parental origin

## EXAMINATION

- Site of node(s)
- Size of node(s)
- ENT examination
- Skin – especially eczema
- Axillae, supraclavicular and groin for other nodes
- Abdomen for hepatosplenomegaly

## DIFFERENTIAL DIAGNOSIS

### Acute unilateral

- Reactive
  - URTI (*Strep. pneumoniae*)
  - skin infection (*Group A Strep*, *Staph. aureus*)
  - dental infection (anaerobes)
- Kawasaki (see **Kawasaki disease** guideline)
- Cat scratch disease (*Bartonella*: tender, axillary lymphadenopathy)
- Kikuchi-Fujimoto disease (histiocytic necrotising lymphadenitis)

### Acute bilateral

- Reactive
  - viral URTI
  - EBV, CMV (generalised lymphadenopathy, hepatosplenomegaly)

### Subacute

- Non-tuberculous mycobacteria (aged <5 yr, unilateral, non-tender, purple, systemically well)
- Mycobacterium tuberculosis
- Toxoplasma gondii (generalised lymphadenopathy, fatigue, myalgia)

# CERVICAL LYMPHADENOPATHY • 2/3

## Chronic

- Reactive
- Neoplasia
- lymphoma, leukaemia
- soft tissue tumours
- juvenile chronic arthritis, SLE

## For urgent investigation to exclude significant underlying disease (red flags)

### Nodes:

- Supraclavicular – diagnostic of significant pathology
- >2 cm at 4–6 weeks
- Growing in size for  $\geq 2$  weeks
- Not returned to base line (<1 cm) at 8–12 weeks

### Signs and Symptoms:

- Petechiae/purpura
- Respiratory compromise
- Dysphagia
- Hepatosplenomegaly – also need to exclude EBV
- Weight loss and night sweats – TB/malignancy, early investigation
- Persistent fever (>2 weeks)

## INVESTIGATIONS

- See **Flowchart**
- To be done urgently:
  - FBC, film, ESR, CRP
  - CXR
    - hilar lymphadenopathy on CXR – refer for biopsy
    - hilar lymphadenopathy significantly increases likelihood of neoplastic disease
  - ultrasound scan (USS)
    - high sensitivity and specificity for abscess formation in acute lymphadenitis
    - value in chronic lymphadenopathy for assessing size, architecture and vascularity
- LDH of limited diagnostic value: not to be done routinely
- LFTs: only if suspected viral infection
- Discuss with ENT for biopsy
- Serology for toxoplasma, CMV and EBV
- CT only if suspected deep neck space infection

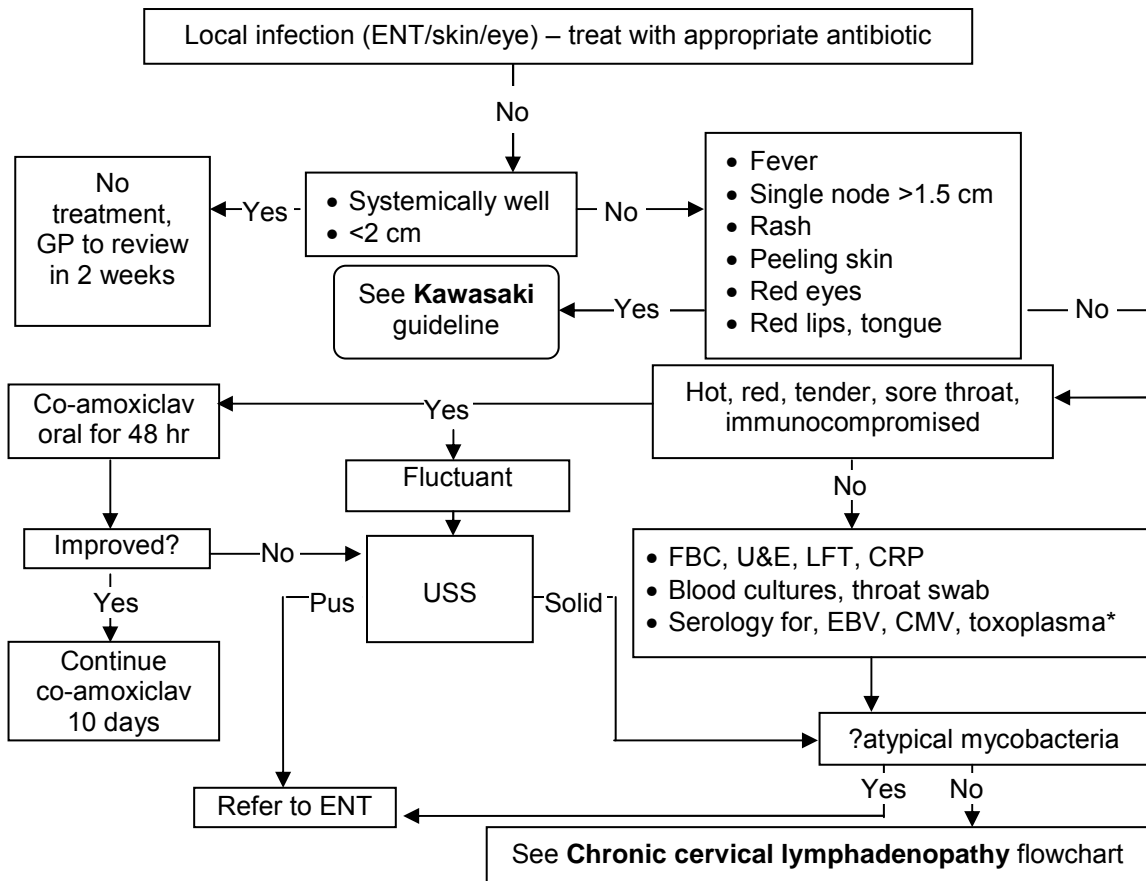
### Surgical excision biopsy

- Atypical mycobacterial infection
- Features highly suggestive of neoplasia:
  - lymph nodes >2 cm diameter
  - all supraclavicular and suprasternal nodes
  - constitutional symptoms
  - hepatosplenomegaly
  - generalised lymphadenopathy
  - abnormal architecture on USS

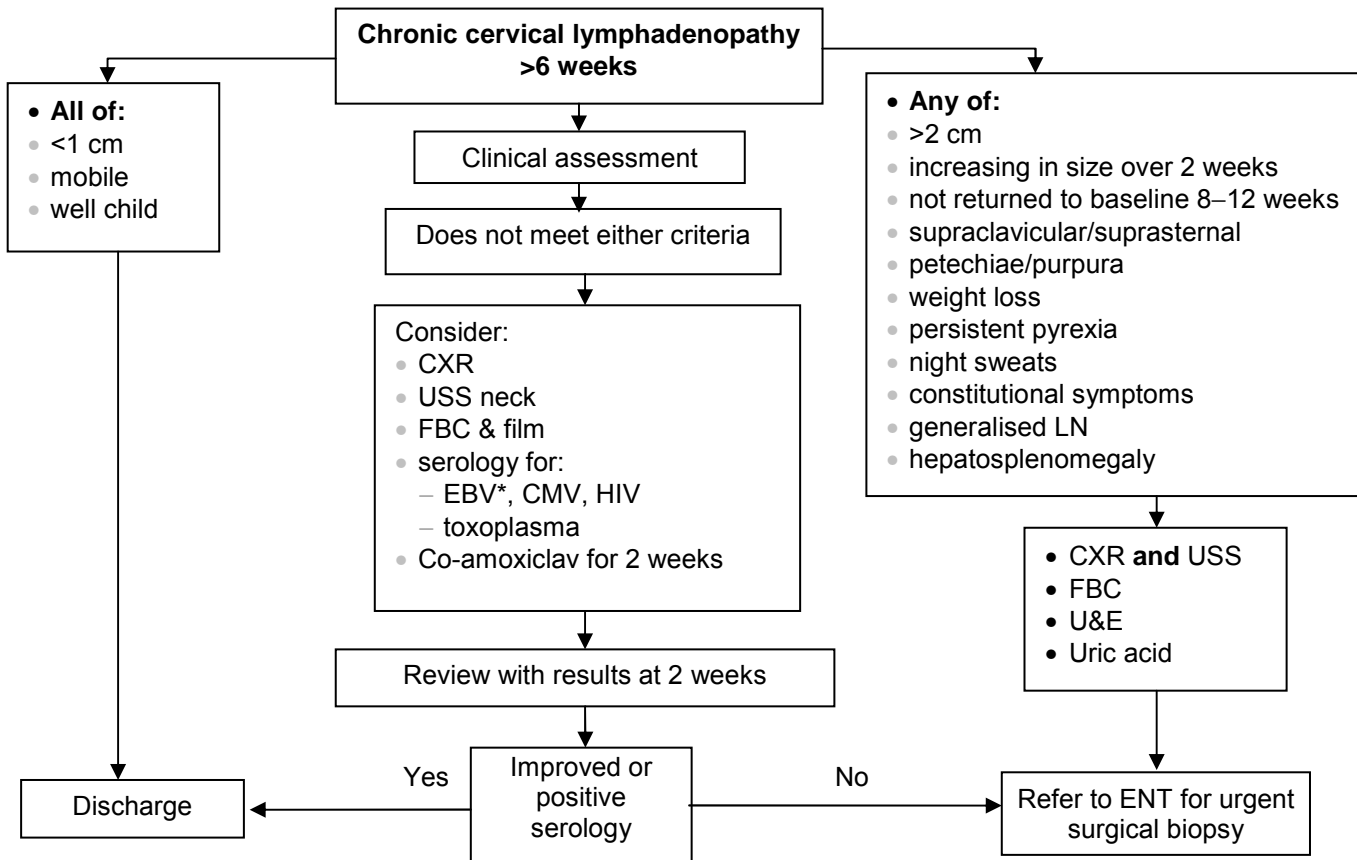
### Children undergoing surgical biopsy for suspected neoplastic disease

- FBC and film
- U&E, uric acid, LFTs
- CXR

# CERVICAL LYMPHADENOPATHY • 3/3



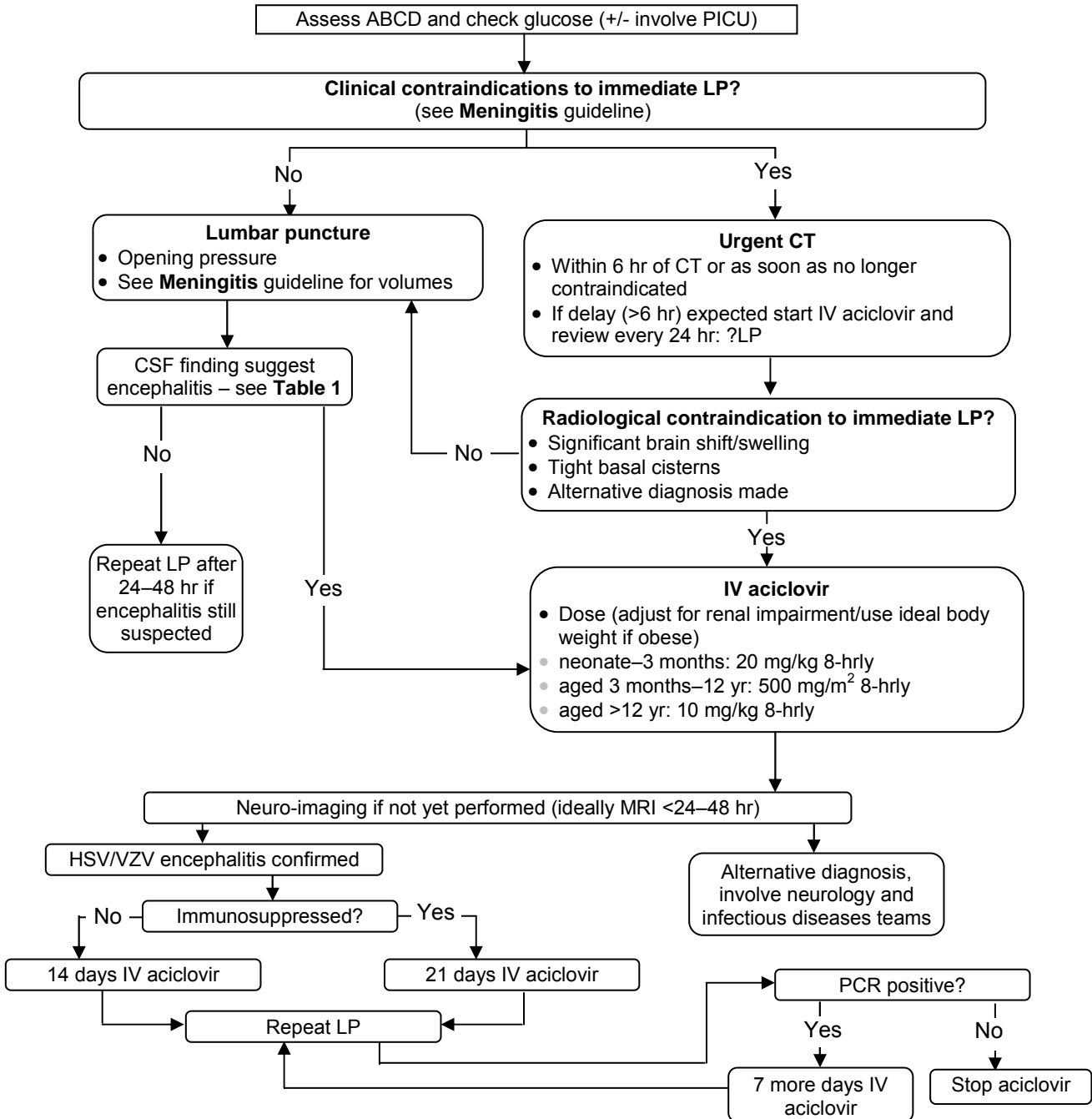
\* For storage pending repeat titre in chronic course



\*If EBV negative and history of clinical suspicion – retest after 2 weeks

# ENCEPHALITIS • 1/2

- History of:
  - altered consciousness, personality or behaviour or
  - focal neurology or
  - focal seizures and
  - fever



# ENCEPHALITIS • 2/2

Table 1: CSF interpretation

Investigation	Normal	Bacterial meningitis	Viral encephalitis	Tuberculous meningitis	Fungal
Opening pressure	10–20 cm	High	Normal/high	High	High/very high
Colour	Clear	Cloudy	'Gin' clear	Cloudy/yellow	Clear/cloudy
Cells	<5	High/very high 100–50000	Slightly increased 5–1000	Slightly increased <500	Normal/high 0–1000
Differential	Lymphocytes	Neutrophils	Lymphocytes	Lymphocytes	Lymphocytes
CSF/Plasma glucose	50–66%	<40%	Low	Low/very low <30%	Normal/low
Protein (g/L)	<0.45	High >1	Normal/high 0.5–1	High/very high 1.0–5.0	Normal/high 0.2–5.0

## ADDITIONAL INVESTIGATIONS

- Swab in viral transport medium
- throat
- vesicle (if present)
- Sputum (if symptoms)
- Urine (if ? mumps for PCR)
- If travel consider
- 3x thick/thin malaria films OR
- rapid malaria antigen test
- CSF flavivirus IgM (Europe, Russia, eastern China)
- If HIV+ve, discuss with infectious diseases

### EEG indications

- If subtle motor status epilepticus suspected
- If unclear if psychiatric cause of encephalopathy

### Involve

- Microbiology
- Virology
- Infectious diseases
- Neurology

# FEVER • 1/4

## ASSESSMENT AND INITIAL MANAGEMENT

- Fever, in child aged <5 yr, usually indicates underlying infection.
- infants aged <3 months, low temperature could indicate infection
- **Parental perceptions of fever are usually accurate and must be taken seriously**

## IDENTIFYING RISK OF SERIOUS ILLNESS

### Three stages of clinical assessment

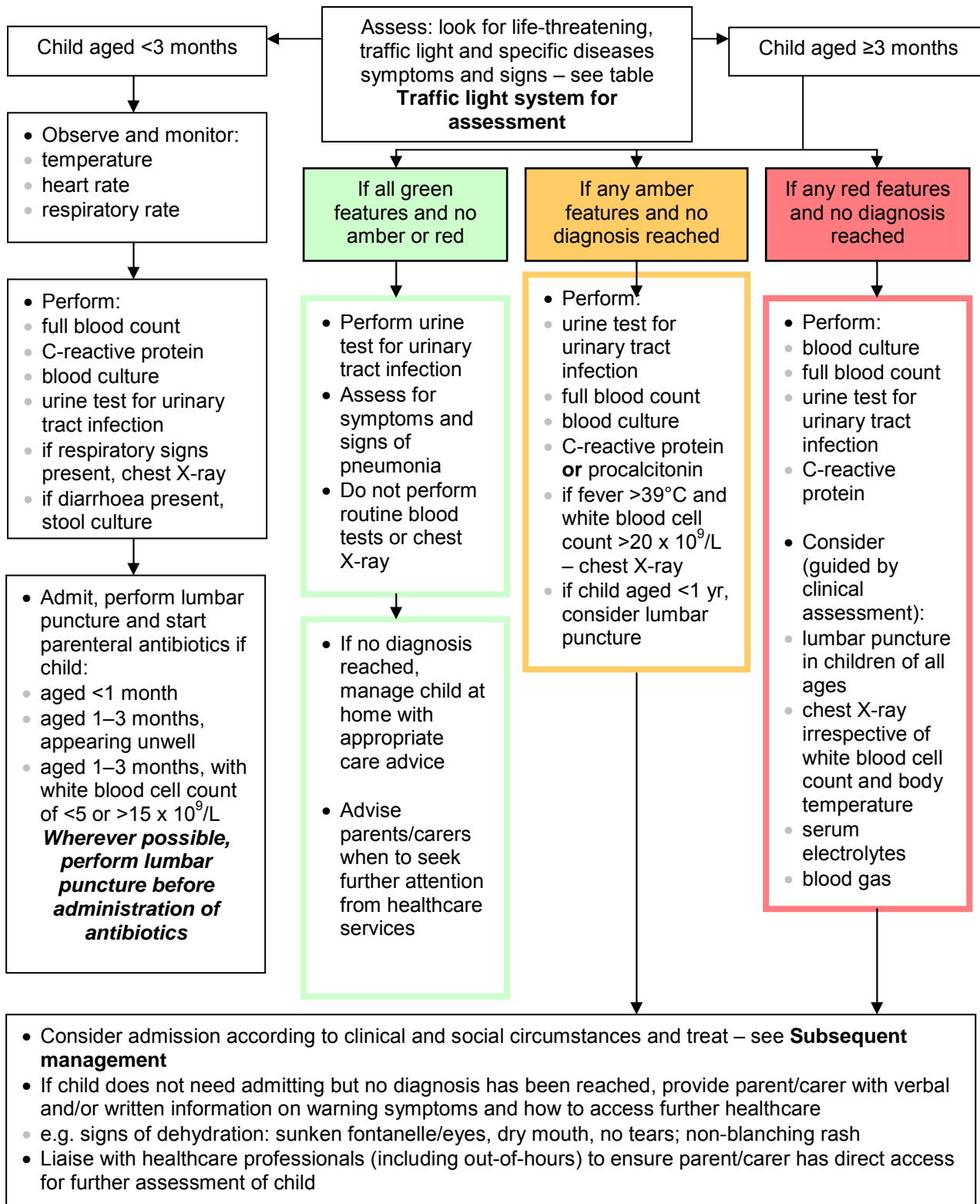
1. Identify life-threatening features (utilising Airway, Breathing, Circulation (hydration) and Disability assessment)
2. Assess risk of serious illness (see **Traffic light system for assessment**) – can be used with Paediatric Early Warning Score (PEWS)
3. Attempt to identify source of infection/features of specific serious conditions. If child has a learning disability, take this into account when interpreting the traffic light system

### Traffic light system for assessment

	Low risk	Intermediate risk	High risk								
<b>Colour</b>	<ul style="list-style-type: none"> <li>• Skin, lips and tongue normal</li> </ul>	<ul style="list-style-type: none"> <li>• Pallor reported by carer</li> </ul>	<ul style="list-style-type: none"> <li>• Pale, mottled, ashen or blue</li> </ul>								
<b>Activity</b>	<ul style="list-style-type: none"> <li>• Responds to normal social cues</li> <li>• Content/smiles</li> <li>• Stays awake/ wakes quickly</li> <li>• Strong normal cry/settled/smiles</li> </ul>	<ul style="list-style-type: none"> <li>• Not responding normally to social cues</li> <li>• Wakes only with prolonged stimulation</li> <li>• Decreased activity</li> <li>• No smile</li> </ul>	<ul style="list-style-type: none"> <li>• No response to social cues</li> <li>• Looks ill</li> <li>• Unrousable/doesn't stay awake after rousing</li> <li>• Weak, high pitched or continuous cry</li> </ul>								
<b>Breathing</b>	<ul style="list-style-type: none"> <li>• Normal</li> </ul>	<ul style="list-style-type: none"> <li>• Nasal flare</li> <li>• Tachypnoea                             <ul style="list-style-type: none"> <li>• respiratory rate <math>\geq 50</math>/min (aged &lt;1 yr)</li> <li>• respiratory rate <math>\geq 40</math>/min (aged &gt;1 yr)</li> </ul> </li> <li>• Oxygen saturation <math>\leq 95\%</math></li> <li>• Crackles on auscultation</li> </ul>	<ul style="list-style-type: none"> <li>• Grunting/nasal flare</li> <li>• Tachypnoea                             <ul style="list-style-type: none"> <li>• respiratory rate <math>&gt; 60</math>/min (any age)</li> </ul> </li> <li>• Chest wall recession (moderate/severe)</li> </ul>								
<b>Circulation and hydration</b>	<ul style="list-style-type: none"> <li>• Normal skin and eyes</li> <li>• Moist mucous membranes</li> </ul>	<ul style="list-style-type: none"> <li>• Dry mucous membranes</li> <li>• Poor feeding (infants)</li> </ul> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Age</th> <th>Heart rate (bpm)</th> </tr> </thead> <tbody> <tr> <td>&lt;1 yr</td> <td>&gt;160</td> </tr> <tr> <td>1–2 yr</td> <td>&gt;150</td> </tr> <tr> <td>2–5 yr</td> <td>&gt;140</td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>• CRT <math>\geq 3</math> sec</li> <li>• Reduced urine output</li> </ul>	Age	Heart rate (bpm)	<1 yr	>160	1–2 yr	>150	2–5 yr	>140	<ul style="list-style-type: none"> <li>• Reduced skin turgor</li> </ul>
Age	Heart rate (bpm)										
<1 yr	>160										
1–2 yr	>150										
2–5 yr	>140										
<b>Other</b>	<ul style="list-style-type: none"> <li>• No amber/red features</li> </ul>	<ul style="list-style-type: none"> <li>• Temperature <math>\geq 39^\circ\text{C}</math> (aged 3–6 months)</li> <li>• Rigors</li> <li>• Fever <math>\geq 5</math> days</li> <li>• New lump <math>&gt; 2</math> cm diameter</li> <li>• Swelling of joint/limb</li> <li>• Not using a limb/weight bearing</li> </ul>	<ul style="list-style-type: none"> <li>• Temperature <math>\geq 38^\circ\text{C}</math> (aged &lt;3 months)</li> <li>• Non-blanching rash</li> <li>• Bulging fontanelle</li> <li>• Neck stiffness</li> <li>• Status epilepticus</li> <li>• Focal neurological signs</li> <li>• Focal seizures</li> <li>• Bilious vomiting</li> </ul>								



# FEVER • 2/4



## Observations

- Measure and record in **all** febrile children:
  - temperature  
 aged <4 weeks: electronic thermometer in the axilla  
 aged >4 weeks: infrared tympanic or electronic thermometer in the axilla
  - respiratory rate, heart rate, capillary refill time
  - signs of dehydration: skin turgor, respiratory pattern, weak pulse, cool extremities
  - travel history
- Re-assess all children with amber or red features within 1–2 hr

## IMMEDIATE TREATMENT

### Antipyretic treatment

- Tepid sponging not recommended
- Do not over or under dress a child with fever
- If child appears distressed or unwell, consider **either** paracetamol or ibuprofen
- Do not routinely administer both drugs at the same time with the sole aim of reducing fever or preventing febrile convulsions
- Alternate if distress persists or recurs before next dose due

### Antibiotics

- Do not prescribe oral antibiotics to children with fever without apparent source
- if aged >3 months consider admission and observation with or without investigations

### Signs of shock

- Increased respiratory and heart rate, cold peripheries, prolonged capillary refill time, pallor/mottled, drowsy/agitated/confused
- Give immediate IV fluid bolus of sodium chloride 0.9% 20 mL/kg. Give additional boluses as necessary
- If signs of shock, SpO<sub>2</sub> <92% or clinically indicated, prescribe oxygen
- Urgent senior support: discuss with PICU
- See **Sepsis (including meningococcal)** guideline

## SUBSEQUENT MANAGEMENT

- Serious bacterial infection suspected:
  - shock
  - unrousable
  - meningococcal disease
  - aged <1 month
  - aged 1–3 months with a white blood cell count <5 or >15 x 10<sup>9</sup>/L
  - aged 1–3 months appearing unwell
- Cefotaxime 50 mg/kg slow IV bolus 6 hrly (see BNFC for neonatal doses)
- When patient is stable change to once daily ceftriaxone by infusion over 30 min: neonates 50 mg/kg; children and infants <50 kg body weight or aged <12 yr, 80 mg/kg (max 4 g); >50 kg and/or aged >12 yr, 4 g
- if ceftriaxone contraindicated (<41 weeks postmenstrual age; neonates with jaundice, hypoalbuminaemia or acidosis; or on IVI calcium) continue cefotaxime
- infants aged <3 months add amoxicillin 50 mg/kg for *Listeria* (see BNFC for frequency)
- If no evidence of bacterial sepsis, stop antibiotics 48 hr after time blood injected in the culture bottle
- Decreased level of consciousness: consider meningitis and herpes simplex encephalitis
- give aciclovir: aged <3 months 20 mg/kg IV 8-hrly; aged >3 months–12 yr 500 mg/m<sup>2</sup>; aged >12 yr 10 mg/kg IV 8-hrly
  - adjust dose frequency in renal impairment
  - if obese, use ideal body weight
- RSV/flu: assess for serious illness/UTI
- If rates of antibacterial resistance are significant, refer to local policy
- See **Sepsis (including meningococcal)** and **Meningitis** guidelines

### Symptoms and signs of specific diseases

#### **Meningococcal disease**

- Non-blanching rash with one or more of the following:
  - ill-looking child
  - lesions >2 mm in diameter (purpura)
  - CRT ≥3 sec
  - neck stiffness

#### **Meningitis**

- Neck stiffness
- Bulging fontanelle
- Decreased level of consciousness
- Convulsive status epilepticus

# FEVER • 4/4

---

## ***Herpes simplex encephalitis***

- Focal neurological signs
- Focal seizures
- Decreased level of consciousness

## ***Pneumonia***

- Tachypnoea, measured as:
  - aged 0–5 months: respiratory rate >60 breaths/min
  - aged 6–12 months: respiratory rate >50 breaths/min
  - aged >12 months: respiratory rate >40 breaths/min
- Crackles in the chest
- Nasal flaring
- Chest indrawing
- Cyanosis
- Oxygen saturation  $\leq 95\%$

## ***Urinary tract infection***

- Vomiting (in children aged >3 months)
- Poor feeding
- Lethargy
- Irritability
- Abdominal pain or tenderness
- Urinary frequency or dysuria
- Offensive urine or haematuria

## ***Septic arthritis/osteomyelitis***

- Swelling of a limb or joint
- Not using an extremity
- Non weight bearing

## ***Kawasaki disease***

- Fever lasting >5 days and at least 4 of the following:
  - bilateral conjunctival injection
  - change in upper respiratory tract mucous membranes (e.g. injected pharynx, dry cracked lips or strawberry tongue)
  - change in peripheral extremities (e.g. oedema, erythema or desquamation)
  - polymorphous rash
  - cervical lymphadenopathy

# FEVER OF UNKNOWN ORIGIN • 1/3

## RECOGNITION AND ASSESSMENT

### Fever

- Type of thermometer used, site, user (factitious)
- Duration, height
- Pattern:
  - intermittent [pyogenic, TB, lymphoma, juvenile idiopathic arthritis (JIA)]
  - baseline raised (viral, endocarditis, lymphoma)
  - sustained (typhoid)
  - days between (malaria, lymphoma)
  - weeks between (metabolic, CNS, cyclic neutropenia, hyperIgD)
- Circumstances when fever (e.g. exercise)
- Appearance
  - when fever: well (factitious)
  - between fever: ill (serious)
- Response to paracetamol and or NSAID (no response: dysautonomia)

### Symptoms

- Red eyes (Kawasaki)
- Nasal discharge (sinusitis)
- Recurrent pharyngitis with ulcers (periodic fever)
- GI: salmonella, intra-abdominal abscess, inflammatory bowel disease (IBD)
- Limb pain (leukaemia, osteomyelitis)

### Contact

- Human illness
- Animals

### Travel

- Years ago (histoplasmosis)
- Part of country
- Prophylaxis and immunisations
- Contaminated water/food
- Bites (tick: arbovirus, malaria)
- Meat: undercooked (brucella, toxoplasma, hepatitis)
- Pica (visceral larva migrans, toxoplasmosis)

### Medical history

- Operations

### Drug history

- All, including any non-prescription

### Ethnic group

- Sephardic Jew, Armenian, Turkish, Arab (Familial Mediterranean Fever)
- Ashkenazi Jew (familial dysautonomia)

### Examination

- Sinuses
- Lymph nodes
- Chest: murmur, crackles
- Abdominal: hepato/spleno-megaly (salmonella, cat scratch, endocarditis, malaria)
- Genito-urinary: girls – pelvic tenderness (child sex abuse – STI)

### Skin

- Rash only during fever (JIA)
- No sweat (familial dysautonomia)
- Petechiae (endocarditis, rickettsia)
- Papules (cat scratch)
- Eschar (tularemia)

# FEVER OF UNKNOWN ORIGIN • 2/3

- Erythema migrans (Lyme)
- Malar (SLE)
- Palpable purpura [polyarteritis nodosa (PAN)]
- Erythema nodosum (JIA, SLE, malignancy, IBD, TB)
- Seborrhic (histiocytosis)
- Sparse hair (ectodermal dysplasia)
- Scars (dysautonomia)

## **Eyes**

- Conjunctivitis:
  - palpebral (infectious mononucleosis)
  - bulbar (Kawasaki)
  - phlyctenular (TB)
- Retinopathy (PAN, miliary TB, toxoplasmosis, vasculitis)
- Pupil dilation (hypothalamic or autonomic dysfunction)

## **Oropharynx**

- Red, no exudates (EBV)
- Stomatitis, pharyngitis, adenitis (PFAPA)
- Dental abscess
- Conical teeth (ectodermal dysplasia)
- Smooth tongue (dysautonomia)
- Gum hypertrophy, tooth loss (leukaemia, histiocytosis)

## **Musculoskeletal**

- Tender:
  - bone (osteomyelitis, malignancy)
  - muscle (trichinella, arbovirus, dermatomyositis, PAN)
- Trapezius (subdiaphragmatic abscess)
- Reflexes
  - brisk (hyperthyroid)
  - absent (dysautonomia)

## **Investigations**

### **All**

- FBC, ESR, CRP, U&E, LFT, blood culture, HIV antibody, urinalysis, urine culture, CXR
- FBC:
  - low Hb (malaria, endocarditis, IBD, SLE, TB)
  - high platelets (Kawasaki)
  - blasts (leukaemia)
  - eosinophils (fungal, parasites, neoplastic, allergic, immune deficiency)
- ESR/CRP: normal (factitious, dysautonomia, drug fever)
- LFTs: abnormal (EBV, CMV)
- Blood cultures: several times (endocarditis)
- Urine: pyuria (Kawasaki, intra-abdominal infection, GU, TB)

### **Selective**

- Stool (if loose)
- Bone marrow (leukaemia, histiocytichaemophagocytosis)
- Serology (syphilis, brucella, EBV, CMV, toxoplasma)
- Auto-antibodies (rheumatoid arthritis, SLE)
- IgG, A & M (recurrent infections)
- IgE (allergy, eosinophilia)
- IgD (periodic fever)
- Gastric aspirate, (induced) sputum (TB)

### **Imaging (selective)**

- X-ray (chest, sinuses)
- US/CT/MR abdo (IBD, abscess, lymphadenopathy)

# FEVER OF UNKNOWN ORIGIN • 3/3

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- White cell scan (abscess)
- Bone scan (osteomyelitis)
- PET scan (abscess)

## ***Other investigations (selective)***

- Echo (endocarditis)
- Ophthalmologist (uveitis, leukaemia)
- Biopsy (lymph node, liver)

## **EMPIRICAL TREATMENT**

- Critically ill: see **Sepsis (including meningococcal)** guideline
- TB treatment: after induced sputum, lymph node biopsy, TB blood culture
- Otherwise avoid antibiotics until organism isolated

## **REFERRAL**

- Rheumatology (JIA, connective tissue disorder)
- Gastroenterology (IBD)
- Cardiology (endocarditis/Kawasaki)

# HEPATITIS • 1/2

Discuss all children with suspected hepatitis B or C with infectious diseases team/regional liver unit for counselling, information, consideration for anti-viral therapy and need for referral

## HEPATITIS B

### Diagnostic tests

- HBsAg (Hepatitis B surface antigen) and HBcAb (IgM and IgG)
- HBsAb (anti-HBs: antibody) indicates previous immunisation if sAg negative
- If HBsAg positive then check HBeAg, HBeAb, genotype and HBV DNA PCR viral load, refer to infectious diseases/regional liver unit and notify Public Health England

### Who to screen

- Infants born to hepatitis B positive women at aged 12 months
- Close contacts of people with confirmed acute and chronic hepatitis B infection
- Migrants from highly endemic areas

### Follow-up of HBsAg positive children

- HBeAg -ve/HbeAb +ve: yearly
- HBeAg +ve: 6 monthly
- Abnormal liver function tests: 3 monthly

### Assessment during follow up

- Clinical assessment
- Serology (clotted specimen): HBsAg, HBeAg, HBeAb
- Hepatitis B DNA PCR viral load (EDTA)
- LFT (bilirubin, ALT/AST, ALP, albumin)
- GGT
- FBC
- Coagulation (INR, PT, PTT)
- Alpha-fetoprotein
- Abdominal ultrasound (yearly if eAg +ve; 5 yearly if eAb +ve) or if rise in alpha-fetoprotein
- Fibroscan yearly, if available

### Action

- If LFT or alpha-fetoprotein abnormal, or viral titres are rising, inform infectious diseases/regional liver unit

## HEPATITIS C

### Diagnostic tests

(For neonates see **Neonatal guidelines**)

- Hepatitis C Virus (HCV) antibody aged >18 months old
- HCV PCR if HCV antibody +ve

### Who to screen

- Children of women found to be infected with hepatitis C
- Close contacts of people diagnosed with hepatitis C
- Migrants from highly endemic areas

### Action

- If HCV Ab -ve, not infected. Discharge
- If HCV Ab +ve and HCV PCR negative in 2 samples taken 6 months apart, not infected (resolved infection or maternal antibody if aged <18 months). Discharge
- If HCV PCR positive, check genotype and yearly bloods below, refer to infectious diseases/regional liver unit

### Yearly follow-up

- Clinical assessment
- HCV PCR viral load (EDTA)
- LFT (bilirubin, ALT/AST, ALP, albumin)
- GGT
- FBC

## HEPATITIS • 2/2

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- Coagulation (INR, PT, PTT)
- Alpha-fetoprotein
- Abdominal ultrasound (and fibroscan if available)



# HIV AND HEPATITIS B POST-EXPOSURE PROPHYLAXIS (PEP) • 1/2

## RISK ASSESSMENT

### Low risk

- Mucous membrane or conjunctival contact with blood or body fluids
- Superficial injury that does not draw blood
- Needle/instrument not visibly contaminated with blood

### Moderate risk

- Skin penetrating injury that draws blood by needle/instrument contaminated with blood or body fluid
- Wound causing bleeding and produced by sharp instrument visibly contaminated with blood
- Sexual contact with individual of unknown HIV status

### High risk

- Significant exposure to blood or body fluids from source known to be HIV, hepatitis B (HBV) or C (HCV) infected
- Sexual assault

## MANAGEMENT

### Low risk

- HBV immunisation standard 0,1, 6 months

### Moderate risk

- HBV immunisation accelerated 0, 1, 2, 12 months

### High risk

- HBV immunisation accelerated 0, 1, 2, 12 months
- HBV immunoglobulin if source known infected with HBV
- HIV PEP

### PEP not indicated

- Low or moderate risk
- Sex with HIV +ve person confirmed viral load <200 copies/mL for >6 months
- Human bite
- Needlestick from a discarded needle in the community

### PEP

Age (yrs)	PEP
10+	Raltegravir + Truvada®
6–9	Raltegravir + tenofovir + zidovudine
<6	Kaletra® + lamivudine + zidovudine

- >35 kg: Truvada® 1 tab daily – do not use if known renal impairment
- >25 kg: raltegravir 400 mg tab 12-hrly
- See CHIVA PEP guidelines for doses  
[http://www.chiva.org.uk/files/2814/3575/6995/CHIVA\\_PEP\\_2015\\_final.pdf](http://www.chiva.org.uk/files/2814/3575/6995/CHIVA_PEP_2015_final.pdf)
- If source has drug-resistant virus, seek expert help
- If patient known to have HIV do not give PEP
- Start as soon as possible (ideally within 24 hr)
- Do not start >72 hr after exposure
- Give starter pack for 5 days treatment until seen by specialist in infectious diseases
- Total treatment course will be 28 days

# HIV AND HEPATITIS B POST-EXPOSURE PROPHYLAXIS (PEP) • 2/2

## INVESTIGATIONS

Table 1: Recommended monitoring during PEP course and follow-up

	Baseline	14 days	4–6 weeks post-completion
HIV	✓		✓
HBsAg (if no history of vaccination)	✓		✓ Only if not immune
Syphilis, Hep C HBsAb/cAb	✓		✓
STI	✓	✓	If further unprotected sexual intercourse has taken place
Creatinine	✓	Only if abnormalities at baseline	
ALT	✓	Only if abnormalities at baseline, Hep B/C co-infected or on Kaletra®	
Urinalysis or uPCR	✓	Only if abnormalities at baseline	If abnormalities at baseline or 2 weeks
Pregnancy test	✓	If appropriate	If appropriate
Creatine kinase		Only if symptomatic of myositis	

- After sexual exposure offer emergency contraception and screen for other sexually transmitted infections with urine for chlamydia and gonorrhoea and syphilis serology
- Check need for tetanus immunisation

## FOLLOW-UP

- Before discharge, provide families embarking on HIV PEP with:
  - appointment to see a paediatrician with experience in antiretroviral drugs or member of ID/GUM team the same day or next working day
  - for local paediatric HIV team see [www.chiva.org.uk/professionals/regional-networks](http://www.chiva.org.uk/professionals/regional-networks)
  - for national specialist advice ask for on-call paediatric infectious disease team at St Mary's London (020 3312 6666)
  - contact telephone number in case of concerns about any aspect of HIV PEP
  - enough antiretroviral medication to last until clinic appointment
  - letter for GP
- If PEP given review at 2 and 4 weeks
  - at 2 weeks repeat STI screen following sexual exposure
  - at 4–6 weeks repeat HIV, hepatitis and syphilis testing
- If source is HCV RNA PCR +ve, arrange the following enhanced HCV follow-up:
  - at 6 weeks: EDTA blood for HCV PCR
  - at 12 weeks: EDTA blood for HCV PCR and clotted blood for anti-HCV antibodies
  - at 24 weeks: clotted blood for anti-HCV antibodies

# HIV TESTING • 1/2

## INTRODUCTION

- HIV is a treatable medical condition
- The majority of those living with the virus are well
- Many are unaware of their HIV infection
- Late diagnosis is life-threatening
- HIV testing can be done in any medical setting and health professionals can obtain informed consent for an HIV test in the same way they do for any other medical investigation

## HOW

### Who can test?

- Doctor, nurse, midwife or trained healthcare worker

### Who should be offered a test?

- First-line investigation for suspected immune deficiency: unusual type, severity or frequency of infection. See **Table 1**
- Sexually active young people: take a sexual history in post-pubertal children
- Children of HIV positive parents who have not previously been tested
- Looked after children only if specific individual risk factors

### *Source patient in a needlestick injury or other HIV risk exposure*

- Consent must be obtained from source patient before testing
- The person obtaining consent must be a healthcare worker, other than person who sustained the injury

### Pre-test discussion with parents and children able to give consent

- Purpose of pre-test discussion is to establish informed consent:
  - patient/parent must be aware of testing for HIV
  - how result will be disclosed
- Lengthy pre-test HIV counselling is not a requirement
- Document patient's consent to testing
- If patient refuses test, explore why and ensure decision has not resulted from incorrect beliefs about the virus or consequences of testing
  - advise that, if negative, testing will not affect patient's insurance
- Some patients, (e.g. those whose first language is not English) may need additional help to reach a decision
- Test as soon as possible, urgently if aged <1 yr [RNA PCR (viral load) if mother know to be positive; HIV antibody if negative will exclude perinatal infection but reactive result may reflect maternal antibody aged <18 months]
- If testing delayed >6 months discuss with child protection team
- Document the offer of an HIV test in medical notes, together with any relevant discussion and reasons for refusal
- Written consent not necessary but record on laboratory request form that consent has been obtained
- Arrange appointment for result to be disclosed personally by testing clinician

## POST-TEST

### HIV negative result: post-test discussion

- If still within window period after a specific exposure, discuss need to repeat test
  - for definitive exclusion of HIV infection a further test after 3 months is recommended
- If reported as reactive or equivocal, refer to infectious diseases (may be seroconversion)

### HIV positive result: post-test discussion

- For all new HIV reactive results, inform paediatric HIV team
- confirmatory tests on a second sample will be required
- Testing clinician must give result personally to patient in a confidential environment and in a clear and direct manner
  - arrange follow-up programme with infectious diseases before informing patient of positive result

# HIV TESTING • 2/2

Table 1: Clinical indicator diseases for HIV infection

	<b>AIDS-defining conditions</b>	<b>Other conditions where HIV testing should be considered</b>
<b>ENT</b>		Chronic parotitis Recurrent and/or troublesome ear infections
<b>Oral</b>		Recurrent oral candidiasis Poor dental hygiene
<b>Respiratory</b>	Pneumocystis CMV pneumonitis Tuberculosis	Recurrent bacterial pneumonia Lymphoid interstitial pneumonitis Bronchiectasis
<b>Neurology</b>	HIV encephalopathy meningitis/encephalitis	Developmental delay Childhood stroke
<b>Dermatology</b>	Kaposi's sarcoma	Severe/recalcitrant dermatitis Multidermatomal or recurrent herpes zoster Recurrent fungal infections Extensive warts or molluscum contagiosum
<b>Gastroenterology</b>	Wasting syndrome Persistent cryptosporidiosis	Unexplained persistent hepatosplenomegaly Hepatitis B infection Hepatitis C infection
<b>Oncology</b>	Lymphoma Kaposi's sarcoma	
<b>Haematology</b>		Any unexplained blood dyscrasia including: <ul style="list-style-type: none"> <li>• thrombocytopenia</li> <li>• neutropenia</li> <li>• lymphopenia</li> </ul>
<b>Ophthalmology</b>	Cytomegalovirus retinitis	Any unexplained retinopathy
<b>Other</b>	Recurrent bacterial infections (e.g. meningitis, sepsis, osteomyelitis, pneumonia etc.) Pyrexia of unknown origin	

# IMMUNODEFICIENCY • 1/2

## RECOGNITION AND ASSESSMENT

- SPUR to recognition: **S**erious, **P**ersistent, **U**nusual, or **R**ecurrent infections
- The younger the onset, the more life-threatening the immune defect likely to be
- bacterial infection; early presentation: antibody defect
- viral/fungal infection; later presentation: cellular defect
- Family history of primary immunodeficiency (PID): focused investigations and refer

### **Warning signs of primary immunodeficiency.**

- $\geq 4$  new bacterial ear infections within 1 yr
- $\geq 2$  serious sinus infections within 1 yr
- $\geq 2$  months on antibiotics without resolution of symptoms
- $\geq 2$  episodes of pneumonia within 1 yr
- Failure to thrive with prolonged or recurrent diarrhoea
- Recurrent, deep skin or organ abscess
- Persistent candida in mouth or napkin area
- Need for IV antibiotics to clear infections
- $\geq 2$  severe infections (e.g. meningitis, osteomyelitis, cellulitis or sepsis)
- Family history of PID

### **Symptoms of immune deficiency**

- Delayed umbilical cord separation of  $\geq 3$  weeks, omphalitis
- Delayed shedding of primary teeth
- Severe adverse reaction to immunisation e.g. BCGitis
- Unusually severe course of measles or chickenpox
- Family history of any syndrome associated with immunodeficiency, (e.g. DiGeorge anomaly or Wiskott-Aldrich syndrome); or of death during early childhood
- High risk group for HIV and no antenatal HIV test (a negative antenatal HIV test does not exclude HIV in the child)
- Autoimmune liver disease, diabetes, vasculitis, ITP
- Poor wound healing
- Unexplained bronchiectasis or pneumatoceles
- $>1$  unexpected fracture

### **Signs of immune deficiency**

- Congenital abnormalities: dysmorphic features, congenital heart disease, situs inversus, white forelock, albinism, microcephaly
- Children who appear chronically ill
- Scarring or perforation of tympanic membranes from frequent infection
- Periodontitis
- Enlargement of liver and spleen
- Hypoplastic tonsils and small lymph nodes
- Lymphadenopathy
- Skin: telangiectasia, severe eczema, erythroderma, granuloma, acneiform rash, molluscum, zoster
- Ataxia

### **Other investigations suggestive of immune deficiency**

- Haemolytic anaemia
- Neutropenia
- Eosinophilia
- Hypocalcaemia

### **Unusual organisms or unusual diseases with common organisms**

- Viruses: CMV, EBV, VZV, warts
- Fungi: candida, aspergillus, cryptococcus, pneumocystis, nocardia
- Protozoa: cryptosporidium, toxoplasma
- Bacteria: salmonella, giardia, mycobacterium (inc. BCG), serratia
- Recurrent infection with common organisms: *H. influenzae*, *S. pneumoniae*, *N. meningitidis*, *S. aureus*

# IMMUNODEFICIENCY • 2/2

**Table 1: Investigations**

Investigations	Sample	Volume	
		Minimum	Ideal
<b>Initial tests (complete all tests for any suspected immune deficiency)</b>			
FBC and differential white cell count	EDTA	1.3 mL	4 mL
Immunoglobulins (G, A, M, D, E)	Clotted	0.5 mL	4 mL
CH50	Clotted	1 mL to reach lab within 2 hr	4 mL to reach lab within 2 hr or separate and freeze immediately
HIV antibody	Clotted	0.5 mL	4 mL
Lymphocyte subsets	EDTA	1 mL	4 mL
<b>Second-line tests (with immunology advice)</b>			
Lymphocyte proliferation	Lithium heparin	Discuss with local immunology centre	
<b>Normal neutrophils</b>			
Neutrophil function test for CGD	EDTA or lithium heparin	0.25 mL	4 mL
		Discuss with local immunology centre	
<b>Recurrent or case with family history of meningococcal disease</b>			
IgG function (antibody response to tetanus, Hib) Retest 4 weeks after vaccination	Clotted	0.5 mL	4 mL

## RESULTS

- Isolated neutropenia or lymphopenia: if concerns possible immune deficiency, recheck 1–2 weeks. If persistent:
- auto-antibodies (ANA), allo-antibodies, Coombs' test (neonates), C3, C4, rheumatoid factor, urine/saliva CMV
- pancytopenia: discuss with haematology
- hypogammaglobulinaemia: discuss with local immunology centre

## SUBSEQUENT MANAGEMENT

- Avoid live vaccines (e.g. BCG, MMR and varicella)
- Ensure that any blood products given to patients with suspected or proven T-cell immunodeficiency are irradiated and CMV negative
- For specific infections, use same antibiotics as in immunocompetent patients, at higher recommended dosage
- Obtain throat, blood and other culture specimens before starting treatment
- Treat infectious episodes for longer than usually recommended (approximately double)
- In patients with B-cell, T-cell or phagocytic defects, request regular pulmonary function tests and home treatment plan of physiotherapy and inhalation therapy similar to that used in cystic fibrosis
- In children with significant primary or secondary cellular (T-cell) immunodeficiency (e.g. aged <1 yr CD4 <25%, aged 1–5 yr CD4 <15% or aged >5 yr <200 CD4 cells/mm<sup>3</sup>), give *Pneumocystis jiroveci* (PCP) prophylaxis with co-trimoxazole

# INFECTION CONTROL • 1/3

## HAND HYGIENE

- Use alcohol gel or soap and water:
  - before touching a patient
  - before aseptic procedure
  - after touching a patient
  - after touching a patient's surroundings
  - on removal of PPE (e.g. gloves and aprons)
- Use soap and water:
  - after contamination with body fluids, excreta, secretions
  - on removal of PPE where there is exposure to body fluids

## DRESS CODE

- No stoned rings
- No wrist jewellery
- No long, varnished or false nails
- Bare below elbows
- Long hair tied back

## PERSONAL PROTECTIVE EQUIPMENT (PPE)

### Aprons

- <2 metres of child with respiratory tract infection
- Contact with infectious materials or equipment anticipated
- Using hazardous chemicals
- Aseptic non-touch technique (ANTT) – see below

### Gloves (non-sterile)

- Contact with respiratory secretions or other infectious material of contaminated surfaces
- Single patient use: new gloves and apron for every procedure
- Take gloves and apron off at point of use and clean hands
- Do not carry gloves in your pocket
- Do not use alcohol hand rub on gloves

***Remove gloves and aprons as soon as clinical activity completed  
before touching pens, notes, phone, computer etc.***

### Sterile gloves and gown

- For central venous line (CVL) including peripheral long line (PICC)

### Masks

- Surgical face mask
- <2 metres child with respiratory tract infection
- FFP3 mask
- Aerosol generating procedure (e.g. intubation, CPAP) with respiratory tract infection

### Eye protection

- <1 metres of child with persistent coughing or sneezing

## ASEPTIC NON TOUCH TECHNIQUE (ANTT)

### Definition

Do not touch 'key parts' which come into contact with sterile parts of the body (e.g. needles, IV fluids)

### Preparation phase

- Decontaminate hands if not socially clean
- Decontaminate tray or trolley choice using chlorhexidine 2% in alcohol 70% (if visibly clean) allow drying for 30 seconds
- PPE (as above)
- Prepare equipment using a non-touch technique protecting key parts at all times by not touching them
- Remove gloves and decontaminate hands

# INFECTION CONTROL • 2/3

## Patient Phase

- Decontaminate hands at point of care
- Apply appropriate PPE non sterile gloves non touching key parts (e.g. IV drug administration, venepuncture/cannulation) sterile gloves if touching key parts (e.g. urinary catheterisation, central line/PICC insertion)
- Prepare all equipment using a non-touch technique, protecting key parts at all times, by not touching them
- Decontaminate key parts/key sites using single use chlorhexidine 2% in alcohol 70% (SEPP/FREPP or ChloraPrep® 3 mL) and allow drying for 30 seconds
- Perform procedure, ensuring protection of key parts/sites at all times

## Decontamination phase

- Dispose of sharps into sharps box immediately if appropriate
- Remove PPE at the patient's bedside
- Dispose of all equipment as clinical waste in the nearest clinical waste bin, return equipment to the clinical room ensuring it is cleaned with detergent wipes
- Decontaminate hands

## ISOLATION

*If unsure, discuss with the infection prevention team*

### Indications for cubicle when available

- Infectious disease
  - airborne: always isolate
  - contact: isolate or cohort
  - enteric: isolate if possible
- Immune deficiency
- Special risk of infection

### Cohort several children with same illness

- Bronchiolitis cohort (intermediate risk – see below)
- Diarrhoea or vomiting (high risk)

1<sup>st</sup> 24 hr treatment, then can move to multi-occupancy bay

- Meningitis (no rash) intermediate risk
- Meningococcal disease (purpuric rash) high risk
- Group A strep (e.g. scarlet fever) high risk

**Low risk:** move to bay if no cubicle in hospital

- Shingles, impetigo, scabies, lice, herpes
- Non-pulmonary TB
- Term neonates (aged <1 month old)
- Transfer from another hospital
- HIV CD4 >350 x10<sup>6</sup>/L or >25%

**Intermediate risk:** move to bay if no cubicle in region

- Preterm infants aged <2 months
- Symptomatic congenital heart disease
- Chronic lung disease in oxygen
- MRSA colonised no skin lesions
- ESBL, VRE or *C difficile* with diarrhoea
- HIV CD4 200–350 x10<sup>6</sup>/L or 15–25%

**High risk:** move to bay only if no cubicle in country

- Neutropenic (<0.5 x 10<sup>9</sup>/L)
- Cystic fibrosis, burns
- PVL *S. aureus*
- MRSA with skin lesions or in sputum



## INFECTION CONTROL • 3/3

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- Carbapenemase colonised
- Gastroenteritis or E coli 0157
- Mumps, hepatitis A
- HIV CD4  $<200 \times 10^6/L$  or  $<15\%$

**Always isolate** or manage at home

- Measles
- Chickenpox
- Smear +ve TB and coughing  $<1$  week into treatment
- Consult with infection control or infectious diseases team

*Early treatment reduces mortality from coronary artery aneurysms*

## RECOGNITION AND ASSESSMENT

### Symptoms and signs

- Fever  $\geq 5$  days and 4 of the following:
  - conjunctivitis: bilateral, bulbar, non-exudative
  - oral changes: red lips/pharynx/tongue
  - peripheral oedema: erythema palms and soles, followed by desquamation fingertips 10–15 days after onset of fever
  - rash: polymorphous (no vesicles or crusts)
  - lymph nodes: acutely enlarged cervical nodes  $>1.5$  cm diameter
- Absence of another diagnosis e.g. group A streptococcal infection (GAS), measles
- Presence of a coronary artery aneurysm with any one of the above features is diagnostic

### Other features

- Most common in children aged  $<5$  yr, peak 18–24 months
- Atypical cases may not fulfil all the above criteria
  - if fever  $<5$  days but 4 signs above
  - persistent raised CRP and no other diagnosis and suspicion of KD
  - fever usually precedes the other signs, unresponsive to antipyretics
  - common features: irritability, erythema of BCG site
  - other symptoms include aseptic meningitis, uveitis, cough, vomiting, diarrhoea, abdominal pain, urethritis, arthralgia and arthritis

### High risk features

- Already failed IVIG
- Aged  $<1$  yr
- Severe inflammation (persistently raised CRP despite IVIG, liver dysfunction, hypoalbuminaemia, anaemia)
- Features of haemophagocytic lymphohistiocytosis (persistent fever, hepatosplenomegaly, cytopenia  $>2$  cell lines, hypertriglyceridaemia, hypofibrinogenaemia, increased D-dimers, hyperferritinaemia)
- Shock
- Evolving coronary or peripheral aneurysms
- Kobayashi risk score  $>5$ 
  - Na  $\leq 133$  = 2
  - $\leq 4$  days of illness = 2
  - ALT  $\geq 100$  iu/L = 1
  - platelets  $\leq 300 \times 10^9/L$  = 1
  - CRP  $\geq 10$  mg/dL = 1
  - age  $\leq 1$  yr = 1
  - $\geq 80\%$  neutrophils = 2

### Investigations

None is diagnostic

- FBC: neutrophilia and thrombocytopenia early
- ESR and CRP elevated
- LFTs: raised bilirubin, ALT, low albumin
- Urine: sterile pyuria
- CSF: lymphocytes
- ECG: ST depression, T wave inversion, heart block
- Echo: do not delay therapy before echocardiogram
- Throat swab for Gp A strep
- Anti-streptolysin O titre (ASOT) or anti-DNase B for evidence of streptococcal infection
- Blood culture
- Urinalysis, microscopy and culture
- If rash present, serology for enterovirus, parvovirus, EBV, CMV; if features of measles urine or throat swab in viral transport medium for PCR

# KAWASAKI DISEASE • 2/3

## IMMEDIATE TREATMENT

- Aspirin 7.5–12.5 mg/kg oral 6-hrly until afebrile or a minimum of 2 weeks
- Intravenous immunoglobulin (IVIG) 2 g/kg
- check concentration (g/mL) for preparation used in your Trust

### Administration of 100 mg/mL (e.g. Flebogamma® DIF)

Rate*	Duration
0.3 mL/kg/hr = ..... mL/hr	30 min
0.6 mL/kg/hr = ..... mL/hr	30 min
1.2 mL/kg/hr = ..... mL/hr	30 min
2.4 mL/kg/hr* = ..... mL/hr	30 min
3.6 mL/kg/hr* = ..... mL/hr	30 min
4.8 mL/kg/hr* = ..... mL/hr	To completion

\* up to a maximum rate of 180 mL/hr

**Start IVIG as soon as possible (delayed treatment increases risk of aneurysm)**

## MONITORING IVIG INFUSION

- Monitor temperature, heart rate, BP and respiratory rate:
  - every 5 min for first 15 min
  - then every 15 min for first hour
- Anticipate anaphylaxis, flushing, fever, headache, shivering
- If tolerated, increase infusion rate to give total dose over remaining 10 hr and monitor hourly
- If mild reaction, stop infusion for 15 min then restart at slower rate

## HIGH RISK

- Methylprednisolone 0.8 mg/kg IV for 5–7 days or until CRP normalises
- then prednisolone 2 mg/kg/day PO and wean over 2–3 weeks

## SUBSEQUENT MANAGEMENT

- If fever persists 36 hr after completion of IVIG, consider a single repeat dose of IVIG
- If fever persists after second dose IVIG give intravenous methylprednisolone as above if not already given
- Discuss with cardiologist about infliximab (6 mg/kg) IV 1–2 doses (2 weeks apart if 2 doses)
- Disease defervescence (fever settled for 48 hr, clinical improvement and falling CRP), reduce dose of aspirin to 2–5 mg/kg oral as single daily dose for minimum 6 weeks (until result of echocardiogram known)

## DISCHARGE AND FOLLOW-UP

- Discharge when fever settles
- Echocardiogram at 10–14 days and 6 weeks from onset of signs and symptoms
- Outpatient appointment 1 week after echocardiogram
- Advise to avoid excessive strenuous activity until out-patient appointment after echocardiogram
- Advise to avoid all live vaccines (e.g. MMR) for 3 months following IVIG therapy

## OUTPATIENT MANAGEMENT

- No aneurysms at 6 weeks echocardiogram
- stop aspirin
- no restriction on activity
- follow-up at 12 months and discharge if well
- Single aneurysm <8 mm diameter
- aspirin 2–5 mg/kg (max 75 mg) once daily until aneurysm disappears
- cardiologist will advise on limitation of activity, exercise stress test, MR/CT angiogram
- 6-monthly ECG and echocardiogram
- lifelong follow-up and advice on reduction of cardiovascular risk factors

## KAWASAKI DISEASE • 3/3

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- Multiple or giant aneurysm or stenosis
- as for single aneurysm **and**
  - lifelong aspirin 2–5 mg/kg/day
  - warfarin (after heparinisation)

***Falciparum is a medical emergency: immediate treatment is essential***

- Test for malaria in anyone with fever
- who has travelled to a malarial area within last 12 months
- or febrile infant whose mother has travelled to a malarial area in pregnancy

### Clinical features

Non-specific	Severe (complicated) malaria
<ul style="list-style-type: none"> <li>• Fever</li> <li>• Malaise</li> <li>• Headache</li> <li>• Sweating</li> <li>• Diarrhoea</li> <li>• Vomiting</li> <li>• Abdominal pain</li> <li>• Splenomegaly</li> <li>• Anaemia</li> <li>• Thrombocytopenia</li> <li>• Jaundice</li> </ul>	<ul style="list-style-type: none"> <li>• Persistent vomiting, severe dehydration</li> <li>• Shock, renal failure (oliguria &lt;0.5 mL/kg/hr)</li> <li>• Depressed conscious state, seizures</li> <li>• Tachypnoea or increased work of breathing</li> <li>• Hypoxia (SpO<sub>2</sub> &lt;95%)</li> <li>• Metabolic acidosis (base deficit &gt;8)</li> <li>• Severe hyperkalaemia (K &gt;5.5 mmol/L)</li> <li>• Hypoglycaemia &lt;3 mmol/L</li> <li>• Severe anaemia (&lt;80 g/L)</li> <li>• Unable to walk</li> <li>• Parasitaemia &gt;2% or schizonts on film</li> </ul>

### Investigations

- EDTA blood sample sent to haematology for an urgent thick blood film
- 3 blood films 12 hr apart
- Negative malaria ICT (stix test) does not exclude malaria
- Do not treat unless proven on blood test
- Admit all patients with falciparum to a unit with experience in managing severe malaria (e.g. infectious disease unit)
- Opportunistic screen for other imported diseases: hepatitis B, HIV

***If malaria is diagnosed on blood film, but type unclear, treat as falciparum malaria***

## SEVERE (COMPLICATED) MALARIA

### Anti-malaria treatment

- Artesunate:
  - <20 kg: 3 mg/kg IV
  - ≥20 kg: 2.4 mg/kg IV
  - in 1 mL sodium bicarbonate (vial provided with drug), dilute further in 5 mL glucose 5% and inject over approximately 2 min at 0, 12 and 24 hrs and then daily
- When parasitaemia resolving and patient improving, switch to oral agent:
  - artemether+lumefantrine (Riamet®) 6 doses – see **Treatment of uncomplicated falciparum malaria** below
  - if Riamet® unavailable give Malarone®, or oral quinine (if neither other agent available)

### ***If artesunate unavailable***

- Quinine dihydrochloride IV diluted to 2 mg/mL with sodium chloride 0.9% or glucose 5%
- loading dose 20 mg/kg max 1.4 g as infusion over 4 hr (NEVER as IV bolus)
- omit loading dose if mefloquine or quinine used in previous 24 hr
- glucose stix 2-hrly during IV quinine, cardiac monitor and daily ECG (check QTc)
- then 8 hr after start of loading dose, 10 mg/kg infusion (max 700 mg) over 4 hr every 8 hr
- when able to swallow give Malarone® (see **Treatment of uncomplicated falciparum malaria** below)
- daily FBC, U&E and blood films as inpatient until asexual parasites undetectable

### Complications

- Parasitaemia >10%: admit PICU
- Renal failure: discuss early filtration/dialysis with PICU
- Hypovolaemia: cautious rehydration (high risk pulmonary oedema)
- Shock: add cefotaxime
- Hypoglycaemia: common, give glucose 10% 2 mL/kg IV bolus then glucose 10% 5 mL/kg/hr with sodium chloride 0.45%/0.9% if serum Na <135 mmol/L
- Anaemia: common, transfuse if Hb <80 g/L
- Thrombocytopenia: expected, transfuse only if bleeding and platelets <20×10<sup>9</sup>/L

# MALARIA • 2/3

## CEREBRAL MALARIA

Impaired level of consciousness

- Correct hypoglycaemia
- Monitor GCS, reflexes, pupils
- Plan for intubation and transfer to PICU if:
  - signs of raised ICP
  - persisting shock after 40 mL/kg fluid
  - or pulmonary oedema

## TREATMENT OF UNCOMPLICATED FALCIPARUM MALARIA (no clinical features of severe malaria)

- If child can tolerate oral intake:

**Riamet**<sup>®</sup> 20 mg/120 mg tablets [artemether with lumefantrine (can be crushed)]

- Not if given treatment overseas for this episode already

Weight (kg)	Dose (repeat at 8, 24, 36, 48 and 60 hr)	Total over 60 hr
5–15	1	6
15–24	2	12
25–34	3	18
35+ (aged 12–18 yr)	4	24

No second agent required

Or

### Artemimol with piperazine phosphate

Euratesim (320 mg/40 mg tablets)

Artekin<sup>®</sup> [Dihydroartemisinin-piperazine (DHA-PPQ)]

- WHO recommended regimen (different from summary of product characteristics)

Weight (kg)	Dose (standard tablet, repeat at 24 and 48 hr)
5–7	0.5
8–10	0.75
11–16	1
17–24	1.5
25–34	2
35–75	3
>75	4

Or

**Malarone**<sup>®</sup> (proguanil with atovaquone) once a day for 3 days (can be crushed)

- Not if on Malarone<sup>®</sup> prophylaxis

Weight (kg)	5–8	9–10	11–20	21–30	31–40	>40
Dose	2 paed tablets	3 paed tablets	1 standard tablet	2 standard tablets	3 standard tablets	4 standard tablets

- Paediatric tablet contains proguanil 25 mg + atovaquone 62.5 mg
- Standard tablet contains proguanil 100 mg + atovaquone 250 mg

No second agent required

Or

### Quinine sulphate

- 10 mg/kg (max 600 mg) oral 8-hrly
- Reduce to a 12-hrly regimen if severe cinchonism (severe tinnitus, deafness, unsteadiness)
- Mild tinnitus and feeling of 'blocked' ears are expected on quinine and resolve once therapy completed
- Continue until blood films negative or for a 7 day course (whichever is longer). A shorter course may be possible but only at infectious diseases consultant's discretion

## MALARIA • 3/3

Weight (kg)	Paediatric dosing of oral quinine sulphate
5–7	50 mg (¼ x 200 mg tablet)
8–12	100 mg (½ x 200 mg tablet)
13–17	150 mg (¾ x 200 mg tablet)
18–22	200 mg (1 x 200 mg tablet)
23–27	250 mg (½ x 300 mg + ½ x 200 mg tablet)
28–37	300 mg (1 x 300 mg tablet)
38–45	400 mg (2 x 200 mg tablet)
46–57	500 mg (1 x 200 mg tablet and 1 x 300 mg tablet)
>57	600 mg (2 x 300 mg tablet)

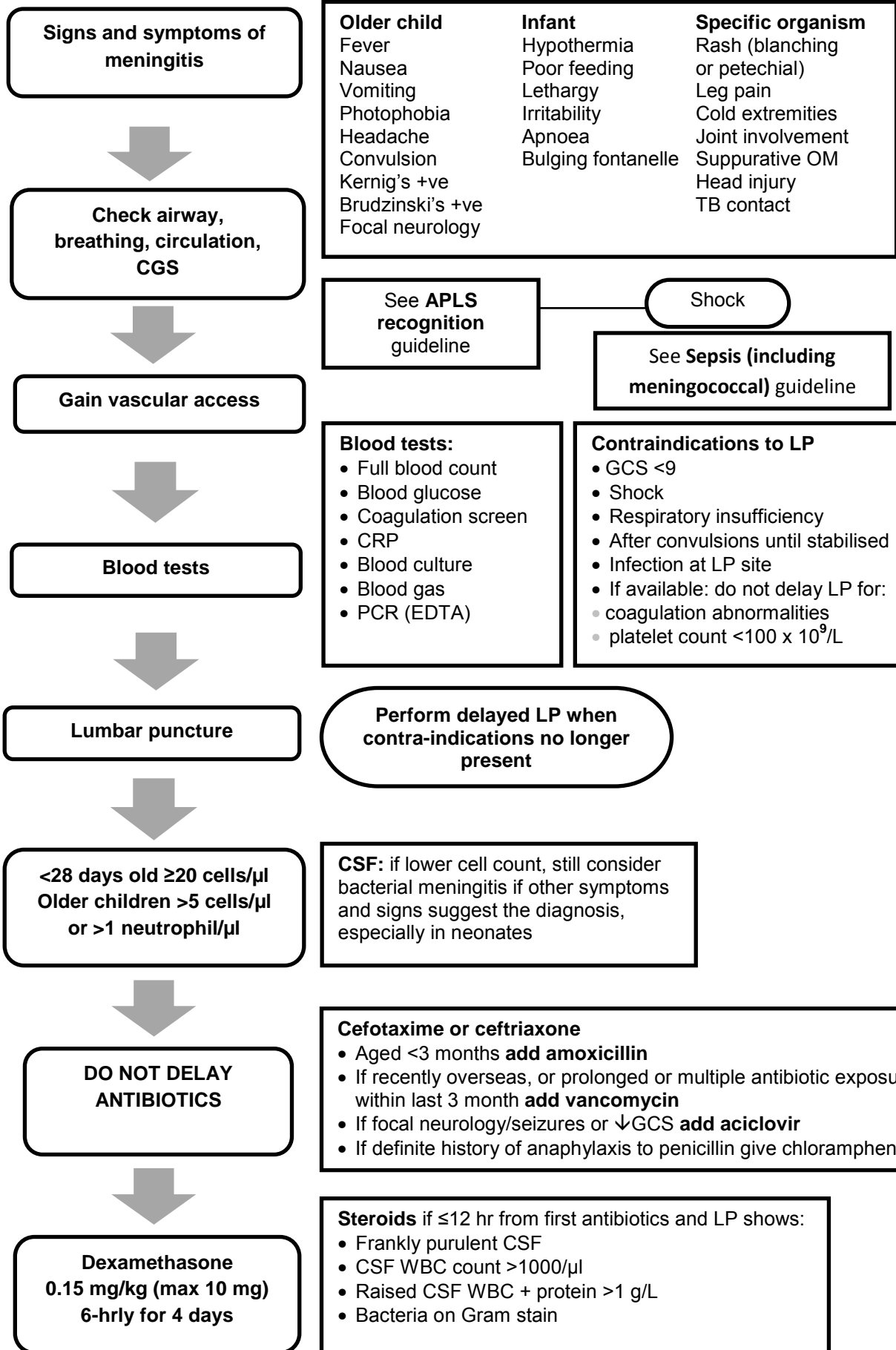
- With quinine give second agent
- aged >12 yr doxycycline 200 mg once/day for 7 days
- aged <12 yr clindamycin 7–13 mg/kg (max 450 mg) 8-hrly for 7 days

***If in doubt treat as severe (complicated) malaria***

### NON-FALCIPARUM MALARIA

- Chloroquine 10 mg (base)/kg oral initial dose (max 620 mg)
- then 5 mg/kg (max 310 mg) after 6 hr, then once daily for 2 days
- liquid Nivaquine® 68 mg/5 mL is equivalent to 50 mg/5 mL chloroquine base
- itch is common, does not respond to antihistamines, if severe give quinine
- Check G6PD levels
- if normal G6PD levels and aged >6 months give primaquine 250 microgram/kg oral (max 15 mg) daily for *P. ovale* and 500 microgram/kg (max 30 mg) daily for *P. vivax* for 14 days
- in mild G6PD-deficiency aged >6 months, primaquine 750 microgram/kg (max 45 mg) once a week for 8 weeks
- Otherwise contact ID specialist

# MENINGITIS • 1/3



Signs and symptoms of meningitis

Check airway, breathing, circulation, CGS

Gain vascular access

Blood tests

Lumbar puncture

<28 days old ≥20 cells/μl  
Older children >5 cells/μl  
or >1 neutrophil/μl

DO NOT DELAY ANTIBIOTICS

Dexamethasone  
0.15 mg/kg (max 10 mg)  
6-hrly for 4 days

**Older child**

Fever  
Nausea  
Vomiting  
Photophobia  
Headache  
Convulsion  
Kernig's +ve  
Brudzinski's +ve  
Focal neurology

**Infant**

Hypothermia  
Poor feeding  
Lethargy  
Irritability  
Apnoea  
Bulging fontanelle

**Specific organism**

Rash (blanching or petechial)  
Leg pain  
Cold extremities  
Joint involvement  
Suppurative OM  
Head injury  
TB contact

See APLS recognition guideline

Shock

See Sepsis (including meningococcal) guideline

**Blood tests:**

- Full blood count
- Blood glucose
- Coagulation screen
- CRP
- Blood culture
- Blood gas
- PCR (EDTA)

**Contraindications to LP**

- GCS <9
- Shock
- Respiratory insufficiency
- After convulsions until stabilised
- Infection at LP site
- If available: do not delay LP for:
  - coagulation abnormalities
  - platelet count <100 x 10<sup>9</sup>/L

Perform delayed LP when contra-indications no longer present

**CSF:** if lower cell count, still consider bacterial meningitis if other symptoms and signs suggest the diagnosis, especially in neonates

**Cefotaxime or ceftriaxone**

- Aged <3 months **add amoxicillin**
- If recently overseas, or prolonged or multiple antibiotic exposure within last 3 month **add vancomycin**
- If focal neurology/seizures or ↓GCS **add aciclovir**
- If definite history of anaphylaxis to penicillin give chloramphenicol IV

**Steroids** if ≤12 hr from first antibiotics and LP shows:

- Frankly purulent CSF
- CSF WBC count >1000/μl
- Raised CSF WBC + protein >1 g/L
- Bacteria on Gram stain



# MENINGITIS • 2/3

## Specimens

- One fluoride tube (and 4 CSF bottles)
- If tap traumatic, may need more samples
- If insufficient CSF discuss priorities with microbiology

**Table 1: Collection of specimens (stated volumes represent minimum required)**

Department	Specimens (6 drops = approx 0.2 mL)
Biochemistry	<ul style="list-style-type: none"><li>• 0.2 mL in a fluoride tube for glucose (also send blood glucose)</li><li>• 0.2 mL in a CSF bottle for protein</li><li>• 0.2 mL for lactate if metabolic disorder suspected</li></ul>
Microbiology	<ul style="list-style-type: none"><li>• 0.2 mL in a CSF bottle for MC&amp;S</li><li>• 0.5 mL for meningococcal and pneumococcal PCR</li><li>• 1 mL for AFB, TB culture and PCR if TB suspected</li></ul>
Virology	If possible viral meningitis or encephalitis: <ul style="list-style-type: none"><li>• 0.5 mL for herpes simplex virus, enterovirus and VZV PCR</li><li>• 0.3 mL for Human Herpes Virus 6 if rash, high temperature or rapid recovery</li></ul>
Cytology	<ul style="list-style-type: none"><li>• 0.2 mL if TB suspected</li></ul>
Save	<ul style="list-style-type: none"><li>• 0.5 mL in plain bottle for additional neurology tests (e.g. oligoclonal bands) depending on other results and progress</li></ul>

## RESULTS

- See **Encephalitis** guideline for interpretation of results
- If history of travel, low CSF, blood glucose ratio +/- raised protein, discuss with TB team urgently about starting TB treatment

## MONITORING TREATMENT

- In a semi-conscious patient, monitor hourly until improvement evident:
  - respiratory rate
  - pulse and BP
  - level of consciousness and pupils
  - in young infants, measure head circumference daily
- If persistent pyrexia and not improving look for other foci
  - repeat blood cultures and other investigations according to signs
  - CT scan at 10 days for microabscess or hypodensity
  - if CT normal, repeat LP

## SUBSEQUENT MANAGEMENT

### Length of antibiotic course

- Meningococcus: 7 days
- *Haemophilus influenzae*: 10 days
- Pneumococcus or Group B Streptococcus: 14 days
- Gram-negatives: 21 days
- Listeria: 21 days (with gentamicin for first 7 days)
- No organism identified: aged >3 months, 10 days; aged <3 months, 14 days
- Other, discuss with microbiologist

### Fluid restriction

- Maintenance fluids: sodium chloride 0.9% with glucose 5% with potassium chloride 10 mmol/500 mL if not hyperkalaemic
- Restrict fluid to 80% maintenance if:
  - severe illness
  - hyponatraemia
  - raised intracranial pressure
- Measure urine and plasma osmolalities daily whilst severely ill

### Public health

- Inform Public Health consultant of a case of suspected meningitis
- Public Health England Department will arrange prophylaxis for close contacts

## MENINGITIS • 3/3

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- Meningococcal meningitis
- if ceftriaxone given as treatment, eradication treatment not required for patient
- close contacts (all ages): ciprofloxacin single dose
- *Haemophilus influenzae*
- close contact aged <10 yr, give rifampicin oral once daily for 4 days

### DISCHARGE AND FOLLOW-UP

- Organise formal hearing test 6 weeks after discharge from hospital
- If severely ill during admission, discuss with consultant about follow-up to monitor developmental progress
- If viral cause unconfirmed but still possible, repeat viral titres 6 weeks after day of admission
- If >1 episode of meningococcal disease, not serogroup B, recurrent serious bacterial infections or family history of meningococcal disease or immune deficiency, refer to immunology or infectious diseases

# NOTIFIABLE INFECTIOUS DISEASES AND FOOD POISONING • 1/2

## URGENT NOTIFICATION

- Urgent out-of-hours notifications (to be followed by normal paper notification later)
- meningitis (suspected bacterial)
- meningococcal infection (clinical diagnosis)
- haemolytic uraemic disease (suspected)
- infectious bloody diarrhoea

## NOTIFIABLE DISEASES

Admitting doctor is required to notify **suspected** or confirmed cases of the following to Health Protection Unit:

- Cluster or outbreak suspected ( $\geq 2$  cases epidemiologically linked)
- Any other case where the potential for transmission is significant (e.g. highly infectious)
- Where contacts are particularly susceptible (e.g. healthcare worker, school)
- Where public health action is known to be effective (e.g. prophylaxis, immunisation)
- Other infections or contaminations (e.g. chemical) not listed below if potential risk of further harm
- Anthrax
- Botulism
- Brucellosis
- Cholera
- Diphtheria
- Diarrhoea, infectious bloody
- Encephalitis
- Food poisoning\*
- Group A streptococcal invasive disease
- Haemolytic uraemic syndrome
- Hepatitis (viral)
- Legionnaires'
- Leprosy
- Malaria
- Measles\*
- Meningitis (viral, bacterial or fungal)
- Meningococcal disease
- Mumps
- Paratyphoid fever
- Plague
- Poliomyelitis
- Rabies
- Rubella\*
- Severe acute respiratory syndrome (SARS)
- Scarlet fever\*
- Smallpox
- Tetanus
- Tuberculosis\*
- Typhoid fever
- Typhus
- Viral haemorrhagic fever
- Whooping cough\*
- Yellow fever

### \*Definitions

- **Food poisoning or suspected food poisoning:** inform public health if acquired abroad or if family member is a food handler or healthcare worker
- **Measles:** fever, maculopapular rash for  $\geq 3$  days and 2 or more of following: Koplik's spots, coryza, conjunctivitis, raised measles IgM, measles encephalitis or pneumonitis. Inform public health of MMR or measles vaccination history. Do not bring children with suspected measles in primary care to hospital for diagnosis, only if hospital based treatment required or if immunocompromised: arrange for immediate isolation on arrival

# NOTIFIABLE INFECTIOUS DISEASES AND FOOD POISONING • 2/2

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- **Rubella:** rash and occipital lymphadenopathy or arthralgia (if not parvovirus), **or** congenital rubella or raised IgM to rubella. Inform public health of MMR vaccine history
- **Scarlet fever:** tonsillitis, fever, rash with either culture of *Streptococcus pyogenes* from throat or raised ASO or anti-DNaseB titre
- **Tuberculosis:** diagnosed clinically, not just microbiologically (atypical mycobacterial infection or patients given chemoprophylaxis but not thought to have TB are not notifiable)
- **Whooping cough:** cough with a whoop, with history of contact with similar illness **or** positive pernasal swabs for *Bordetella pertussis* or raised IgM to *B. pertussis* in an adult or child. Inform public health of pertussis immunisation history

## Non-statutory notifiable diseases

It has been agreed that, although they are not statutorily notifiable, the following diseases will nevertheless be reported to the consultant in communicable disease control:

- AIDS/HIV infection
- Legionnaires' disease
- Listeriosis
- Psittacosis
- Cryptosporidiosis
- Giardiasis
- Creutzfeldt-Jakob disease and other prion diseases

## CONTACT DETAILS

Complete a notification form immediately on diagnosis of a suspected notifiable disease. Don't wait for laboratory confirmation of a suspected infection or contamination before notification –

<https://www.gov.uk/guidance/notifiable-diseases-and-causative-organisms-how-to-report>

# ORBITAL CELLULITIS AND SINUSITIS • 1/1

## RECOGNITION AND ASSESSMENT

Preseptal	Orbital
Facial erythema and tenderness	Painful eye movements
Normal eye movements	Orbital pain and tenderness
Normal vision	Visual impairment (red-green colour differentiation lost early)
Preceding superficial trauma	Proptosis
Eye pain	Chemosis
Periorbital swelling	Ophthalmoplegia
Fever	Preceding sinusitis

- If uncertain, manage as orbital cellulitis pending CT and ophthalmologist review

### Investigations

- Eye swab (send pus if present)
- FBC
- Blood culture
- CT scan if:
  - orbital involvement suspected
  - central neurological signs
  - unable to assess eye movements/vision or if eyelid cannot be opened
  - bilateral oedema
  - deterioration despite treatment
- MRI if neurological signs

## MANAGEMENT

### Preseptal peri-orbital cellulitis

- Oral co-amoxiclav
- Review eye movements and red-green colour vision twice daily
- If no improvement after 48 hr, give IV co-amoxiclav
  - if improving, convert to oral high dose co-amoxiclav
  - if penicillin allergy give clindamycin
- Total duration of treatment (including IV) 14 days

### Orbital cellulitis

- Urgent ophthalmology/ENT review within 4 hr for assessment for surgical drainage
- IV cefotaxime or ceftriaxone
- If toxaemic add clindamycin
- If history of anaphylaxis to penicillin give ciprofloxacin and clindamycin
- If improving, convert to oral high dose co-amoxiclav
- If penicillin allergy give clindamycin
- Total duration of treatment (including IV) 21 days (up to 6 weeks if bone involvement)

### Intracerebral complications

- Urgent neurosurgical review

### Sinusitis

- URTI symptoms  $\geq 10$  days and  $\geq 1$  of:
  - nasal congestion and discharge
  - persistent cough (often nocturnal)
- Treat with amoxicillin if acute
- Change to co-amoxiclav if no response after 48 hr (IV if severe)
- Total 7 days antibiotics
- Severe if:
  - falling GCS, temperature  $>39^{\circ}\text{C}$ , purulent discharge
- ENT, neurosurgical review
- If complications are present:
  - orbital – CT with contrast
  - neurological – MRI with contrast
- Plain CT of sinuses for sinusitis
- if stable can be done as outpatient

# OSTEOMYELITIS • 1/3

- See also **Limping child** guideline

## RECOGNITION AND ASSESSMENT

### Symptoms and signs

- Fever
- Loss of function e.g. limp
- Pain in bone or joint
  - localised, constant, increasing
- Restricted range of movement
- Soft tissue swelling
- Point tenderness of bone
- Effusion

***The above symptoms and signs are indicative of osteomyelitis or septic arthritis (in absence of clear history of obvious trauma) irrespective of WBC, CRP, ESR and fever or radiological appearance***

### Previous history

- Ask about:
  - duration of symptoms
  - injuries
  - fever
  - antibiotics
  - antipyretics/anti-inflammatories

### Urgent investigations

- FBC
- ESR
- CRP
- Blood culture **before antibiotics** (minimum 4 mL older children, 2 mL neonates)
- If cause of fever uncertain, collect other specimens (e.g. urine) for culture before antibiotics

### Osteomyelitis

- Plain X-ray AP and lateral of the affected part
- Tissue or pus for Gram stain and culture if surgically explored or needle aspiration

### Septic arthritis

- Aspiration of joint for Gram stain and culture
  - interventional radiologist or orthopaedic registrar
  - for sedation and analgesia contact paediatric registrar or on-call paediatric anaesthetist

### Further investigations

***Perform as soon as possible (must be within 36 hr)***

- If plain X-ray normal, infection clinically localised and urgent MRI is available:
  - consultant paediatrician or orthopaedic surgeon to authorise urgent MR of bone
  - if deep sedation or general anaesthetic required, contact on-call paediatric anaesthetist
- If plain X-ray normal, and infection clinically localised and MRI not available, request ultrasound scan to look for fluid and synovial thickening in the knee and hip joint.
- If localising signs poor or possible multifocal infection, request isotope bone scan
- If cardiac murmur or multifocal *Staph. aureus*, request echocardiogram

## IMMEDIATE TREATMENT

- Admit
- Nil-by-mouth and maintenance fluids IV
- Bed rest
- Refer immediately to orthopaedic and on-call paediatric registrar for urgent assessment
- Early involvement of on-call consultant orthopaedic surgeon

### Antibiotics (see BNFC for neonatal doses)

- Start following surgery, unless it will take >4 hr from admission to get to theatre

## OSTEOMYELITIS • 2/3

- Severe sepsis with organ dysfunction (e.g. hypotension, oxygen requirement, GCS <12, platelet <80, creatinine x 2 normal, abnormal LFTs)
- after blood and urine cultures taken, start cefotaxime 50 mg/kg 6-hrly (high dose; max 12 g/day) IV over 3–4 min
- No organ dysfunction; as soon as possible (must be within 4 hr):
  - if aged <5 yr: cefotaxime 50 mg/kg (max 3 g/dose) 6-hrly **or** ceftriaxone 80 mg/kg (max 4 g) daily and flucloxacillin 50 mg/kg IV (max 2 g/dose) 6-hrly
  - if aged >5 yr: flucloxacillin 50 mg/kg IV (max 2 g/dose) 6-hrly
- Targeted antibiotic therapy
- If organism identified, use narrowest spectrum possible with good bone/joint penetration
  - *Staph aureus* sensitive to flucloxacillin 50 mg/kg 6-hrly IV (high dose max 2 g/dose)
- Penicillin allergy, substitute flucloxacillin for:
  - history of rash: cefuroxime
  - history of anaphylaxis or high risk MRSA: clindamycin

### Analgesia

- If necessary initially, to allow splintage, use morphine IV (see **Analgesia** guideline)
- Elevate and splint affected limb
- plaster backslab for peripheral joints
- rest in skin traction on a pillow for central joints

### Surgery

Ask parent(s) to stay with child until consent obtained

- Resuscitate if severe sepsis
- Emergency theatres to be alerted as soon as possible (must be within 36 hr of admission)
- Contact:
  - anaesthetic office to arrange paediatric anaesthetist
  - orthopaedic RSO to book patient onto planned emergency list
  - consultant paediatrician and orthopaedic surgeon
  - transfer to Trauma Theatre (nurse escort)

## SUBSEQUENT MANAGEMENT

Inform paediatric orthopaedic surgeon and paediatrician

### Uncomplicated septic arthritis (not complicated by associated osteomyelitis)

- Aspirate or drain joint in theatre
- Request long line insertion under GA and repeat any blood tests required
- If discharged for hospital at home IV treatment, change to ceftriaxone
- If treatment started within **24 hr** of first symptoms and clinically improving, discuss with consultant about changing IV to oral antibiotics after 72 hr if:
  - recovery of joint movement
  - absence of pyrexia after 4-hrly monitoring for 48 hr
  - WCC <11, CRP and ESR falling on 2 successive specimens ≥24 hr apart
- If agreed by consultant, give oral antibiotic to complete treatment
  - no organism identified: co-amoxiclav (double dose)
  - organism identified: narrowest spectrum with good bone penetration
    - if *Staph. aureus* sensitive to flucloxacillin: flucloxacillin oral (high dose) if capsules tolerated; or co-amoxiclav (double dose) if can only take suspension
  - allergic to penicillin: clindamycin oral
- Stop treatment only if CRP is normal: agree duration of treatment with orthopaedic consultant depending on individual case

### Early-presenting osteomyelitis

- If IV antibiotics started within 24 hr of onset of symptoms with a good clinical response as above, follow **Uncomplicated septic arthritis**

### Established osteomyelitis or complicated septic arthritis

- Presentation >24 hr after onset of symptoms or partial treatment (e.g. oral antibiotics)
- Formal debridement in theatre with insertion of Hickman line

## OSTEOMYELITIS • 3/3

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- Antibiotics IV as above. Discuss with consultant about switch to oral antibiotics after 14 days, if afebrile, pain free for 48 hr and CRP <20
- Continue antibiotics until ESR <20 (minimum 6 weeks)
- Continue oral antibiotics until all inflammatory markers are normal and clear evidence of healing established on radiographs
- Discuss duration of antibiotics with orthopaedic consultant in each case

### **Septic arthritis or osteomyelitis (deteriorating condition/failure to improve within 48 hr)**

- Inform orthopaedic team for exploration to drain pus
- Review culture result
- Discuss with consultant microbiologist and paediatrician
- Arrange for repeat blood cultures
- consider a change of antibiotic therapy or targeted antibiotic therapy
- Complete or repeat any investigations listed above
- Consultant paediatric medical and orthopaedic review
- Exclude important differential diagnoses
- systemic inflammatory response as seen in juvenile chronic arthritis
- transient synovitis, associated with intercurrent infection
- acute leukaemia, septicaemia, multifocal disease, endocarditis, Ewing sarcoma
- Continuing problems with local sepsis
- return to theatre for further debridement and insertion of Hickman line

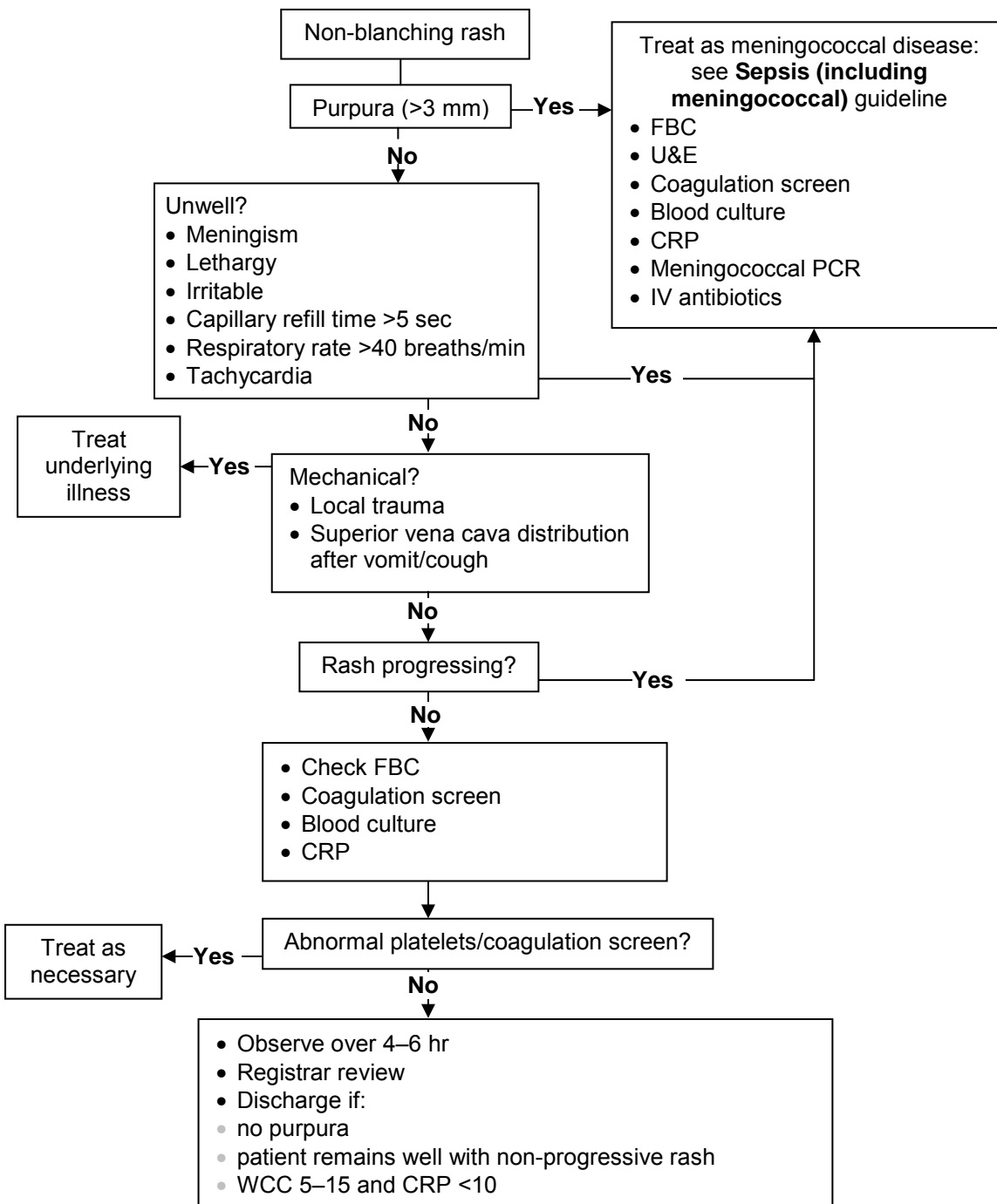
### **MONITORING TREATMENT**

- Peripheral colour, warmth, movement of affected limb: hourly for first 4 hr then 4-hrly for 24 hr
- Respiratory rate, pulse, temperature 4-hrly
- If not improving, repeat blood cultures, additional imaging for metastatic infection, assess for deep vein thrombosis and discuss with infectious diseases/microbiology about increasing antimicrobial spectrum



# PETECHIAL RASHES • 1/1

## RECOGNITION AND ASSESSMENT



# SEPSIS (INCLUDING MENINGOCOCCAL • 1/4

*Asses Airway, Breathing and Circulation and resuscitate as required*  
*Disability: be alert to coexisting meningitis, see Meningitis guideline.*  
**DON'T EVER FORGET GLUCOSE**  
*Treat IMMEDIATELY (<1 hr) as delay increases mortality*

## RECOGNITION AND ASSESSMENT

### High risk criteria

- Behaviour:
  - appears ill to healthcare professional
  - no response to social cues
  - does not wake, or if roused does not stay awake
  - weak, high pitched/continuous cry
  - objective evidence of new altered behaviour/mental state
- Respiratory:
  - respiratory rate in red (see **Table 1**)
  - grunting
  - moderate – severe chest indrawing
  - new need for oxygen >40% to keep SpO<sub>2</sub> >92%
  - cyanosis
- Cardiovascular:
  - heart rate in high risk range (see **Table 1**)
  - systolic BP in high risk range (see **Table 1**)
  - reduced skin turgor
  - no wet nappies/not passed urine in 18 hr, or <0.5 mL/kg/hr if catheterised
  - colour of skin, lips/tongue: pale, mottled/ashen
- Non-blanching rash
- Temp <36°C
- If <3 months temp ≥38°C

### Moderate risk criteria

- Behaviour:
  - not responding normally to social cues, not wanting to play, no smile
  - decreased activity
  - wakes only with prolonged stimulation
  - parent/carer concern that child is behaving differently to usual
  - acute deterioration of functional ability
- Respiratory:
  - respiratory rate moderate risk (see **Table 1**)
  - increased work of breathing – nasal flaring
  - SpO<sub>2</sub> <94% in air if aged <5 yr
  - crackles in chest if aged <5 yr
- Cardiovascular:
  - heart rate in moderate risk range (see **Table 1**)
  - systolic BP in moderate risk range (see **Table 2**)
  - not passed urine/reduced urine output in last 12–18 hr, or 0.5–1 mL/kg/hr if catheterised
  - capillary refill ≥3
  - poor feeding in infants
  - pale/flushed pallor reported by carer
- History of rigors
- Temp <36°C
- Temp ≥39°C if aged 3–6 months
- Factor putting at a higher risk of developing sepsis (see above)
- Leg pain/cold hands and feet

# SEPSIS (INCLUDING MENINGOCOCCAL • 2/4

## Low risk criteria

- Behaving normally, responds to social cues, content/smiles
- Stays awake/awakens quickly
- Strong normal cry/not crying
- Normal colour
- No high/moderate risk criteria met

Table 1

Age	High risk		Moderate risk	
	Resp rate	Heart rate	Resp rate	Heart rate
<1 yr	>60	>160 or <60	50–59	150–159
1–2 yr	>50	>150 or <60	40–49	140–149
3–4 yr	>40	>140 or <60	35–39	130–139
5 yr	>29	>130 or <60	27–28	120–129
6–7 yr	>27	>120 or <60	24–26	110–119
8–11 yr	>25	>115 or <60	22–24	105–114
>12 yr	>25	>130	21–24	91–130

Table 2

Age	High risk	Moderate risk
	Systolic BP	Systolic BP
>12 yr	≤90 or >40 mmHg below norm	91–100 mmHg

- Suspect sepsis if signs/symptoms indicate possible infection even if normal temperature
- do not rely on fever or hypothermia to rule sepsis in/out
- May present with non-specific, non-localised signs
- Give attention to concerns by family/carers
- Assess carefully if unable to gain clear history (language barrier/communication problems)
- Take into account factors putting people at higher risk of developing sepsis
  - aged <1 yr
  - impaired immunity/immunosuppression
  - surgery/trauma in last 6 weeks
  - indwelling lines
  - breach in skin integrity (wound infection/breakdown)
- Neonates: be alert to risk factors for early-onset neonatal infection, see **Neonatal infection** guidelines
- Assess temperature, heart rate, respiratory rate, systolic BP, level of consciousness capillary refill time, oxygen saturation, and apply an early warning score
- Assess history for risk factors for sepsis
- Carry out clinical assessment/examination taking into account baseline physiology
- Stratify risk of mortality and morbidity from sepsis into high, moderate or low risk

## IMMEDIATE MANAGEMENT

- Give oxygen if suspected sepsis and signs of shock or SpO<sub>2</sub> <92% in air

### High risk

- Give IV antibiotics at maximum recommended dose within 1 hr
- Discuss with consultant
- Arrange immediate review by senior clinical decision maker (≥ST4)
  - blood culture
  - meningococcal PCR
  - FBC
  - clotting screen
  - group and save
  - U&Es
  - CRP
  - cortisol

# SEPSIS (INCLUDING MENINGOCOCCAL • 3/4

- glucose
- gas (including lactate)
  
- See **Antibiotics** below
- If lactate >4, **OR** SBP <90 if aged >12 yr: give 20 mL/kg IV fluid bolus without delay and refer for critical care review/admission (central access, inotropes)
- If lactate 2–4: give IV fluid bolus (20 mL/kg isotonic crystalloid) e.g. sodium chloride 0.9% (neonate 10–20 mL/kg) without delay
  - reassess after completion, if no improvement repeat
  - if no improvement after second bolus alert consultant to attend
- Discuss with critical care
- Call anaesthetist for ventilation, invasive monitoring and central access
- Peripheral access only: give dopamine
  - dopamine 3 mg/kg, weight (kg) x 3 = mg dopamine made up to 50 mL with glucose 5% (max concentration peripherally 3.2 mg/mL) 10 mL/hr = 10 microgram/kg/min
- Central/IO access use adrenaline 0.05–2 microgram/kg/min
- Weight (kg) x 0.3 = mg of adrenaline (1:1000 1 mg/mL) made up to 50 mL sodium chloride 0.9% at 1 mL/hr = 0.1 microgram/kg/min
  
- If lactate <2 start IV fluids
- Carry out observations ≤30 min, or continuously in ED
- Monitor mental state with GCS or AVPU scale
- Consultant to attend in person, if not already present, if:
  - patient does not improve within 1 hr of initial IV antibiotic and/or IV fluid resuscitation
  - lactate not decreased by ≥20% or <2 mmol
  - decreased level of consciousness
  - respiratory rate or systolic BP still in high risk range (see **Table 1** and **2**)
- Use human albumin solution 4.5 or 5% for fluid resuscitation only in patients with sepsis with shock
- Fluid refractory shock (>60 mL/kg)

## Moderate risk

### If ≥2 moderate to high risk criteria

- Perform venous blood for:
  - blood culture
  - FBC
  - CRP
  - U&E
  - gas for lactate
- Clinician and results review ≤1 hr of meeting ≥2 moderate criteria
- If lactate >2 **OR** assessed as having acute kidney injury (AKI), escalate to high risk
- If lactate <2 and no AKI:
  - manage defined condition/infection if identified
  - if no definitive condition identified, repeat structured assessment at least hourly, and ensure review by senior clinical decision maker (≥ST4) within 3 hr of meeting ≥2 moderate criteria

### If only 1 moderate–high risk criterion

- Clinician review and consider/perform blood tests ≤1 hr of meeting moderate criteria for assessment
- Manage defined condition/infection if identified and discharge home if appropriate with information
- If no definitive condition identified, lactate <2 and no AKI: repeat structured assessment hourly and ensure review by senior clinical decision maker (≥ST4) ≤3 hr of meeting more moderate criteria

## Low risk

- Clinical assessment and management according to clinical judgement

## ANTIBIOTICS

- Give IV antibiotics to infants aged <3 months as follows:
  - infants aged <1 month with fever
  - all infants aged 1–3 months with fever moderate/high risk above
  - infants aged 1–3 months with WBC count <5 x 10<sup>9</sup>/L or >15 x 10<sup>9</sup>/L

# SEPSIS (INCLUDING MENINGOCOCCAL • 4/4

- Take microbiological samples before prescribing an antimicrobial
- within 1 hr of meeting a high risk criterion
- review prescription when results available
- If suspected sepsis take blood cultures before antibiotics are given
- Follow local antibiotic guideline for antibiotic choice and doses

## Empiric antibiotics

- Give ceftriaxone 80 mg/kg (max 4 g) daily over 30–60 min (see **BNFc** for dose aged <4 weeks) OR
- cefotaxime 50 mg/kg (max 3 g) IV bolus
- Do not give ceftriaxone:
  - with calcium IV (including TPN) or
  - <41 weeks postmenstrual age or
  - neonate with hyperbilirubinaemia, hypoalbuminaemia or acidosis
- If documented history of definite anaphylaxis to cephalosporin: give meropenem IV (1% cross reaction)
- If anaphylaxis to meropenem: give vancomycin and gentamicin
- If aged <1 month and rash or raised AST/ALT: add aciclovir
- If aged <3 months: add amoxicillin high dose IV
- If group A streptococcus (GAS) suspected (chickenpox or other skin lesion, painful cellulitis): add clindamycin
- If MRSA suspected: add vancomycin IV
- If anaerobic infection suspected: add metronidazole IV
- If hospital acquired: give piperacillin with tazobactam (Tazocin<sup>®</sup>)
- If neutropenic: give piperacillin with tazobactam (Tazocin<sup>®</sup>)
- If no organism identified or meningococcus: give 7 days antibiotics
- If *Streptococcus pyogenes* (GAS): treat 10 days, *Staph aureus*: treat 14 days
- If meningococcus discuss prophylaxis with HPA (e.g. ciprofloxacin all ages) for close contacts

## FURTHER INVESTIGATION

- Carry out thorough clinical examination to look for sources of infection
- Tailor investigations to clinical history and examination
- Urine analysis and CXR aged >5 yr with suspected sepsis
- If no likely sources identified – ultrasound abdomen/pelvis
- If intra-abdominal or pelvic infection suspected involve paediatric surgical teams early
- Perform lumbar puncture in following with suspected sepsis (unless contraindicated):
  - infants aged <1 month
  - all infants aged 1–3 months who appear unwell
  - infants aged 1–3 months with a WBC <5 x 10<sup>9</sup>/L or >15 x 10<sup>9</sup>/L

## DISCHARGE AND FOLLOW-UP

- Ensure patient and family/carer aware of diagnosis of sepsis
- Discharge notification to GP to include diagnosis of sepsis
- Give patient and family/carer opportunity to discuss concerns (why they developed sepsis, whether they will get it again, recovery, short and long-term problems)
- Give the following:
  - information about follow-up/further tests (if needed)
  - information about community care details (if needed)
  - information about patient support groups

# TUBERCULOSIS • 1/4

## RECOGNITION AND ASSESSMENT

*History is most important factor in diagnosing tuberculosis*

### Symptoms

Suspect TB when following symptoms persist for weeks:

- Persistent, non-remitting cough for 2–4 weeks
- Weight loss
- Failure to thrive
- Lack of energy
- Fever and sweats
- Lymph nodes, especially if painless and matted
- Headache or irritability for >1 week
- Limp, stiff back
- Joint swelling
- Abdominal distension

### Signs

- Delayed growth: plot weight and height on growth chart and compare with earlier records
- Fever
- Wasting
- Lymphadenopathy
- Chest signs
- Cardiac tamponade
- Ascites
- Meningism
- Conjunctivitis
- Limited flexion of spine
- Kyphosis
- Swollen joint
- Cold abscess

### Family and social history

- Ask about recent contact with any family member (specifically grandparent or parent) who has:
  - chronic cough
  - previous treatment for TB, especially multi-drug resistant (MDR) TB, failed/defaulted TB treatment, or recurrent TB
  - travelled to regions/countries with a high prevalence of TB/MDR TB
  - recently died

## INVESTIGATIONS

- For suspected active TB do not request Tuberculin purified protein derivative (PPD) skin test (Mantoux) or interferon-gamma release assay (IGRA e.g. QuantiFERON<sup>®</sup> TB Gold or T-SPOT<sup>®</sup> TB) which are used for diagnosis of latent TB
- if active TB suspected discuss with expert in paediatric TB, even if rapid diagnostic tests are negative

### Pulmonary TB

- CXR: look for hilar lymphadenopathy, apical consolidation, pleural effusion, miliary nodules
- Sputum: send at least 3 (1 early morning) for AFB and TB culture in cooperative child, expectoration may require physio +/- nebulised sodium chloride 0.9% as necessary (with FFP3 mask and HEPA filtered ventilation if available)
- If unable to provide sputum specimen, send gastric aspirate (for TB culture only as microscopy is unreliable) early morning before feed, daily for 3 days
  - if no aspirate, rinse stomach with small volumes of sodium chloride 0.9% (5 mL aliquots maximum 20 mL)
  - do not send saliva
- Discuss broncho-alveolar lavage for AFB and TB culture via bronchoscopy with respiratory consultant
- Request 1 TB PCR test per specimen type

# TUBERCULOSIS • 2/4

## Pleural effusion

- CXR (preferably PA erect film)
- 3 x respiratory sample (deep cough sputum, induced sputum or gastric aspirate)
- Pleural biopsy for histology and microbiology (AFB and TB culture)
- Pleural fluid AFB, TB culture, cytology and adenosine deaminase
- Discuss with cardiothoracic surgeons

## Lymphadenopathy

- If single node, excision biopsy
- If large matted nodes, ultrasound scan +/- simultaneous guided aspiration (discuss before scan)
- Lymph node aspirate: fine needle aspiration biopsy (FNAB; 23 G needle)
  - low risk, high yield with sedation and local anaesthetic
- Send aspirate in 2 separate bottles:
  - one to microbiology for AFB, TB culture and PCR with no preservative
  - one to histology in 10% formalin
- If atypical mycobacterial infection suspected, excision biopsy

## Meningism

- MRI: preferred (CT if GA required but too sick to tolerate)
- CSF: AFB, TB culture, cytology, PCR and adenosine deaminase

## Bone/joint pain

- Plain X-ray initial imaging modality. CT and/or MRI, may be needed to evaluate extent and bone destruction – discuss with paediatric radiologist
- Biopsy/aspiration important for diagnosis and sensitivities
- Spinal TB: LP

## Abdominal distension

- Ultrasound then CT abdomen
- Ascites/bowel biopsy AFB, TB culture, cytology, adenosine deaminase

## Pyuria

- Urinalysis: if blood and leucocytes present, send for culture
  - non-tuberculous acid-fast bacteria common in urine
- Ultrasound kidneys
- Early morning urine culture

## Pericardial effusion

- Echocardiogram
- Pericardial fluid AFB, TB culture and PCR, cytology, adenosine deaminase

## Disseminated (inc. miliary)

- CT thorax and ultrasound abdomen
- LP (CT or MR first if CNS signs or symptoms)
- Bronchial wash
- Blood for TB culture
- Bone marrow biopsy if diagnosis uncertain

## IMMEDIATE MANAGEMENT

*Discuss treatment with local TB team and lead paediatrician for TB*

- If clinical signs and symptoms consistent with diagnosis of TB, start treatment – do not wait for culture results
- Send specimens for microscopy and culture before starting treatment unless life-threatening disease
- Inform Public Health through TB nurse team, who will organise CXR and Mantoux for all close and visiting contacts
- Inform infection prevention and control team: advise anyone with cough to avoid visiting ward

# TUBERCULOSIS • 3/4

- Admission not mandatory but useful to ensure adherence with treatment. If supervision can be guaranteed, allow treatment at home, contact TB nurse team before discharge
- If sputum +ve and hospitalisation necessary, strict barrier nurse in single room for 2 weeks or until discharge
- Patient should wear a surgical mask if leaves room
- Masks, gowns and barrier nursing unnecessary unless MDR TB or aerosol generating procedure
- Negative pressure room for aerosol generating procedure if TB considered (e.g. nebuliser)

## Drugs

- Isoniazid (H): 10 mg/kg once daily up to max 300 mg
  - (suspension; 50 mg, 100 mg tab)
- Rifampicin (R): 15 mg/kg once daily up to max 450 mg if <50 kg; up to max 600 mg if ≥50 kg
  - (suspension; 150 mg, 300 mg capsule)
- Pyrazinamide (Z): 35 mg/kg once daily up to max 1.5 g if <50 kg; up to max 2 g if ≥50 kg
  - (500 mg tablets can be crushed)
- Round up doses of HRZ to give easily measured volumes of syrup or appropriate strengths of tablet. Re-calculate doses with weight gain
- Ethambutol (E): 20 mg/kg once daily (100 mg, 400 mg tablets can be crushed)
  - do not round up dose
  - check renal function and visual acuity with Snellen chart if possible first
- Use drug combinations if possible
- Rimstar<sup>®</sup> (Voractiv<sup>®</sup>) H 75 mg; R 150 mg; Z 400 mg; E 275 mg
  - 30–39 kg 2 tablets daily
  - 40–54 kg 3 tablets daily
  - 55–70 kg 4 tablets daily
  - >70 kg 5 tablets daily
- Rifater<sup>®</sup>: H 50 mg; R 120 mg; Z 300 mg and ethambutol (round down to closest tablet size)
  - 30–40 kg 3 tab + ethambutol
  - 40–49 kg 4 tab + ethambutol
  - 50–64 kg 5 tab + ethambutol
  - ≥65 kg 6 tab + ethambutol
- Rifinah<sup>®</sup> **150/100**: R 150 mg; H 100 mg; **300/150**: R 300 mg; H 150 mg
  - 15–19 kg 2 tab Rifinah 150/100
  - 20–24 kg 1 tab Rifinah 150/100+ 1 tab Rifinah 300/150
  - 25–49 kg 3 tab Rifinah 150/100
  - ≥50 kg 2 tab Rifinah 300/150

Presentation	Treatment
TB without CNS involvement	Rifampicin and isoniazid for 6 months Pyrazinamide and ethambutol for first 2 months
TB with CNS involvement	Rifampicin and isoniazid for 12 months Pyrazinamide and ethambutol for first 2 months Prednisolone 4 mg/kg (max 40 mg), with gradual withdrawal over 4–8 weeks

- Add pyridoxine 10 mg (all ages) to prevent isoniazid neuropathy in malnourished or breastfed infants, diabetes, HIV or renal failure
- Pericardial TB: add prednisolone 1 mg/kg/day (max 40 mg/day)
- Inform patient/parents of both common (gastrointestinal upset, rash) and rare but important side effects (staining of secretions, signs of hepatotoxicity)
- Advise patient/parents and GP of indications for seeking advice: fever, malaise, vomiting, jaundice or unexplained deterioration. Consider co-existent viral hepatitis. If AST/ALT level rises to 5x normal, stop treatment and seek advice re: alternate regimen

## SUBSEQUENT MANAGEMENT

- HIV test
- Other drugs may be necessary once sensitivities available: if resistant, seek specialist advice

## MONITORING TREATMENT

- If baseline ALT/AST raised but ≤2x normal, repeat at 2 weeks; if falling only recheck if fever, malaise, vomiting, jaundice or unexplained deterioration



# TUBERCULOSIS • 4/4

- If ALT/AST >2x, monitor weekly for 2 weeks then 2-weekly until normal, check viral hepatitis serology
- Stop treatment only if ≥5x normal
- If on ethambutol and unable to report visual problems, check visual evoked response

## DISCHARGE AND FOLLOW-UP

- Discharge if tolerating treatment and adherence guaranteed
- If concerns about adherence, will need direct observed therapy, organised through TB nurse team
- Review to ensure adherence:
  - at least monthly for first 2 months
  - 2-monthly until treatment complete
  - for 3 months after end of treatment
  - further as clinically indicated

## LATENT TB

### Asymptomatic close contact with pulmonary TB or new entrant from high-incidence country

- If immunocompromised discuss with TB specialist
- If treatment for latent TB indicated but not taken: CXR at 3 and 12 months
- If treating for latent TB: test for HIV, hepatitis B and C

### Neonate

- Assess for active disease
- Treat with isoniazid for 3 months then Mantoux
  - if ≥5 mm: assess for active disease, if not active TB, continue isoniazid total 6 months
  - if <5 mm, IGRA: if both -ve stop isoniazid and refer to TB nurse team for BCG, if +ve assess for active disease, if not active TB, continue isoniazid for total 6 months

### Aged 4 weeks to 2 years

- Start rifampicin and isoniazid and refer to TB nurse team for Mantoux
- If ≥5 mm: assess for active TB, if not active TB treat for latent TB rifampicin and isoniazid for 3 months or isoniazid for 6 months
- If <5 mm: continue rifampicin and isoniazid for 6 weeks, then repeat Mantoux and do IGRA
- If both -ve: stop isoniazid
- If either +ve: assess for active TB, if not active TB, complete treatment for latent TB

### Aged >2 yr

#### **Mantoux:**

- if >5 mm assess for active TB: if not active TB, treat for latent TB
- If <5 mm and contact smear +ve: after 6 weeks repeat Mantoux and do IGRA
- if both -ve: stop isoniazid
- if either +ve: assess for active TB
  - if not active TB: complete treatment for latent TB

# VANCOMYCIN • 1/1

## INDICATIONS

- MRSA
- Neutropenic sepsis with meropenem as second line treatment
- Teicoplanin is alternative, particularly for coagulase negative staphylococcal infection

## DOSE

### 29–35 weeks postmenstrual age

- 15 mg/kg 12-hrly adjusted according to trough levels

### >35 weeks postmenstrual – aged 18 yr

- 15 mg/kg 8-hrly, adjusted according to trough levels (up to maximum initial dose 700 mg 8-hrly)

## PRESCRIBING

- Prescribe in antibiotic section of drug chart
- specify time of administration using 24 hr clock
- Avoid in renal impairment
- In obese children use ideal weight for height
- Avoid if on furosemide/other nephrotoxic medication
- Correct dehydration first

## ADMINISTRATION

- Frequency of administration varies with postmenstrual (gestation + age in weeks) age as it is removed exclusively by the kidneys
- Vancomycin is given over  $\geq 60$  min, at a rate not exceeding 10 mg/min to avoid anaphylactoid reactions
- Dilute with sodium chloride 0.9% or glucose 5%, to maximum concentration of 5 mg/mL for peripheral administration
- If fluid restriction can be administered at concentration of 10 mg/mL **centrally**

## MONITORING

### General monitoring

- Daily creatinine and urea levels, and urine output (vancomycin is nephrotoxic)

### Therapeutic monitoring

- Therapeutic trough levels required to maintain efficacy
- Microbiology lab tests levels between 0830–1600 hr
- Measure levels immediately before 3<sup>rd</sup> dose (before 2<sup>nd</sup> dose if concerns about renal function)
- Do not withhold the next dose if awaiting results (unless concerns about renal function due to increase creatinine and urea, or reduced urine output)
- Pre-dose trough levels should usually be between 10–15 mg/L [15–20 mg/L for less sensitive (e.g. MRSA) organisms]
- If level below desired therapeutic level, reduce time between dosing to next dose interval e.g. if 8-hrly give 6-hrly and repeat levels before 3<sup>rd</sup> dose
- If level  $>20$  mg/L but  $<25$  mg/L increase time between dosing to next time interval and repeat levels on 3<sup>rd</sup> dose, e.g. if 8-hrly increase to 12-hrly
- If level  $>25$  mg/L: do not administer further doses but check levels every 12 hr until 10–15 mg/L (use time since last dose as dose interval)

# HEADACHE • 1/3

## CAUSES

- Viral illness, ENT infections (sinusitis and throat infections), and minor head trauma
- Primary headache
- **Neurological conditions needing urgent attention:**
  - bacterial meningitis
  - intracranial haemorrhage
  - shunt related
  - idiopathic intracranial hypertension (IIH)
  - new hydrocephalus
  - brain tumour
  - brain abscess

## ASSESSMENT

- Headache history (LIQDIFOE): **L**ocation, **I**ntensity, **Q**uality, **D**uration, **F**requency, **O**ther symptoms (nausea, vomiting, photophobia, dizziness) **E**ffect/degree of impairment due to headache
- **Associated symptoms:**
  - alteration in sensorium (drowsiness or low GCS)
  - seizure
  - persistent vomiting
  - new visual symptoms: diplopia, abnormal eye movement, visual impairment
  - behaviour change
  - recent change in gait/balance/co-ordination
  - any other neurological symptoms
  - recent head trauma
  - systemic symptoms

### Red flags

- Recent onset of severe headache
- Change in headache severity and frequency
- Early morning/waking from sleep
- Postural headache
- Fixed (side locked headache) or unusual location
- Ophthalmological symptoms/signs (especially new onset)
- Abnormal growth/puberty
- Deterioration in school work/personality
- Parental worry

***Be cautious of first and worst headache, short history of progressively worse headache – see Imaging below***

- **General physical examination:**
  - fever, skin rash
  - abnormal head position, torticollis
  - marker of neuro-cutaneous syndrome
  - BP, pulse, oxygen saturation, temperature
  - weight, height
  - BMI
  - pubertal status
  - scalp, face, neck, oral cavity
  - full ENT examination
- **Neurological examination (especially look for):**
  - new onset of squint
  - cranial nerve palsy
  - any other focal neurological deficit
  - cerebellar signs, including nystagmus, meningeal signs
- **Fundus**
  - if uncertain/abnormal, discuss with ophthalmologist

# HEADACHE • 2/3

## IMAGING

- Investigations and management based on clinically suspected cause of headache
- MRI brain scan (if contraindication to MRI – CT brain)

### Indications

- If any red flags present and headache is difficult to classify into one of the primary headaches, e.g. migraine/tension type headache
- First/worst headache
- Short history of progressively worse headaches
- Presence of new neurological symptoms/signs associated with headache
  - persistent/recurrent vomiting
  - balance/co-ordination problems
  - abnormal eye movements
  - behaviour change (particularly lethargy)
  - seizures
  - abnormal head position/head tilt

## IDIOPATHIC INTRACRANIAL HYPERTENSION (IIH)

- **Suspect IIH presenting with papilledema, with/without:**
  - sixth cranial nerve palsy causing diplopia
  - intact conscious level
  - with any pattern of headache
- **Features of raised intracranial pressure:**
  - nausea and vomiting
  - headache worse lying down/with coughing/bending/exercise
- **Additional features:**
  - child waking up in sleep with headache
  - pulsatile tinnitus
  - dizziness
  - ataxia
  - back/neck pain or stiffness
- **Common visual symptoms:**
  - transient visual loss/blurring of vision
    - request ophthalmologist to confirm papilledema
    - obtain colour vision and visual field charting
- Normal neurological examination (except 6th nerve palsy and papilledema)

### Causes

- Obesity – usually association/risk factor
- Drugs (may be cause/contributory factor): steroid therapy or withdrawal, growth hormone, tetracycline, oral contraceptive pills
- Endocrine: hypo/hyperthyroidism, hypo/hyperparathyroidism, adrenal insufficiency, Cushing syndrome
- Haematological: iron deficiency anaemia, sickle cell anaemia
- Infections and systemic disorders: otitis media, Lyme disease, HIV, chronic renal failure, SLE
- Obstructive sleep apnoeas
- Cerebral venous thrombosis

### Investigations

- Initial: FBC, bone profile, TFT, U&E, parathyroid
- Other as clinically indicated
- **Imaging:**
  - MRI brain modality of choice (CT brain only if contraindication to MRI/significant urgency for examination)
  - MRV: discuss with consultant and/or radiologist

### Lumbar puncture

- Opening pressure of over 28 cm H<sub>2</sub>O, normal cell count and biochemistry
- CSF pressure can be falsely high/low
- Hyperventilation can reduce pressure

# HEADACHE • 3/3

- Distress, anxiety, Valsalva can increase pressure
- Can be performed under analgesia, sedation or general anaesthetic; sedation can increase pressure
- End tidal CO<sub>2</sub> should be monitored and kept in normal range for LP under general anaesthetic

## Treatment

- First line of treatment: acetazolamide

***Be careful about child with papilledema suspected on routine eye check in an asymptomatic child. Seek advice before starting investigations***

***Do not diagnose IIH on high CSF pressure alone in absence of typical clinical features***

## HEAD INJURY

### CT head scan <1 hr if high risk factor:

- Suspicion of non-accidental injury
- Post-traumatic seizure but no history of epilepsy
- On initial emergency department assessment, GCS 14, or for children aged <1 yr GCS (paediatric) <15
- At 2 hr after injury, GCS <15
- Suspected open/depressed skull fracture or tense fontanelle
- Any sign of basal skull fracture (haemotympanum, 'panda' eyes, cerebrospinal fluid leakage from ear/nose, Battle's sign)
- Focal neurological deficit
- For children aged <1 yr, presence of bruise, swelling or laceration >5 cm on the head

### No high risk factor and >1 of moderate risk factors CT <1 hr:

- Loss of consciousness lasting >5 min (witnessed)
- Abnormal drowsiness
- >2 discrete episodes of vomiting
- Dangerous mechanism of injury
  - high-speed road traffic accident: as pedestrian, cyclist/vehicle occupant
  - fall from height of >3 m,
  - high-speed injury from projectile or other object
- Amnesia (antegrade/retrograde) >5 min

### None of above and 1 moderate risk factor:

- Observe 4 hr after head injury. If during observation any of the risk factors below, CT head scan <1 hour:
  - GCS <15
  - further vomiting
  - further episode of abnormal drowsiness
- If none of above risk factors occur during observation, use clinical judgment to determine whether longer period of observation needed
- If on warfarin with no other risk factors:
  - CT head scan head scan <8 hr after injury

# FACIAL PALSY • 1/1

## RECOGNITION AND ASSESSMENT

### Definition

- Bell's palsy: idiopathic lower motor neurone facial nerve palsy
- Exclude secondary causes of facial nerve palsy due to infection, inflammation, tumour, trauma, vascular event clinically and/or with appropriate investigations

### Symptoms and signs

- Asymmetry of face or smile and loss of nasiolabial fold on same side
- demonstrable weakness in lower motor neurone distribution (includes loss of wrinkles on forehead)
- Increased or decreased lacrimation
- Hyperacusis
- Altered taste
- Facial pain
- Difficulty in closing eye

### History

- History of prior viral infection may be present
- Abrupt onset with no progression
- No history of preceding seizure or head injury

### Examination

- Full neurological examination, including other cranial nerves, and fundoscopy
- Ears, nose and throat to exclude cholesteatoma, mastoiditis or herpes infection
- Blood pressure to exclude hypertension
- Check for lymphadenopathy, hepatosplenomegaly, pallor or bruising to exclude malignancy

## INVESTIGATIONS

- If all history/examination unremarkable and no other neurological signs/symptoms, no investigations needed
- If difficulty in closing eye, ophthalmology referral
- Bilateral facial palsy – consider Lyme disease, Guillain-Barré syndrome, brain stem pathology: discuss further investigations with senior
- Recurrent facial palsy: discuss with senior
- Recurrent infections: first line immune deficiency investigations (including HIV)
- Severe pain associated with VZV

## IMMEDIATE TREATMENT

- If difficulty in closing eye, provide eye patch and carbomer ointment
- If no other signs, no other treatment necessary
- If vesicles suggest HSV, prescribe aciclovir
- Within 72 hr prednisolone 1 mg/kg/day for 5–7 days. Can be given as per adult practice (discuss with a senior)

## DISCHARGE AND FOLLOW-UP

- 4 weekly GP follow-up until symptoms and signs have resolved (95% by 1 yr)
- If facial palsy does not improve considerably within 4 weeks consider imaging
- If any other neurological signs/symptoms consider early/immediate imaging

# EPILEPSY • 1/6

## DEFINITIONS

- Seizures/convulsions: paroxysmal disturbance of consciousness, behaviour, motor function, sensation – singly or in combination
- Epilepsy: recurrent seizures without any provoking factor and happening in different situations
- Seizure type: (focal, generalised or any other type) based on history and EEG
- Try to categorise into one of epilepsy syndromes

## RECOGNITION AND ASSESSMENT

- Detailed and accurate history from an eyewitness (beginning, middle and end of the episode)
- When history unclear, recording the episode with a camcorder/mobile phone can be very useful
- Episodes occurring only in certain situations with certain provoking factors (such as fall, emotions, certain posture etc., except photosensitive stimuli) are likely to be non-epileptic
- Any underlying problem: learning difficulties, cerebral palsy, HIE, head injury or other CNS insult
- Look for any co-morbidity
- Family history may be positive in certain idiopathic generalised epilepsies, some symptomatic epilepsies (tuberous sclerosis), autosomal dominant frontal epilepsies
- Genetic conditions (e.g. Angelman's syndrome)
- Neurocutaneous syndromes, café-au-lait spots/depigmented patches, use Woods Light
- Neurological examination
- If in doubt about diagnosis, do not label as epilepsy but watch and wait or refer to specialist

***Diagnosis of epilepsy is clinical***

### **Seizure types**

#### ***Generalised***

- Tonic-clonic/tonic
- Clonic
- Atonic
- Absence – typical absences, absences with special features such as myoclonic absences or eyelid myoclonia, atypical absences
- Myoclonic – myoclonic, myoclonic-atonic

#### ***Focal***

- Characterised by  $\leq 1$  following features:
  - aura
  - motor
  - autonomic
  - awareness/responsiveness: altered (dyscognitive) or retained
- May evolve to bilateral convulsive seizures

### **Underlying cause**

- In most cases epilepsy is idiopathic but a few cases have an underlying cause
- actively look for the cause to guide prognosis, other treatment and recommendation for epilepsy surgery

## EPILEPSY SYNDROMES

### **Identification**

- Based on:
  - seizure type
  - age of onset
  - neurodevelopmental status
  - appearance of EEG (ictal and interictal)

### **Electroclinical syndromes**

#### ***Neonatal***

- Self-limited:
  - neonatal seizures
  - familial neonatal epilepsy
- Otahara syndrome
- Early myoclonic encephalopathy

# EPILEPSY • 2/6

## **Infancy**

- Febrile seizures/febrile seizures plus:
- self-limited infantile epilepsy
- West syndrome
- Dravet syndrome
- myoclonic epilepsy in infancy
- epilepsy of infancy with migrating focal seizures

## **Childhood**

- Febrile seizures/febrile seizures plus:
- early onset occipital epilepsy (Panayiotopoulos syndrome)
- epilepsy with myoclonic atonic (previously astatic) seizures
- childhood absence epilepsy
- epilepsy with centrotemporal spikes
- autosomal dominant frontal lobe epilepsy
- Lennox Gastaut syndrome
- epileptic encephalopathy with continuous spike and wave during sleep
- Landau-Kleffner syndrome

## **Adolescence**

- Juvenile absence epilepsy
- Juvenile myoclonic epilepsy
- Epilepsy with generalised tonic clonic seizures alone
- Autosomal dominant epilepsy with auditory features
- Other familial temporal lobe epilepsies

## **Common childhood/adolescent epilepsy syndromes**

### **Childhood absence epilepsy**

- Usually presents aged 3–8 yr
- More common in girls
- Several (up to 100) brief episodes in a day
- Very quick recovery
- Typical EEG 3 per sec spike and wave
- 10–30% of children have generalised seizures at some stage, usually in teenage years

### **Juvenile absence epilepsy**

- Usually presents after age 9–10 yr
- Absence frequency is less than in childhood absence epilepsy
- Cluster after awakening
- 90% of children have generalised seizures in the same period while they have absences
- EEG generalised spike and wave

### **Juvenile myoclonic epilepsy (JME)**

- Usually presents between ages 12–18 yr
- Myoclonic jerks are hallmark of this syndrome
- Jerks after awakening (myoclonic jerks), common and often go unrecognised
- 90% of children have generalised seizures at some stage
- 15–30% of children will have absences

### **Benign epilepsy of childhood with rolandic spike**

- Usually nocturnal seizures
- Unilateral focal motor seizures of face, palate and arm with gurgling and salivation focal oromotor
- May become secondary generalised
- May present with nocturnal generalised seizures
- Spikes in one or the other centro temporal areas
- Awake interictal EEG could be normal and sleep EEG would usually show the abnormality

### **Panayiotopoulos syndrome**

- Younger children (peak age 5 yr)
- usually nocturnal and happens in sleep
- Usually starts with vomiting and child initially conscious



# EPILEPSY • 3/6

- Child continues to vomit repeatedly and becomes unresponsive
- Subsequent deviation of eyes to one side or may end in hemiclonic seizure or (rarely) generalised seizure
- Other autonomic features very common (e.g. dilated pupils, pale skin or flushing, incontinence)
- Usually lasts for a few to 30 min, occasionally for several hours

## Common focal epilepsies in children

### *Temporal lobe epilepsy (TLE)*

- Focal seizures with impaired consciousness and complex automatism
- Aura is common before the seizure, which could be a sense of fear, abnormal abdominal sensation or any other
- Children are very tired and sleepy after episode
- Children with history of prolonged febrile seizure in the early years of life may have mesial temporal sclerosis as a cause of their seizures
- Other known causes: cortical dysplasia, gliomas, dysembryonic neuroectodermal tumour
- Some patients can be a candidate for epilepsy surgery

### *Frontal lobe epilepsy*

- Usually focal motor seizures
- Either tonic or clonic seizures – may have speech arrest and head rotation or complex partial seizures or focal with secondary generalisation
- Multiple brief seizures in the night
- Repeated/multiple brief nocturnal seizures are a characteristic feature of frontal lobe epilepsy
- Ictal EEG can be normal
- Can mimic pseudo seizures

## Epileptic encephalopathy

### *West syndrome*

***Early diagnosis is important: suspect infantile spasm in an infant presenting with any abnormal movements and request urgent opinion***

- Typically present aged 3–7 months with:
  - infantile spasms (flexor, extensor or mixed) occurring in clusters, usually on waking
  - abnormal EEG (hypsarrhythmia)
  - developmental regression/intellectual disability with visual inattention
- Arrange same/next day EEG
- Further investigations include cranial MR scan (preferably as inpatient)
- Treat with high dose of steroids and/or vigabatrin

## INVESTIGATIONS

### Indications for EEG

- Clinically diagnosed epilepsy
- After an episode of status epilepticus
- Unexplained coma or encephalopathy
- Suspicion of non-convulsive status in children with learning difficulties and epilepsy
- Acquired regression of speech or language function
- Developmental regression suspected to have neurodegenerative condition
- To monitor progress in West's syndrome and non-convulsive status

### *EEG not indicated*

- Funny turns, apnoeic attacks, dizzy spells, strange behaviour
- Non-convulsive episodes [e.g. syncope, reflex anoxic seizures, breath-holding episodes (ECG more appropriate)]
- Febrile seizures
- Single uncomplicated generalised tonic-clonic seizures
- To monitor progress in well-controlled epilepsy
- Before stopping treatment

## Indications for MRI of brain

- Focal epilepsy (including TLE) except rolandic seizures
- Epilepsy in children aged <2 yr
- Myoclonic epilepsy
- Intractable seizures
- Loss of previous good control
- Seizures continuing in spite of first line medication
- Associated neurological deficits or appearance of new neurological signs
- Developmental regression in children with epilepsy
- Infantile spasms (West's syndrome)

## Other investigations

- Sleep or sleep-deprived EEG useful in all children in whom there is a high clinical suspicion but awake EEG normal
- sleep EEG useful to pick up some focal/generalised epilepsies and sleep-deprived EEG useful in generalised epilepsies in young adults including JME. Perform sleep EEG with melatonin
- Video telemetry useful if diagnostic dilemma, pseudo seizures or before surgery
- Drug levels: phenytoin, phenobarbitone (other anticonvulsants only if concerns about compliance and overdose)
- Biochemistry: glucose, calcium, LFT, lactate, ammonia; metabolic and genetic investigations where suspicion of metabolic disorder (e.g. progressive developmental delay)
- Epileptic encephalopathies, such as West's Syndrome, need a series of investigations (discuss with paediatric neurologist)

## TREATMENT

### General guidelines

- Discuss treatment with a consultant before starting
- Start/offer anti-epileptic only if diagnosis certain ( $\geq 2$  unprovoked seizures)
- Preferably after initial EEG results obtained
- Start with small dose and build up to half maintenance. If seizures continue, increase to full maintenance
- Increase dose stepwise every 2–3 weeks

### First line drugs

- See **Table** for choice of anti-epileptic drug
- Carbamazepine: start with 2.5–5 mg/kg/day in 2 divided doses gradually increasing to 20 mg/kg/day (max 1.8 g daily)

OR

- Sodium valproate: start with 5–10 mg/kg/day in 2 divided doses gradually increasing to 40 mg/kg/day (max 2.5 g daily)
- Avoid polypharmacy; do not add a second medication unless the full or maximum tolerated dose of the first medication has been reached (discuss with a paediatrician with special interest or paediatric neurologist before adding second drug)
- Aim to switch to monotherapy after a period of overlap
- Give liquids as sugar-free preparations
- Advise GP and parents of risk of loss of seizure control when switching between different manufacturers of carbamazepine, phenytoin, phenobarbitone and primidone, once stable on therapy
- recommend prescribing by brand and obtaining supplies from their usual pharmacy wherever possible
- Make sure you discuss potential adverse effects with parents and document these in notes
- In girls of present and future childbearing potential, discuss possible risk of malformation and neurodevelopmental impairments in an unborn child, particularly with high doses of this AED or when using as part of polytherapy
- valproate not to be prescribed to female children/women of child-bearing potential/pregnant women, unless other treatments are ineffective/not tolerated
- discuss risk associated with taking valproate whilst pregnant and document in notes at each clinical review
- If child develops adverse effects, discuss and reduce dose
- Prescribe buccal midazolam or rectal diazepam for use in the community for children who have had a previous episode of prolonged or serial convulsive seizures

# EPILEPSY • 5/6

## Discussion with child and parents

- Provide additional advice regarding safety (e.g. supervision when swimming) and document discussion in notes
- Discuss and prescribe rescue treatment, especially in generalised epilepsy, with training for parents
- Provide written information, including information about national or local epilepsy associations and website for Epilepsy Action ([www.epilepsy.org.uk](http://www.epilepsy.org.uk))
- Explain how to gain access to epilepsy specialist nurse
- Allow parents and children to ask questions, especially about sensitive issues such as sudden death

**Table 1: Drugs of first, second and third choice in treatment of seizure types**

Seizure type	First	Second	Third
Generalised epilepsy	Sodium valproate* OR Lamotrigine <sup>†</sup>	Carbamazepine* OR Sodium valproate*	Levetiracetam Topiramate
Childhood absence epilepsy	Sodium valproate* Ethosuximide	Lamotrigine <sup>†</sup>	Levetiracetam Topiramate
Focal epilepsy including TLE	Carbamazepine* Lamotrigine <sup>†</sup>	Sodium valproate* Topiramate Levetiracetam	Clobazam Phenytoin
Infantile spasms	Prednisolone/tetracosactide AND/OR Vigabatrin	Sodium valproate <sup>‡</sup> Nitrazepam	Trial of pyridoxine

\* Carbamazepine should be avoided in childhood absences, juvenile absences and juvenile myoclonic epilepsy and can increase seizures in some epileptic encephalopathies and primary generalised epilepsies

<sup>†</sup> Lamotrigine can increase myoclonic seizures in some myoclonic epilepsy syndromes

<sup>‡</sup> Be aware of teratogenic and developmental risks of sodium valproate

## Epilepsy in adolescence – additional factors to be considered

- Compliance
- Career choices
- Driving
- Contraception and pregnancy, including pre-pregnancy counselling
- Alcohol and drugs

## SUBSEQUENT MANAGEMENT

- Increase dose of anti-epileptic gradually towards full dose or maximum tolerated dose until control good
- If control suboptimal with one drug or unacceptable side effects, start second-line drug

## OUT-PATIENT MANAGEMENT

- Initial follow-up at 6–8 weeks
- Subsequent follow-up/structured review every 3–12 months based on clinical need

## FURTHER OPINION/REFERRAL TO SPECIALIST SERVICE OR TERTIARY CENTRE (NICE GUIDELINES)

### Refer immediately

- Behavioural or developmental regression
- Epilepsy syndrome cannot be identified

### Refer soon

- When one or more of the following are present:
  - child aged <2 yr
  - seizures continuing despite being on anti-epileptic drug (AED) for 2 yrs
  - 2 AEDs have been tried and are unsuccessful
  - risk of unacceptable side effects of medication
  - unilateral structural lesion
  - psychological or psychiatric co-morbidity
  - diagnostic doubt about seizure type and/or syndrome

### Refer

- Refer specific syndromes such as:
  - Sturge-Weber syndrome

## EPILEPSY • 6/6

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- Rasmussen's encephalitis
- hypothalamic hamartoma

### **WITHDRAWAL OF ANTI-EPILEPTIC DRUGS**

- Consider when child has been seizure free for 2 yrs
- Discuss the risks of recurrence (25–30%), if this occurs, recommence treatment
- Recurrence is very high in some syndromes (e.g. juvenile myoclonic epilepsy, 70–80% usually requires lifelong treatment)
- Postpone withdrawing anti-epileptic medication if important events such as GCSEs are looming
- Gradual withdrawal over 2–3 months usual
- Some drugs (phenobarbital or benzodiazepines) need very slow withdrawal over 6–12 months

# STATUS EPILEPTICUS • 1/1

- Follow each step until fits resolve, but do not treat post-ictal posturing as seizure
- Prepare next step in algorithm immediately after previous one administered
- Do not give more than 2 doses of benzodiazepine, including any pre-hospital doses

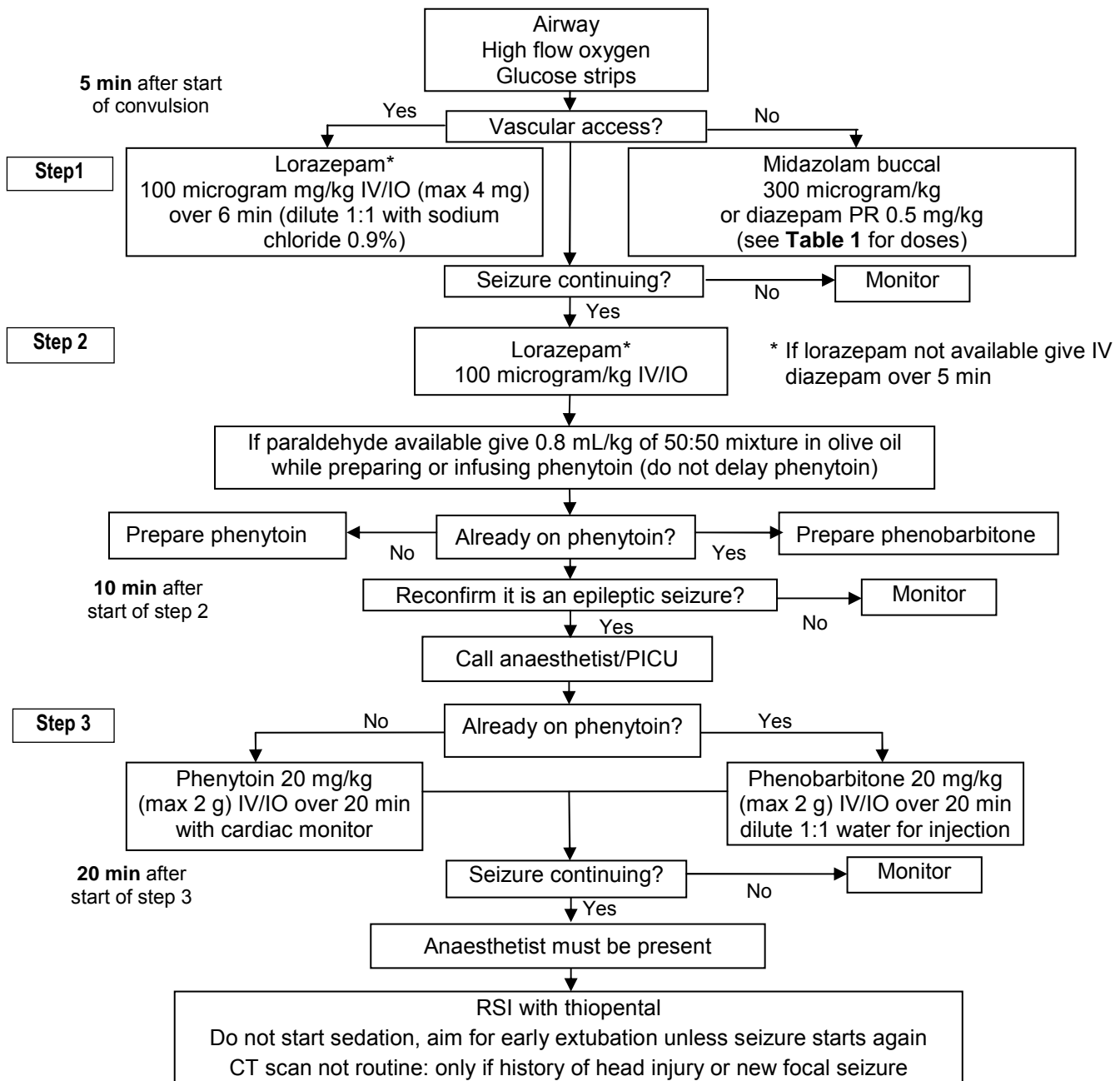


Table 1

Midazolam (buccal)	Diazepam (IV)	Diazepam (rectal)
Aged <3 months: 300 microgram/kg (max 2.5 mg)	Aged 1 month–12 yr: 300 microgram/kg (max 10 mg) over 3–5 min	Aged 1 month–2 yr: 5 mg
Aged 3 months–1 yr: 2.5 mg		Aged 2–12 yr: 5–10 mg
Aged 1–5 yr: 5 mg	Aged >12 yr: 10 mg over 3–5 min	Aged >12 yr: 10 mg
Aged 5–10 yr: 7.5 mg		
Aged >10 yr: 10 mg		

# NEUROMUSCULAR DISORDERS • 1/2

## ON ADMISSION

- Ask parents if they have a copy of a care plan
- Inform child's long-term consultant

## CLINICAL HISTORY

- Adequacy of cough and swallowing
- Previous sleep difficulties, wakefulness at night (nocturnal hypoventilation)
- Difficulty waking in morning, early morning headache (nocturnal hypoventilation)
- Poor appetite, weight loss (chronic respiratory failure)
- Learning or behavioural problems, school attendance (chronic respiratory failure)
- Palpitations, breathlessness, chest pain (cardiomyopathy)
- Muscle cramps, skeletal pain, back pain (for fractures)
- Abdominal pain, distension, melaena (GI perforation)

## ASSESSMENT

- May not show overt signs of respiratory distress such as tachypnoea, recessions and use of accessory muscles even in respiratory failure
- Assess adequacy of chest wall excursion and cough
- Look for pallor, tachycardia, signs of circulatory compromise
- Assess for abdominal signs (GI bleed, perforation, gastritis)
- Measure:
  - SpO<sub>2</sub> in air
  - CO<sub>2</sub> by blood gas, transcutaneous CO<sub>2</sub> or end-tidal CO<sub>2</sub>, especially if on oxygen
  - spirometry: FVC most useful if previous readings available
- ECG
- Blood gas for cardiac status
- CXR: clinical signs can fail to detect collapse/consolidation/cardiomegaly
- Consider skeletal/spinal X-rays for possible fractures

### Medical problems commonly found in children with myopathy

- Respiratory failure (hypoxaemia and hypercapnia) without signs of respiratory distress. Susceptibility to respiratory failure due to:
  - muscle weakness (upper airway, intercostals, diaphragm)
  - scoliosis
  - poor secretion clearance
  - aspiration, chest infections
  - sleep disordered breathing
  - cardiac failure
- Lower respiratory infection, aspiration pneumonitis
- Cardiomyopathy and cardiac decompensation
- Gastro-oesophageal reflux, gastritis and gastric ulceration (especially if on corticosteroids)
- Adrenal insufficiency (if on corticosteroids)
- Fractures, especially vertebral, if on long-term corticosteroids
- Malignant hyperthermia following anaesthesia in certain muscular dystrophies and myopathies

## MANAGEMENT

- If unwell, on **long-term corticosteroids**, double usual daily dose of steroids for 2–3 days. If unable to tolerate oral steroids, use IV hydrocortisone

### Respiratory failure

- Prescribe and carefully titrate administration of oxygen by mask/nasal cannulae to achieve SpO<sub>2</sub> between 94–98%. Monitor CO<sub>2</sub> and respiratory effort as risk of rising CO<sub>2</sub> and respiratory failure (despite normal oxygen saturations) if hypoxic respiratory drive overcome by oxygen therapy
- High-flow high-humidity air or oxygen (e.g. Optiflow™): monitor CO<sub>2</sub>
- Mask ventilation (bi-level positive airway pressure, BIPAP)
- Chest physiotherapy and postural drainage
- Use insufflator-exsufflator (e.g. Cough Assist) if patient has one
- Suction

# NEUROMUSCULAR DISORDERS • 2/2

- if copious loose secretions use glycopyrronium bromide 40–100 microgram/kg oral max 2 mg 6-hrly (use 200 microgram/mL IV solution if special manufacturer solution not available)
- Antibiotics
- obtain cough swab or sputum specimen, ideally before starting treatment
- check previous culture results
- choice same as for community acquired pneumonia
- if bronchiectasis use broad spectrum for 14 days to cover pseudomonas (discuss with senior)
- if not improving on 1<sup>st</sup> line antibiotics add macrolide for atypical pneumonia
- Consult senior to discuss need for ITU care, escalation of respiratory support

## Cardiac failure

- Fluid restriction
- Diuretics
- Oxygen and respiratory support
- Cardiology consultation

## GI tract bleed: prevention and treatment

- Nil-by-mouth and IV fluids
- Ranitidine (omeprazole or alternative PPI if severe reflux)
- Senior advice

## Fractures

- Analgesia
- Orthopaedic consultation
- Check calcium and vitamin D
- Discuss with metabolic bone expert about IV bisphosphonates for vertebral fractures

## Malignant hyperthermia

***Malignant hyperthermia is a medical emergency***

- Occurs following general anaesthesia and may be first presentation of a neuromuscular disorder
- Check creatine kinase, calcium, renal function, urine output and for myoglobinuria: dialysis may be needed
- In addition to temperature control and general life support measures, use IV dantrolene to control excessive muscle contraction
- Obtain senior anaesthetic advice and liaise with PICU

# GLASGOW COMA SCORE • 1/1

## Response aged $\geq 4$ yr

Eye opening	Score
Spontaneously	4
To verbal stimuli	3
To pain	2
No response to pain	1

Best motor response	Score
Obeys verbal commands	6
Localises pain	5
Withdraws from pain	4
Abnormal flexion to pain (decorticate)	3
Abnormal extension to pain (decerebrate)	2
No response to pain	1

Best verbal response	Score
Orientated and converses	5
Disorientated and converses	4
Inappropriate words	3
Incomprehensible sounds	2
No response to pain	1

## Response aged $<4$ yr

Eye opening	Score
Spontaneously	4
To verbal stimuli	3
To pain	2
No response to pain	1

Best motor response	Score
Obeys commands or spontaneous	6
Localises pain or withdraws to touch	5
Withdraws from pain	4
Abnormal flexion to pain (decorticate)	3
Abnormal extension to pain (decerebrate)	2
No response to pain	1

Best verbal response	Score
Alert; babbles, coos, words to usual ability	5
Less than usual words, spontaneous irritable cry	4
Cries only to pain	3
Moans to pain	2
No response to pain	1



# GLOMERULONEPHRITIS • 1/3

## RECOGNITION AND ASSESSMENT

### Definition

- Acute inflammatory process affecting the glomeruli leading to haematuria, proteinuria, oedema, hypertension and renal insufficiency

### Symptoms and signs

- Reduced urine output
- Macroscopic haematuria, coca-cola coloured urine
- Headache/breathlessness, (could be indicative of pulmonary oedema)
- History of sore throat in preceding 2–3 weeks
- Oedema variable, periorbital/pedal
- check weight, trend is useful
- check jugular venous pressure (JVP), if raised, indicates volume overload
- Oliguria (urine output: infant/child <1 mL/kg/hr)
- Hypertension +/- features of encephalopathy (headache, nausea, vomiting, visual disturbance, restlessness, confusion)
- Signs of cardiac failure (tachypnoea, raised JVP, gallop rhythm, basal crackles, enlarged liver)

### Investigations

#### Urine

- Urine dipstick (usually >3 plus blood with proteinuria)
- check early morning urine protein creatinine ratio (UP/Cr)
- Urine microscopy (haematuria, red cell and granular casts)

#### Biochemistry

- U&E, Ca, phosphate, LFTs, blood gas
- low sodium is likely to be dilutional, albumin usually normal/low normal

#### Haematology

- FBC (low Hb usually dilutional)
- Blood film if HUS suspected
- Coagulation screen

#### Microbiology

- Antistreptolysin O Titres (ASOT) and Anti-DNAase B
- Throat swab for Group A streptococcus

#### Immunology

- First line: C3, C4, anti-nuclear antibodies (ANA) and IgA
- Second line: dsDNA, ANCA, ENA, anti-GBM (discuss with nephrologist)

#### Imaging

- Renal ultrasound scan

### Differential diagnosis

- Sequelae of other bacterial/viral infections
- Chronic renal failure with acute exacerbation
- IgA nephritis, Henoch-Schönlein purpura (HSP)
- IgA nephropathy
- Mesangiocapillary glomerulonephritis
- Alport hereditary nephritis
- ANCA positive vasculitis
- Anti GBM disease
- SLE

# GLOMERULONEPHRITIS • 2/3

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## IMMEDIATE TREATMENT

- Admit
- Strict fluid balance monitoring and management
- see **Acute kidney injury** guideline
- Treatment of volume overload/hypertension
- furosemide
- see **Hypertension** guideline
- severe cases of fluid overload will require dialysis
- Treatment of abnormal chemistry consequent to renal failure
- see **Acute kidney injury** guideline
- Oral antibiotics: phenoxymethyl penicillin if tolerated/able to take tablets or amoxicillin suspension for 10 days. (If penicillin allergy azithromycin for 5 days) for post streptococcal glomerulonephritis (PSGN)
- Nutrition: encourage high carbohydrate intake

## DISCHARGE FROM HOSPITAL

- BP under good control
- Passing urine normally on free fluids
- Renal function improving
- Normal serum potassium

## SUBSEQUENT MANAGEMENT

### Follow-up/progress for PSGN

- Gross haematuria, oliguria and abnormal chemistry usually resolves by 2–3 weeks
- BP usually normal by 3–4 weeks
- Serum C3 usually normal by 8–10 weeks
- Proteinuria resolves by 6 months
- Microscopic haematuria usually resolves by 12 months

### Indications for tertiary referral

- Significant proteinuria (UPCR >200 mg/mmol)
- Family history of glomerular disease
- Microscopic haematuria >2 years
- Macroscopic haematuria >2 weeks
- Persistent proteinuria (UPCR >50 mg/mmol) >6 weeks
- Oliguria/acute kidney injury (AKI)
- Hypertension
- Low C3 for >8 weeks
- Positive ANA, dsDNA, anti-GBM or ANCA
- Recurrent nephritis

### Complement abnormalities at presentation in nephritis

#### **Normal C3 and C4**

- IgA nephropathy
- Henoch-Schönlein purpura
- ANCA positive GN

#### **Low C3, normal C4**

- Acute post streptococcal glomerulonephritis
- Mesangioproliferative glomerulonephritis

#### **Low C3, low C4**

- Systemic lupus erythematosus
- Mesangioproliferative glomerulonephritis
- Shunt nephritis
- Infective endocarditis

## **GLOMERULONEPHRITIS • 3/3**

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### **DISCHARGE FROM FOLLOW-UP**

- Normal BP (when not receiving antihypertensive treatment)
- Normal renal function
- Normal urinalysis

# HAEMOLYTIC URAEMIC SYNDROME • 1/2

## RECOGNITION AND ASSESSMENT

### Definition

- Triad of features
- microangiopathic haemolytic anaemia
- thrombocytopenia
- acute kidney injury (AKI)

### Symptoms and signs

- Diarrhoea with blood and mucus (rarely HUS can occur in absence of diarrhoea), rectal prolapse
- dehydration if diarrhoea has been severe, see **Diarrhoea and vomiting** guideline
- check BP: hypotension
- Vomiting
- Abdominal pain
- Pallor, lethargy
- Reduced urine output/facial puffiness
- Tachycardia
- Reduced consciousness: consider cerebral oedema, intracranial thrombosis/haemorrhage
- Convulsions: consider hyponatraemia, cerebral oedema, intracranial thrombosis/haemorrhage
- Paralysis: consider intracranial thrombosis/haemorrhage
- Over-hydration
  - oedema (periorbital/pedal) variable
  - weight gain, observe trend
  - raised jugular venous pressure (JVP) indicates volume overload
  - oliguria (urine output <1 mL/kg/hr)
  - tachypnoea
  - liver enlargement
- Non renal complications:
  - toxic megacolon
  - perforation
  - intussusception
  - rectal prolapse
  - cardiomyopathy
  - diabetes mellitus
  - intracranial thrombosis, haemorrhage, oedema

### Investigations

- FBC and blood film (look for fragmented red cells)
- low Hb and platelets
- Clotting studies (normally activated – should not be DIC picture)
- U&E, creatinine, LDH (to confirm haemolysis)
- Bicarbonate
- Calcium, phosphate, uric acid
- Glucose, amylase
- Liver function tests
- Serum *E. coli* O157 lipopolysaccharides (LPS) antibodies
- Urine stick test for significant blood and protein (indicating glomerular damage) and leucocytes
- Stool culture for *E. coli* (and typing for O157 strain)

## IMMEDIATE TREATMENT

- Admit, discuss with regional paediatric nephrology team in all cases
- Strict fluid balance monitoring and management, electrolyte abnormalities
  - see Acute kidney injury guideline
- Dehydration
  - if signs of hypovolaemic shock give circulatory support (sodium chloride 0.9% 20 mL/kg IV immediately)
  - correct dehydration, see **Diarrhoea and vomiting** guideline
- Over-hydration
  - if signs of overload/cardiac failure, furosemide IV 2–4 mg/kg over 1 hr (max rate 4 mg/min), repeated 6-hrly if response obtained

# HAEMOLYTIC URAEMIC SYNDROME • 2/2

- if furosemide ineffective, discuss dialysis with regional paediatric renal centre
- Hypertension – see **Hypertension** guideline
- Anaemia
- daily FBC: only transfuse after discussion with regional paediatric nephrology team as may require dialysis. If asymptomatic, Hb can drop as low as 60 g/L
- Thrombocytopenia
- do not transfuse platelets unless there are life threatening bleeds/instrumentation required
- AVOID antibiotics, anti-diarrhoeal treatment, NSAIDs, and other nephrotoxic medication
- Observe for non-renal complications e.g. encephalopathy and seizures, cardiomyopathy, diabetes mellitus 1
- Consider protein and sodium restriction

## DISCHARGE FROM HOSPITAL

- Patient may be discharged when:
- diarrhoea/abdominal pain resolved
- Hb stable (haemolysis ceased)
- drinking fluids freely and passing normal amounts of urine
- urea and electrolytes improving with normal serum potassium
- Prescribe folic acid 2.5 or 5 mg daily until Hb normal

## SUBSEQUENT MANAGEMENT

### Tertiary referral

- If significant renal impairment (oligo/anuria, rising creatinine, severe acidosis, hyperkalaemia or complications) dialysis required (see **Acute kidney injury** guideline), refer to regional paediatric renal centre
- Refer urgently if non-diarrhoeal HUS

### Follow-up

- Weekly until renal function normal
- if impaired renal function or proteinuria persists, arrange paediatric renal follow-up
- Once renal function normal, arrange GP or general paediatric follow-up every year to check BP and early morning urine (protein:creatinine ratio) with a detailed renal specialist review every 5 yrs for formal GFR
- Advise that women with history of haemolytic uraemic syndrome require close monitoring during pregnancy
- Advise about avoiding smoking and obesity

## DISCHARGE FROM FOLLOW-UP

- Renal function normal
- No proteinuria
- Renal growth and function satisfactory at 5-yrly review for 15 yr

# HYPERTENSION • 1/6

## RECOGNITION AND ASSESSMENT

Diagnosis is difficult because symptoms can be minimal and often go unrecognised

- Severe hypertension can cause:
  - loss of consciousness
  - convulsion
  - hemiplegia
  - facial palsy

### Definition

- Depends on age, sex and height of child
- Measure on at least 3 separate occasions with auscultatory method
- Normal: systolic and diastolic BP <90<sup>th</sup> centile for age, sex and height
- High normal: systolic and diastolic BP between 90<sup>th</sup> and 95<sup>th</sup> centile for age, sex and height (>120/80 even if below 90<sup>th</sup> centile in adolescents)
- Stage 1 hypertension: 95<sup>th</sup>–99<sup>th</sup> centile **plus** 5 mmHg
- Stage 2 hypertension: >99<sup>th</sup> centile **plus** 5 mmHg **and** symptoms

### Symptoms and signs

#### **Hypertension**

Listed in order of frequency with common presenting features first:

- Infants
  - congestive cardiac failure
  - respiratory distress
  - failure to thrive, vomiting
  - irritability
  - convulsions
- Older children
  - headaches
  - nausea, vomiting
  - hypertensive encephalopathy (see below)
  - polydipsia, polyuria
  - visual problems
  - tiredness, irritability
  - cardiac failure
  - facial palsy
  - hemiplegia
  - epistaxis
  - poor growth, weight loss
  - cardiac murmur
  - abdominal pain

#### **Hypertensive encephalopathy (accelerated hypertension)**

- Any neurological sign associated with grossly elevated blood pressure, most commonly:
  - severe generalised headache
  - visual disturbance (+/- retinal changes)/blindness
  - seizure
  - posterior reversible encephalopathy syndrome (PRES)

***Do not delay initiation of treatment pending investigations once diagnosis has been made***

### History

- Family history of hypertension, diabetes, cardiovascular and cerebrovascular disease, obesity, hereditary renal and endocrine disease
- Past history of renal, cardiac, endocrine or neurological problems
- Presenting complaints as listed above
- Drug intake such as corticosteroids, ciclosporin, tacrolimus, methylphenidate, antidepressants

### Examination

- Detailed clinical examination of all systems
- **Do not** forget fundoscopy

# HYPERTENSION • 2/6

- Height and weight
- Skin for neurocutaneous stigmata
- Check for cardiovascular causes
  - femoral pulses
  - right arm and leg blood pressure
- Thyroid status
- Ambiguous genitalia
- Cushingoid
- Abdominal bruit

## Investigations

- Check for evidence of renal disease
  - serum creatinine, urea and electrolytes, calcium, chloride, TCO<sub>2</sub>
  - urinalysis for blood and protein
  - if urine dipstick positive for protein send early morning urine for protein:creatinine ratio
  - renal ultrasound scan
  - plasma renin and aldosterone concentration (after strict recumbancy for 1–2 hr)
  - DMSA scan may be required to exclude scarring
  - ECG for left ventricular hypertrophy (LVH)
  - echocardiogram
- Check for endocrine causes
  - fasting plasma glucose
  - 24 hr urinary free cortisol and/or discuss with endocrinologist for further investigations
  - urine metadrenalines (performed at Manchester Children's Hospital)
  - lipid profile
- Check for malignant causes
  - urine catecholamines (contact biochemistry department for details of how to perform test)

## Differential diagnosis

- Incorrectly sized (too small) or placed BP cuff
- Transient hypertension secondary to pain, anxiety, distress

## IMMEDIATE TREATMENT

### Hypertensive encephalopathy (accelerated hypertension)

***Urgent treatment necessary but bring BP under control slowly***

Abrupt BP reduction can result in cerebral ischaemia with the risk of permanent neurological sequelae owing to failure of cerebral auto-regulation after sustained elevation of BP

- Excess BP = actual BP – acceptable BP (**Table 1** and **2**)
- 'acceptable BP' given by the 90<sup>th</sup> percentile according to height
- Reduce BP gradually. Aim to reduce 'excess BP' by 1/3 in first 8 hr, another 1/3 in next 12 hr, and final 1/3 in next 48 hr
- Mark target BP ranges on chart so nurses know when to ask a doctor to review
- Monitor perfusion: may need volume expansion in first 12 hr if rapid BP drop
- Discuss choice of drug treatment with **consultant**
- Options comprise in following order: (**Table 3**)
  - **labetalol** infusion
    - starting dose 0.5–1 mg/kg/hr
    - increase by 1 mg/kg/hr every 15–30 min until effective
    - maximum dose 3 mg/kg/hr (max 120 mg/hr)
    - stop infusion when effective
    - restart as BP starts to rise again
    - normally lasts 4–6 hr
  - **sodium nitroprusside** infusion
    - give in high dependency or intensive care unit as close BP monitoring (intra arterial) required
    - starting dose 500 nanogram/kg/min
    - increase in increments of 200 nanogram/kg/min
    - maximum 8 microgram/kg/min for first 24 hr, reducing to 4 microgram/kg/min thereafter

# HYPERTENSION • 3/6

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- only effective whilst infused as short half-life
- stop infusion slowly over 15–30 min to avoid any rebound effects
- **hydralazine** infusion (or bolus as alternative)
- **nifedipine** oral (not 1st line for encephalopathy)
  - 200–300 microgram/kg 8-hrly
  - avoid quick acting, use modified release to prevent large drop in BP
  - can be crushed but may have more rapid onset
  - may be used to clip peaks of BP
  - dose varies with product: check with pharmacy

## SUBSEQUENT MANAGEMENT

### Essential hypertension

- High normal BP
- non pharmacological measures such as weight loss, dietary modification (low salt diet), exercise
- medication (**Table 3**) only if compelling indications such as if symptomatic, diabetes mellitus, heart failure, left ventricular hypertrophy
- Stage 1 hypertension
  - non pharmacological measures
  - give medications (**Table 3**) if symptomatic, presence of end organ damage, diabetes, persistent hypertension despite non pharmacological measures
- Stage 2 hypertension
  - non pharmacological measures
  - start medications (**Table 3**)
  - add drug therapy only after discussion with a consultant

### Renal hypertension

- In children with impaired renal function, keep BP within same target range as for children with normal renal function



# HYPERTENSION • 4/6

## OUT-PATIENT MANAGEMENT

Table 1: Blood pressure (BP) for boys by age and height percentiles

Age (years)	BP percentile	Systolic (mmHg) percentile of height							Diastolic (mmHg) percentile of height						
		5 <sup>th</sup>	10 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	90 <sup>th</sup>	95 <sup>th</sup>	5 <sup>th</sup>	10 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	90 <sup>th</sup>	95 <sup>th</sup>
1	90 <sup>th</sup>	94	95	97	99	100	102	103	49	50	51	52	53	53	54
	95 <sup>th</sup>	98	99	101	103	104	106	106	54	54	55	56	57	58	58
	99 <sup>th</sup>	105	106	108	110	112	113	114	61	62	63	64	65	66	66
2	90 <sup>th</sup>	97	99	100	102	104	105	106	54	55	56	57	58	58	59
	95 <sup>th</sup>	101	102	104	106	108	109	110	59	59	60	61	62	63	63
	99 <sup>th</sup>	109	110	111	113	115	117	117	66	67	68	69	70	71	71
3	90 <sup>th</sup>	100	101	103	105	107	108	109	59	59	60	61	62	63	63
	95 <sup>th</sup>	104	105	107	109	110	112	113	63	63	64	65	66	67	67
	99 <sup>th</sup>	111	112	114	116	118	119	120	71	71	72	73	74	75	75
4	90 <sup>th</sup>	102	103	105	107	109	110	111	62	63	64	65	66	66	67
	95 <sup>th</sup>	106	107	109	111	112	114	115	66	67	68	69	70	71	71
	99 <sup>th</sup>	113	114	116	118	120	121	122	74	75	76	77	78	78	79
5	90 <sup>th</sup>	104	105	106	108	110	111	112	65	66	67	68	69	69	70
	95 <sup>th</sup>	108	109	110	112	114	115	116	69	70	71	72	73	74	74
	99 <sup>th</sup>	115	116	118	120	121	123	123	77	78	79	80	81	81	82
6	90 <sup>th</sup>	105	106	108	110	111	113	113	68	68	69	70	71	72	72
	95 <sup>th</sup>	109	110	112	114	115	117	117	72	72	73	74	75	76	76
	99 <sup>th</sup>	116	117	119	121	123	124	125	80	80	81	82	83	84	84
7	90 <sup>th</sup>	106	107	109	111	113	114	115	70	70	71	72	73	74	74
	95 <sup>th</sup>	110	111	113	115	117	118	119	74	74	75	76	77	78	78
	99 <sup>th</sup>	117	118	120	122	124	125	126	82	82	83	84	85	86	86
8	90 <sup>th</sup>	107	109	110	112	114	115	116	71	72	72	73	74	75	76
	95 <sup>th</sup>	111	112	114	116	118	119	120	75	76	77	78	79	79	80
	99 <sup>th</sup>	119	120	122	123	125	127	127	83	84	85	86	87	87	88
9	90 <sup>th</sup>	109	110	112	114	115	117	118	72	73	74	75	76	76	77
	95 <sup>th</sup>	113	114	116	118	119	121	121	76	77	78	79	80	81	81
	99 <sup>th</sup>	120	121	123	125	127	128	129	84	85	86	87	88	88	89
10	90 <sup>th</sup>	111	112	114	115	117	119	119	73	73	74	75	76	77	78
	95 <sup>th</sup>	115	116	117	119	121	122	123	77	78	79	80	81	81	82
	99 <sup>th</sup>	122	123	125	127	128	130	130	85	86	86	88	88	89	90
11	90 <sup>th</sup>	113	114	115	117	119	120	121	74	74	75	76	77	78	78
	95 <sup>th</sup>	117	118	119	121	123	124	125	78	78	79	80	81	82	82
	99 <sup>th</sup>	124	125	127	129	130	132	132	86	86	87	88	89	90	90
12	90 <sup>th</sup>	115	116	118	120	121	123	123	74	75	75	76	77	78	79
	95 <sup>th</sup>	119	120	122	123	125	127	127	78	79	80	81	82	82	83
	99 <sup>th</sup>	126	127	129	131	133	134	135	86	87	88	89	90	90	91
13	90 <sup>th</sup>	117	118	120	122	124	125	126	75	75	76	77	78	79	79
	95 <sup>th</sup>	121	122	124	126	128	129	130	79	79	80	81	82	83	83
	99 <sup>th</sup>	128	130	131	133	135	136	137	87	87	88	89	90	94	94
14	90 <sup>th</sup>	120	121	123	125	126	128	128	75	76	77	78	79	79	80
	95 <sup>th</sup>	124	125	127	128	130	132	132	80	80	81	82	83	84	84
	99 <sup>th</sup>	131	132	134	136	138	139	140	87	88	89	90	91	95	92
15	90 <sup>th</sup>	122	124	125	127	129	130	131	76	77	78	79	80	80	81
	95 <sup>th</sup>	126	127	129	131	133	134	135	81	81	82	83	84	85	85
	99 <sup>th</sup>	134	135	136	138	140	142	142	88	89	90	91	92	93	93
16	90 <sup>th</sup>	125	126	128	130	131	133	134	78	78	79	80	81	85	82
	95 <sup>th</sup>	129	130	132	134	135	137	137	82	83	83	84	85	86	87
	99 <sup>th</sup>	136	137	139	141	143	144	145	90	90	91	92	93	94	94
17	90 <sup>th</sup>	127	128	130	132	134	135	136	80	80	81	82	83	84	84
	95 <sup>th</sup>	131	132	134	136	138	139	140	84	85	86	87	87	88	89
	99 <sup>th</sup>	139	140	141	143	145	146	147	92	93	93	94	95	96	97

# HYPERTENSION • 5/6

Table 2: Blood pressure (BP) for girls by age and height percentiles

Age (years)	BP percentile	Systolic (mmHg) percentile of height							Diastolic (mmHg) percentile of height						
		5 <sup>th</sup>	10 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	90 <sup>th</sup>	95 <sup>th</sup>	5 <sup>th</sup>	10 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	90 <sup>th</sup>	95 <sup>th</sup>
1	90 <sup>th</sup>	97	97	98	100	101	102	103	52	53	53	54	55	55	56
	95 <sup>th</sup>	100	101	102	104	105	106	107	56	57	57	58	59	59	60
	99 <sup>th</sup>	108	108	109	111	112	113	114	64	64	65	65	66	67	67
2	90 <sup>th</sup>	98	99	100	101	103	104	105	57	58	58	59	60	61	61
	95 <sup>th</sup>	102	103	104	105	107	108	109	61	62	62	63	64	65	65
	99 <sup>th</sup>	109	110	111	112	114	115	116	69	69	70	70	71	72	72
3	90 <sup>th</sup>	100	100	105	103	104	106	106	61	62	62	63	64	64	65
	95 <sup>th</sup>	104	104	105	107	108	109	110	65	66	66	67	68	68	69
	99 <sup>th</sup>	111	111	113	114	115	116	117	73	73	74	74	75	76	76
4	90 <sup>th</sup>	101	102	103	104	106	107	108	64	64	65	66	67	67	68
	95 <sup>th</sup>	105	106	107	108	110	111	112	68	68	69	70	71	71	72
	99 <sup>th</sup>	112	113	114	115	117	118	119	76	76	76	77	78	79	79
5	90 <sup>th</sup>	103	103	105	106	107	109	109	66	67	67	68	69	69	70
	95 <sup>th</sup>	107	107	108	110	111	112	113	70	71	71	72	73	73	74
	99 <sup>th</sup>	114	114	116	117	118	120	120	78	78	79	79	80	81	81
6	90 <sup>th</sup>	108	105	106	108	109	110	111	68	68	69	70	70	71	72
	95 <sup>th</sup>	104	109	110	111	113	114	115	72	72	73	74	74	75	76
	99 <sup>th</sup>	115	116	117	119	120	121	122	80	80	80	81	82	83	83
7	90 <sup>th</sup>	106	107	108	109	111	112	113	69	70	70	71	72	72	73
	95 <sup>th</sup>	110	111	119	113	115	116	116	73	74	74	75	76	76	77
	99 <sup>th</sup>	117	118	119	120	122	123	124	81	81	82	82	83	84	84
8	90 <sup>th</sup>	108	109	110	111	113	114	114	71	71	71	72	73	74	74
	95 <sup>th</sup>	112	112	114	115	116	118	118	75	75	75	76	77	78	78
	99 <sup>th</sup>	119	120	121	122	123	125	125	82	82	83	83	84	85	86
9	90 <sup>th</sup>	110	110	112	113	114	116	116	72	72	72	73	74	75	75
	95 <sup>th</sup>	114	114	115	117	118	119	120	76	76	76	77	78	79	79
	99 <sup>th</sup>	121	121	123	124	125	127	127	83	83	84	84	85	86	87
10	90 <sup>th</sup>	112	112	114	115	116	118	118	73	73	73	74	75	76	76
	95 <sup>th</sup>	116	116	117	119	120	121	122	77	77	77	78	79	80	80
	99 <sup>th</sup>	123	123	125	126	127	129	129	84	84	85	86	86	87	88
11	90 <sup>th</sup>	114	114	116	117	118	119	120	74	74	74	75	76	77	77
	95 <sup>th</sup>	118	118	119	121	122	123	124	78	78	78	79	80	81	81
	99 <sup>th</sup>	125	125	126	128	129	130	131	85	85	86	87	87	88	89
12	90 <sup>th</sup>	116	116	117	119	120	121	122	75	75	75	76	77	78	78
	95 <sup>th</sup>	119	120	121	123	124	125	126	79	79	79	80	81	82	82
	99 <sup>th</sup>	127	127	128	130	131	132	133	86	86	87	88	88	89	90
13	90 <sup>th</sup>	117	118	119	121	122	123	124	76	76	76	77	78	79	79
	95 <sup>th</sup>	121	122	123	124	126	127	128	80	80	80	81	82	83	83
	99 <sup>th</sup>	128	129	130	132	133	134	135	87	87	88	89	89	90	91
14	90 <sup>th</sup>	119	120	121	122	124	125	125	77	77	77	78	79	80	80
	95 <sup>th</sup>	123	123	125	126	127	129	129	81	81	81	82	83	84	84
	99 <sup>th</sup>	130	131	132	133	135	136	136	88	88	89	90	90	91	92
15	90 <sup>th</sup>	120	121	122	123	125	126	127	78	78	78	79	80	81	81
	95 <sup>th</sup>	124	125	126	127	129	130	131	82	82	82	83	84	82	85
	99 <sup>th</sup>	131	132	133	134	136	137	138	89	89	90	91	91	92	93
16	90 <sup>th</sup>	121	122	123	124	126	127	128	78	78	79	80	81	81	82
	95 <sup>th</sup>	125	126	127	128	130	131	132	82	82	83	84	85	85	86
	99 <sup>th</sup>	132	133	134	135	137	138	139	90	90	90	91	92	93	93
17	90 <sup>th</sup>	122	122	123	125	126	127	128	78	79	79	80	81	81	82
	95 <sup>th</sup>	125	126	127	129	130	131	132	82	83	83	84	85	85	86
	99 <sup>th</sup>	133	133	134	136	137	138	139	90	90	91	91	92	93	93

# HYPERTENSION • 6/6

**Table 3: Drugs commonly used for management of hypertension in children**

<b>Drug</b>	<b>Mechanism of action</b>	<b>Advice</b>
Atenolol	Beta-adrenoceptor blocker	<ul style="list-style-type: none"> <li>• Reduces heart contractility – contraindicated in early stages of hypertensive heart failure</li> <li>• Avoid in confirmed asthmatics</li> </ul>
Labetalol	Non-cardioselective beta-blocker with additional alpha-blocking properties	<ul style="list-style-type: none"> <li>• Combining alpha- and beta-blockade reduces tachycardia that can be a problem without beta-blockade</li> <li>• Contraindicated in asthmatics and in heart failure</li> <li>• Injection can be given orally</li> </ul>
Nifedipine	Calcium channel blocker	<ul style="list-style-type: none"> <li>• Can be used in heart failure as any negative inotropic effect offset by a reduction in left ventricular work</li> <li>• Side-effects vasodilatation: flushing and headache, ankle swelling</li> </ul>
Amlodipine	Calcium channel blocker	<ul style="list-style-type: none"> <li>• Does not reduce myocardial contractility or produce clinical deterioration in heart failure</li> <li>• Side-effects vasodilatation: flushing and headache, ankle swelling</li> </ul>
Enalapril	Angiotensin-converting enzyme (ACE) inhibitor	<ul style="list-style-type: none"> <li>• Recommended in children with renal hypertension. First dose should be given at night to prevent transient hypotension</li> <li>• In children with impaired renal function, check serum creatinine and potassium 2–3 days after starting treatment and consider withdrawal if they have risen</li> <li>• Contraindicated in bilateral renal artery stenosis</li> <li>• Tablets can be crushed and dispersed in water</li> </ul>
Losartan	Angiotensin II receptor blocker	<ul style="list-style-type: none"> <li>• In children with impaired renal function, check serum creatinine and potassium 2–3 days after starting treatment and consider withdrawal if they have risen</li> <li>• Contraindicated in bilateral renal artery stenosis</li> </ul>
Sodium nitro-prusside	Vasodilator	<ul style="list-style-type: none"> <li>• Use for hypertensive emergencies</li> <li>• Avoid in hepatic or renal impairment</li> <li>• Monitor blood cyanide if used &gt;3 days</li> <li>• Symptoms of cyanide poisoning (sweating, tachycardia hyperventilation) see Toxbase</li> </ul>

# NEPHROTIC SYNDROME • 1/4

## RECOGNITION AND ASSESSMENT

### Definition

- Oedema
- Hypoalbuminaemia: plasma albumin <25 g/L
- Heavy proteinuria, defined as:
  - dipstick 3+ or more, or
  - urinary protein >40 mg/m<sup>2</sup>/hr, or
  - early morning protein:creatinine ratio >200 mg/mmol
- Hypercholesterolaemia

### Symptoms and signs

#### Oedema

- Peri-orbital, pedal, sacral, scrotal
- Also ascites or pleural effusion

#### Cardiovascular

#### Can be difficult to assess due to oedema

Assess for hypovolaemia carefully

- Child with diarrhoea and vomiting and looks unwell
- Abdominal pain: strongly suggestive
- Poor peripheral perfusion and capillary refill >2 sec
- Pulse character: thready, low volume, difficult to palpate
- Tachycardia or upward trend in pulse rate
- Hypertension may be an early sign, hypotension a late sign
- Jugular venous pressure (JVP) low

***Muffled heart sounds suggest pericardial effusion***

#### Respiratory

- Tachypnoea and recession: suggest pleural effusion

#### Abdomen

- Swelling and shifting dullness: suggest ascites
- Tenderness with fever, umbilical flare: suggest peritonitis
- Scrotal oedema: stretching can cause ulceration or infection

### Investigations

***Femoral blood sampling is contraindicated because of risk of thrombosis***

#### Urine

- Urinalysis
- Early morning urine protein:creatinine ratio first morning after admission
  - normal value <20 mg/mmol; nephrotic >200 mg/mmol, usually >600 mg/mmol
  - low urine sodium (<10 mmol) suggests hypovolaemia

#### Baseline bloods

- U&E and creatinine
- Albumin
- FBC
- Immunoglobulins G, A and M
- Complement C3 and C4
- Zoster immune status: as a baseline
- Hepatitis B and C serology

#### Second-line tests

Request only if features suggestive of more aggressive nephritis (hypertension, macroscopic haematuria, high creatinine, no response to corticosteroids)

- Anti-streptolysin O titre and anti-DNase B

# NEPHROTIC SYNDROME • 2/4

- Antinuclear antibodies
- Anti-ds DNA antibodies

## Interpretation

- High haematocrit suggests hypovolaemia
- Raised creatinine or urea suggests hypovolaemia, tubular plugging or other nephritis
- Serum cholesterol and triglycerides: often elevated
- IgG usually low
- C3 normal

## Differential diagnosis

- Minimal change disease (95%)
- Focal segmental glomerular sclerosis (FSGS)
- Multisystem disorders (e.g. HSP, diabetes mellitus, SLE,)
- Congenital nephrotic syndrome very rare and seen in under 2's

## IMMEDIATE TREATMENT

### General

- Admit
- Strict fluid balance monitoring
- daily weight: **mandatory**
- Avoid added salt, but a low salt diet not indicated
- Manage hypovolaemia – see **Complications**
- seek **senior advice before volume resuscitation**, as risk of volume overload

### Fluid restriction

- Restrict to insensible losses e.g. 300 mL/m<sup>2</sup> plus urine output
- If not tolerated, aim for:
  - 600 mL/day in children aged <5 yr
  - 800 mL/day in children aged 5–10 yr
  - 1000 mL/day in children aged >10 yr

### Medication

- Prednisolone 60 mg/m<sup>2</sup> oral once daily (maximum 80 mg), in the morning (see **BNFc** for surface area)
- Phenoxyethylpenicillin (penicillin V) for pneumococcal prophylaxis (**presentation only**)
- If oedema upsetting to patient or causing discomfort, add furosemide 1–2 mg/kg oral or 1 mg/kg IV
  - may intensify hypovolaemia, in which case use 20% albumin: discuss with **consultant or specialist centre**
- If disease severe, especially with hypovolaemia, as judged by poor perfusion, high haemoglobin, thrombophilia, or abdominal pain, treat with
  - dipyridamole to reduce risk of thrombotic complications. Discuss need for heparin/warfarin with specialist
- Give omeprazole for gastro protection whilst on high dose steroids

## COMPLICATIONS

### Hypovolaemia

- Abdominal pain, looks unwell, tachycardia, poor perfusion, high Hb
- Seek **senior advice before volume resuscitation**, as a risk of volume overload
- give sodium chloride 0.9% 10 mL/kg or human albumin **4.5%** (if available)

**Do not confuse 4.5% albumin with 20% as the latter is hyperosmolar and can easily cause fluid overload**

- Start dipyridamole
- More common in corticosteroid-resistant disease
- Looks unwell, abdominal pain and vomiting
- Low JVP, rising urea and creatinine, and poor response to diuretics
- Treatment: check with consultant first
- salt-poor hyperosmolar albumin **20%** 0.5–1 g/kg (2.5–5 mL/kg) over 2–4 hr with furosemide 1–2 mg/kg IV midway through infusion over 5–10 min (maximum 4 mg/min)

# NEPHROTIC SYNDROME • 3/4

- regular observations for signs of circulatory overload (e.g. raised JVP, tachycardia, gallop rhythm, breathlessness, low SaO<sub>2</sub>)
- often required daily: liaise with a specialist centre
- Start dipyridamole

## Peritonitis

- Difficult to recognise
- steroids may mask signs, including fever, or cause leucocytosis
- Abdominal pain
- consider hypovolaemia and appendicitis: request an early surgical opinion
- Obtain blood culture and peritoneal fluid (for gram stain and culture) if possible, then start piperacillin with tazobactam (Tazocin<sup>®</sup>) IV pending culture results
- if penicillin allergic discuss with microbiologist or consultant in infectious diseases

## Cellulitis

- Commonly caused by haemolytic streptococci and pneumococci – treat promptly

## Thrombosis

- Renal vein: an important differential in abdominal pain
- Cerebral vasculature
- Pulmonary vein
- Femoral vein: femoral blood sampling contraindicated
- A fall in platelets, rise in D-Dimers and reduced PTT are suggestive
- USS with Doppler study to look at perfusion and to image renal vein and IVC can be helpful
- If in any doubt, seek advice from nephrologist regarding investigation/management

## DISCHARGE POLICY AND SUBSEQUENT MANAGEMENT

- Discharge once in remission
- defined as trace/negative urine protein for 3 days
- patients with normal BP and stable weight who are well may be allowed home on ward leave with **consultant approval**. Normally twice weekly review will be required until in remission
- Arrange plan of care with patient and carers – see **below**
- Out-patient review in 4 weeks

## New patients

- Prednisolone 60 mg/m<sup>2</sup> (maximum 80 mg) once daily for 4 weeks
- Then 40 mg/m<sup>2</sup> (maximum 40 mg) alternate days for 4 weeks
- gradually reduce dose aiming to stop after 3 weeks
- Response usually apparent in 7–10 days
- No response after 4 weeks daily steroid 60 mg/m<sup>2</sup> suggests corticosteroid resistance

## Relapsing patients

- Three consecutive days of 3+ or more early morning proteinuria, having previously been in remission = relapse
- Start prednisolone 60 mg/m<sup>2</sup> (maximum 80 mg) once daily
- continue until nil or trace proteinuria for 3 days
- then 40 mg/m<sup>2</sup> (maximum 40 mg) alternate days for a further 4 weeks, gradually reduce dose aiming to stop after 3 weeks
- If relapses frequent despite alternate-day prednisolone, discuss with a paediatric nephrologist

## Oral prednisolone

- While on prednisolone 60 mg/m<sup>2</sup> once daily advise to:
  - carry a corticosteroid card
  - seek prompt medical attention for illness, especially zoster contacts (if not zoster immune)

## Other management

- Urine testing
- teach technique and provide appropriate dipsticks
- test only first daily urine sample

# NEPHROTIC SYNDROME • 4/4

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- keep a daily proteinuria diary and bring to **every** clinic attendance
- Corticosteroid diary with instructions regarding corticosteroid dosage

## **Infectious precautions**

- Avoid live immunisations for 3 months after completion of treatment with high-dose corticosteroids
- Benefit of inactivated vaccines can be impaired by high-dose corticosteroids and so a similar delay advisable where possible
- where not possible because of frequent relapse, give INACTIVATED vaccines after a shorter delay and check for an antibody response
- Continue phenoxymethylpenicillin (penicillin V) (**presentation only**) prophylaxis until oedema has resolved (if penicillin allergic give azithromycin)
- If zoster non-immune (VZV IgG negative) and on high-dose corticosteroids, give intramuscular zoster immunoglobulin:
  - after definite zoster contact, a contact will be infectious 2 days before onset of rash, and cease when all lesions are crusted over
  - can be given up to 10 days after exposure. Contact consultant microbiologist on duty (or local virology lab) for release of VZIG
  - at first sign of illness give aciclovir IV
  - varicella vaccine (live vaccine) available and should be given if a suitable opportunity arises between relapses
- Give pneumococcal vaccine if child has not received pneumococcal conjugate vaccine – see BNFC for schedule

## **Refer for specialist advice if:**

- Corticosteroid-resistant disease
  - non-responsive after 4 weeks of daily prednisolone, but start discussions with specialist centre in third week
- Corticosteroid-dependent disease
  - two consecutive relapses during corticosteroid treatment or within 14 days of cessation
- Significant corticosteroid toxicity
- Aged <1 yr or >12 yr at first presentation
- Mixed nephritic/nephrotic picture: macroscopic (not microscopic) haematuria, renal insufficiency or hypertension
- Low complement C3/C4
- ANA +ve

# RENAL CALCULI • 1/4

## RECOGNITION AND ASSESSMENT

### Definition

- Presence of crystalline material within urinary tract

### Symptoms and signs

- Non-specific recurrent abdominal pain
- Dysuria or painful micturition
- Classical renal colic
- Urinary infection (particularly *Proteus* spp)
- Persistent pyuria
- Macroscopic or microscopic haematuria
- Passage of gravel/stones
- Renal failure

### Initial investigations

- Renal ultrasound scan
- KUB AXR
- Urine microscopy, pH and culture

### Further investigations

- DMSA scan
  - to determine function when calculi multiple or large
- Repeat renal ultrasound scan
  - to see if stones have been passed
  - to monitor progress of stones
  - six weeks after treatment (see below)

## IMMEDIATE TREATMENT

- Analgesia for severe pain
- If obstruction is present, urgent referral to urology at renal specialist centre
- Cefalexin oral if symptomatic for urinary tract infection, adjusted once sensitivities available
- antibiotic treatment unlikely to eradicate organism in presence of stones

## OUTPATIENT MANAGEMENT

### Investigations in patients with proven renal calculi

- Blood sample for:
  - creatinine
  - calcium
  - phosphate
  - parathyroid hormone (if calcium raised)
  - uric acid
  - venous bicarbonate
  - pH (warm arterialised capillary sample to coincide with urine pH)
- Random mid-stream urine
  - microscopy, culture and sensitivity
- Early morning urine (first voided specimen) and 24 hr collection (request 'urinary stone screen' and record height and weight on request form) for:
  - calcium
  - oxalate
  - citrate
  - uric acid
  - cystine
  - creatinine
  - pH (to coincide with blood pH)
  - L-glyceric acid
- if 24 hr urine collection unsuccessful request:
  - calcium:creatinine ratio
  - oxalate:creatinine ratio



# RENAL CALCULI • 2/4

- urate:creatinine ratio

## Stone analysis

- May give useful information about aetiology, discuss with biochemistry department first
- If stone passage is frequent or associated with symptoms, ask parents to strain urine

**Table 1: Characteristics of urinary stones**

Type	Appearance	Causes	Radio-opaque*
Magnesium ammonium phosphate	Very soft, white, toothpaste consistency or gravel fragments	<ul style="list-style-type: none"> <li>• Infection with urea-splitting organisms, especially in children with urinary stasis</li> </ul>	No
Calcium oxalate	Hard grey-brown rough surface	<ul style="list-style-type: none"> <li>• Hypercalciuria (any cause)</li> <li>• Hyperoxaluria</li> </ul>	Yes
Calcium phosphate	Large, smooth, pale, friable	<ul style="list-style-type: none"> <li>• Infection</li> <li>• Renal tubular acidosis</li> <li>• Vitamin D toxicity</li> <li>• Idiopathic hypercalciuria</li> <li>• Immobilisation</li> <li>• Hyperparathyroidism</li> <li>• Sarcoidosis</li> </ul>	Yes
Cystine	Pale-yellow, crystalline Maple syrup	<ul style="list-style-type: none"> <li>• Cystinuria</li> </ul>	Yes
Uric acid	Hard, yellow	<ul style="list-style-type: none"> <li>• Lesch-Nyhan syndrome</li> <li>• Dietary</li> <li>• Induction in haematological malignancies</li> </ul>	No
Xanthine	Smooth, soft, brown yellow	<ul style="list-style-type: none"> <li>• Xanthinuria</li> </ul>	No
Dihydroxyadenine	Friable, grey-blue	<ul style="list-style-type: none"> <li>• Adenine phosphoribosyl transferase deficiency</li> </ul>	No

\* Radiolucency depends on amount of calcium in the stone and individual patient can have more than one type of stone, each with different radiolucencies

## Interpretation of results

- Urinary pH
  - pH <5.3 in presence of normal capillary pH and bicarbonate excludes distal renal tubular acidosis
  - when above criteria not met, a more formal test of renal acidification required in those with nephrocalcinosis or in recurrent stone formers
  - pH >6 with capillary bicarbonate <18 mmol/L is seen in mild distal tubular acidosis
- Calcium:creatinine (mmol/mmol) ratio consistently >0.2 indicates hypercalciuria
  - absorptive hypercalciuria – normal fasting calcium:creatinine ratio raised post-milk
  - renal hypercalciuria – calcium:creatinine ratio raised fasting and post-milk
- Oxalate:creatinine (mmol/mmol) ratio is age-dependent, and suggestive of hyperoxaluria if it exceeds following thresholds:
  - aged <6 months: 0.35
  - aged 6–11 months: 0.2
  - aged 1–2 yr: 0.18
  - aged 3–6 yr: 0.11
  - aged 7–14 yr: 0.08
  - aged >14 yr: 0.065
- Uric acid/creatinine (mmol/mmol) ratio is age-dependent, and suggestive of hyperuricaemia if it exceeds following thresholds:
  - aged <1 yr: 1.5
  - aged 1–2 yr: 1.26
  - aged 3–6 yr: 0.83
  - aged 7–10 yr: 0.67
  - aged 11–14 yr: 0.45
  - aged >14 yr: 0.4

## RENAL CALCULI • 3/4

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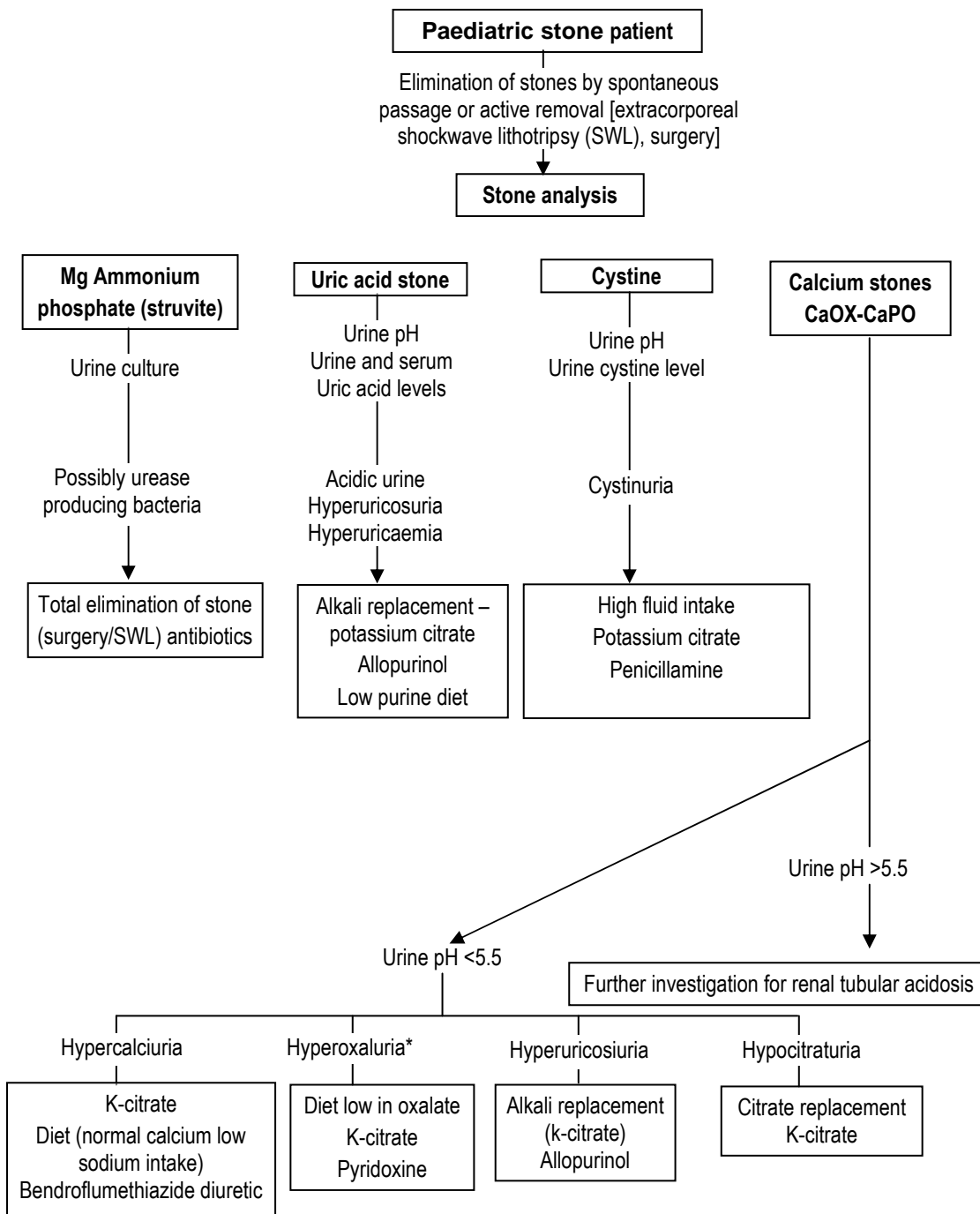
- Magnesium:creatinine ratio  $<0.2$  may increase stone formation
- Calcium:citrate ratio  $<0.6$  may increase stone formation
- Cystine, if present, is indicative of cystinuria
- Overall solubility index (RS value)
  - negative value: stable urine
  - value 0–1: metastable (liable to precipitate if seeded)
  - value  $>1$ : spontaneous precipitation

### TREATMENT

- Treat any metabolic disorder identified by above investigations, seek advice from regional nephrology service
- Keep urine free from infection, particularly in those with history of *Proteus mirabilis* infection by prompt treatment if symptomatic
- Advise liberal fluid intake
  - adolescent 3 L/day
  - pre-puberty (school age) 1.5 L/day
- Additional measures for recurrent stone formation or idiopathic hypercalciuria (in order):
  - dietary assessment to optimise oxalate, vitamin C, calcium, and vitamin D intake
  - reduced sodium intake in idiopathic hypercalciuria, if sodium excretion  $>3$  mmol/kg/day
  - high fibre diet with cellulose or whole wheat flour to reduce calcium and oxalate absorption
- For specific treatments – see algorithm below and discuss with renal team

# RENAL CALCULI • 4/4

## Algorithm for metabolic investigations



\*Hyperoxaluria patients should be referred to the regional renal centre

# ACUTE KIDNEY INJURY • 1/3

## RECOGNITION AND ASSESSMENT

### Definition

- Acute kidney injury: sudden deterioration in renal function associated with retention of nitrogenous waste and acute disturbance of water and electrolyte balance

### Presentation

- Poor/absent urine output (oliguria) with puffiness/oedema:
- <0.5 mL/kg/hr

### Differential diagnosis

#### *Pre-renal*

- Secondary to hypotension (e.g. hypovolaemia from gastroenteritis or septicaemia)
- Urine osmolality >300 mOsm/kg
- Urine:plasma urea ratio >5
- Urine sodium <20 mmol/L

#### *Renal*

- Haemolytic uraemic syndrome – see **Haemolytic uraemic syndrome** guideline
- Acute nephritis – see **Glomerulonephritis** guideline
- Acute tubular necrosis or renal vein thrombosis
- Unrecognised chronic renal failure (oliguria usually not a feature)
- Acute-on-chronic renal failure (e.g. dehydration or infection in a child with chronic kidney disease)

#### *Post-renal*

- Urinary tract obstruction (rare)

### Assessment

- Hydration (under/over)
- Weight (compare with previous if available)
- Skin (turgor/oedema)
- Ascites
- BP/capillary refill
- Jugular venous pressure (JVP), heart sounds
- Urine output

### Immediate investigations

- See separate **guidelines for specific causes**
- Blood
  - U&E, creatinine, calcium, phosphate
  - FBC and film if considering haemolytic uraemic syndrome
  - venous blood gas
- Urine
  - urinalysis for blood, protein, nitrites and leucocytes
- Renal ultrasound scan
  - size and appearance of kidneys, perfusion
  - swelling
  - evidence of obstruction

## IMMEDIATE TREATMENT

- Correct volume status and maintain fluid and electrolyte balance
- Prevent hyperkalaemia
- Treat underlying cause where appropriate
- Maintain adequate nutrition
- Review prescription to exclude nephrotoxic drugs/modify dose

# ACUTE KIDNEY INJURY • 2/3

## Fluid and sodium balance

### Initial correction

- Dehydration
  - for shock, give sodium chloride 0.9% 20 mL/kg immediately
  - for correction of dehydration – see **Diarrhoea and vomiting** guideline
- Volume overload/hypertension
  - low plasma sodium usually indicates fluid overload
  - furosemide 1 mg/kg IV immediately (max rate: 500 microgram/kg/min up to 4 mg/min): if no urine output after 30 min, give a further 1 mg/kg and if still no urine discuss with renal unit

### Metabolic acidosis

- Sodium bicarbonate may be required – discuss with on-call consultant

### Potassium

- Hyperkalaemia can lead to cardiac arrest or serious arrhythmias
- severely restrict potassium intake by introducing low potassium diet and avoiding potassium in IV fluids unless plasma potassium <3.5 mmol/L or there are ongoing losses
- If potassium >6.0 mmol/L, ECG monitoring essential, discuss with on-call consultant
- watch for development of prolonged P-R interval and/or peaked T wave
- as toxicity worsens, P wave is lost, QRS widens and S-T depression develops
- Once toxicity develops, the following (see **Table 1**) are holding measures whilst dialysis is set up
- give salbutamol IV or by nebuliser if no IV access as first-line emergency treatment, followed by oral/rectal calcium polystyrene sulphonate (even if salbutamol effective) to start to reduce potassium load
- if ECG still unstable, give calcium gluconate by slow IV injection
- if patient acidotic pH <7.30, give sodium bicarbonate
- if further reduction required after other measures implemented, use insulin and glucose
- After starting treatment discuss with on-call consultant

**Table 1: Emergency treatment of hyperkalaemia**

Treatment	Dose	Onset	Mode of action
Salbutamol nebuliser	2.5–5 mg	5 min. Lasts up to 2 hr; repeat as necessary	Shifts potassium into cells
Salbutamol infusion	4 microgram/kg over 5 min repeat as necessary. Limited by tachycardia	Immediate. Effect maximal at 60 min	Shifts potassium into cells
Calcium gluconate 10%	0.11 mmol/kg (0.5 mL/kg) IV [max 4.5 mmol (20 mL)] over 5–10 min. Monitor ECG Do NOT administer through same line as bicarbonate	1 min Repeat after 5 min if ECG changes persist	Antagonises effect of high potassium
Sodium bicarbonate 4.2% infusion (only if patient acidotic)	1 mmol/kg IV over 15 min (2 mL/kg of 4.2% diluted 1 in 5 with sodium chloride 0.9%) Do NOT administer through same line as calcium	1 hr Effect may last 2 hr	Shifts potassium into cells
Glucose/insulin infusion	Glucose 10% 0.5 g/kg/hr (5 mL/kg/hr) and when blood glucose >10 mmol/L infuse insulin 0.1 units/kg/hr (50 units insulin in 50 mL sodium chloride 0.9%). Stop glucose and insulin when K <sup>+</sup> falls by 0.5 mmol/L	15 min. Effect may last several hours Frequent glucose stick checks	Shifts potassium into cells
Furosemide	1 mg/kg IV over 5 min	May not be effective in chronic renal failure	Potassium excreted in urine

## ACUTE KIDNEY INJURY • 3/3

Polystyrene sulphonate resins	Calcium polystyrene sulphonate Oral 250 mg/kg 6-hrly (max 15 g/dose) Rectal 1 g/kg; can be repeated if potassium level life threatening, and while awaiting dialysis	Oral 2 hr Rectal 30 min (irrigate to remove residue before next dose)	Removes potassium from body
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- Hypokalaemia is also dangerous
- if patient becomes potassium depleted from heavy ongoing losses (fistula or diuretic phase), it is most important that replacement is given
- amount and rate of replacement depend on estimation of losses and response to initial supplementation. If in doubt, discuss with on-call consultant

### SUBSEQUENT MANAGEMENT

#### Fluid and sodium balance

- Once normal hydration restored, aim to replace insensible loss (300mL/m<sup>2</sup>/day) + urine output + other losses
- In anuric patients (as opposed to oliguric), give fluids that are free of electrolytes to compensate for insensible loss; in patients having IV fluids, glucose 5% is most appropriate initially, although glucose 4%/sodium chloride 0.45% may be required later to compensate for sodium loss from sweat
- Replace sodium losses in urine and in other fluids (diarrhoea, gastric aspirate, fistula)
- in most patients, dietary sodium will suffice
- in those with large fluid losses, consider IV sodium to match losses

#### Nutrition

- Involve a paediatric dietitian
- A low-protein high-energy diet is ideal. Optimise nutritional intake in accordance with blood results and renal function
- Avoid high potassium and phosphate foods
- Be realistic about what a child will take

#### Indications for discussion with renal unit

- Anuric patient
- Fluid overload unresponsive to diuretics
- Fluid overload with uncontrolled hypertension (for height-related 97<sup>th</sup> centiles – see **Hypertension** guideline)
- Potassium toxicity (as indicated by features listed previously)
- Metabolic acidosis (pH <7.2) unresponsive to base supplementation
- Convulsions (secondary to hypertension or hyponatraemia)
- Loss of general well being +/- alteration in conscious level – see **Glasgow coma score** guideline
- Blood product requirement
- AKI + multisystem disease
- Spontaneous resumption of renal function likely to be delayed
  - acute-on-chronic renal failure
  - haemolytic uraemic syndrome

### MONITORING TREATMENT

- Accurate fluid balance – maintain strict input-output chart
- Re-assess fluid intake at least 12-hrly
- Record weight twice daily
- Check K<sup>+</sup> hourly if >6 or <3 mmol/L
- Check U&E 12-hrly if K<sup>+</sup> 3–6 mmol/L in renal failure
- Respond promptly to increase in urine volume, fall in serum creatinine and increase in urine osmolality by increasing fluid intake
- Once diuresis begins, increase electrolyte replacement, including potassium
- once stable, reduce fluid intake gradually to avoid prolonged diuretic phase

# RENAL INVESTIGATIONS • 1/3

## PROTEIN EXCRETION

- As a diagnostic indicator in any child thought to have an underlying renal disorder
- To monitor progress in renal disorders
- Normally glomerular, rarely tubular in origin
- Investigate as below in patients with persistent proteinuria where cause is unknown
- Request protein:creatinine ratio (**must** be first urine specimen voided in the morning)

### Protein:creatinine ratio

- Performed on first urine specimen voided in the morning
- Request albumin:creatinine ratio if need to confirm glomerular proteinuria
- Upper limit of normal 20 mg/mmol
- Significant proteinuria >100 mg/mmol
- Heavy proteinuria (nephrotic) >200 mg/mmol

### Timed urine collection

- Only appropriate for older patients (out of nappies)
- Night-time collection to rule out orthostatic proteinuria
  - empty bladder at bedtime and discard sample
  - collect all urine passed during the night
  - empty bladder on rising in morning and collect urine
  - record time from bladder emptying at night to bladder emptying in morning
- Calculate protein output as mg/m<sup>2</sup>/hr (see BNFC for surface area)
- Upper limit of normal = 2.5 mg/m<sup>2</sup>/hr
- Heavy proteinuria >40 mg/m<sup>2</sup>/hr

### Tubular proteinuria

- Request retinol binding protein (RBP):creatinine ratio, elevation confirms tubular proteinuria

## OSMOLALITY

- Used to exclude urinary concentrating disorders
- patients with polyuria (may present as wetting or excessive drinking)
- Test early morning urine after overnight fast >870 mOsm/kg virtually excludes a concentrating defect
- if concern re diabetes insipidus, do water deprivation test during the day

## SODIUM EXCRETION

- Fractional sodium excretion (FE<sub>Na</sub>) assesses capacity to retain sodium
- ensure normal sodium intake (dietitian to advise)
- stop any existing supplements 6 hr before taking samples
- document weight loss after supplements stopped, may provide useful supporting evidence
- random urine sample for urinary sodium (U<sub>Na</sub>) and creatinine (U<sub>Cr</sub>)
- blood sample immediately after voiding for plasma sodium (P<sub>Na</sub>) and creatinine (P<sub>Cr</sub>)
- enter results into equation (using same units for U and P; 1000 micromol = 1 mmol)
- $$FE_{Na} = \frac{U_{Na} \cdot P_{Cr}}{P_{Na} \cdot U_{Cr}} \times 100$$
- normal values for FE<sub>Na</sub> aged 0–3 months <3  
aged >3 months <1

## PLASMA CREATININE

- Mean and upper limit dependent on height but can be determined roughly from child's age if height not available

## GLOMERULAR FILTRATION RATE (GFR)

- Serial measurements of glomerular filtration rate (in mL/min/1.73 m<sup>2</sup>) predict rate of deterioration when renal function impaired

# RENAL INVESTIGATIONS • 2/3

Table 2

Age	Mean GFR (mL/min/1.73 m <sup>2</sup> )	Range (2 SD)
Up to 1 month	48	28–68
1–6 months	77	41–103
6–12 months	103	49–157
1–2 yr	127	63–191
2–12 yr	127	89–165

## Plasma creatinine method

- Estimates GFR in children with reasonable accuracy from P<sub>Cr</sub> and height, using following formula:  
$$\text{GFR (mL/min/1.73 m}^2\text{)} = \frac{30 \times \text{height (cm)}}{\text{P}_{\text{Cr}} (\mu\text{mol/L})}$$

\*check local lab method of creatinine measurement as constant may vary

- Not suitable for children:
  - aged <3 yr
  - with muscle disease/wasting

## <sup>51</sup>Cr-EDTA slope clearance

- Use only when GFR needs to be determined very accurately
- Request via nuclear medicine
- Provide height and weight of child
- 'correct' result for surface area and express as per 1.73 m<sup>2</sup>
- if result expressed as mL/min 'correct' for surface area

## ULTRASOUND

### Indications

- To identify structural abnormalities of urinary tract

Table 3: Normal values for renal ultrasound measurement

Age	Length (mm)	Range (mm)
Up to 3 months	45	35–60
3–6 months	50	50–60
6–9 months	55	52–60
9–12 months	58	54–64
1–3 yr	65	54–72
3–6 yr	75	64–88
6–9 yr	80	73–86
9–12 yr	86	73–100

- Measurements of pelvicalyceal size at hilum of kidney (during 3<sup>rd</sup> trimester):
  - <9 mm: mild (do not need any intervention/follow-up)
  - 9–15 mm: moderate
  - >15 mm: severe

## ISOTOPE SCANS

### Dynamic imaging (MAG3)

#### Indications

- To assess obstruction in dilated system
- To assess drainage 6 months after pyeloplasty
- Indirect cystography in older children before and/or after surgical correction of reflux

#### Operational notes

- Request via nuclear medicine
- SHO or nurse required to insert venous cannula in young children
- Consider sedation if child has had previous problems lying still during examinations
- Maintain good hydration



# RENAL INVESTIGATIONS • 3/3

- When assessing obstruction in dilated system or outcome of pyeloplasty, give furosemide 0.5 mg/kg slow IV bolus over 3–10 min (max rate 4 mg/min) 15 min before giving isotope. Helps to differentiate genuine obstruction from isotope pooling, provided function of affected kidney not severely impaired
- Do not use furosemide for indirect cystography

## Static imaging ( $^{99m}\text{Tc}$ -DMSA)

### Indications

- To assess differential function between kidneys and within duplex kidneys
- To locate an ectopic kidney
- To identify renal scars after recovery from urine infection
- atypical UTI aged <3 yr or recurrent UTI any age

### Operational notes

- Request via nuclear medicine
- Scan kidney 2–6 hr after injection
- Sedation rarely required
- Delay DMSA for 4–6 months after infection to avoid false positive

## X-RAY IMAGING

### Micturating cystourethrogram (MCUG)

To assess bladder for vesicoureteric reflux, to view urethra

### Indications

- Atypical or recurrent UTI aged <6 months
- Recurrent or atypical UTI in children aged >6 months, but <3 yr if:
  - dilatation on ultrasound
  - poor urine flow
  - non-*E. coli* infection
  - family history of VUR

### Operational notes

- **Patients already taking prophylactic antibiotics:** double dose on day before, day of the test and day after
- **Patients not on antibiotics:** give treatment dose covering day before, day of the test and day after
- Urethral catheter will need to be passed in X-ray dept

# URINARY TRACT INFECTION • 1/4

## RECOGNITION AND ASSESSMENT

*Treat symptomatic urinary tract infection (UTI) in infants promptly to reduce risk of renal scarring*

### Symptoms and signs

Age group		Most common	Intermediate	Least common
Infants aged <3 months		<ul style="list-style-type: none"> <li>• Fever</li> <li>• Vomiting</li> <li>• Lethargy</li> <li>• Irritability</li> </ul>	<ul style="list-style-type: none"> <li>• Poor feeding</li> <li>• Failure to thrive</li> </ul>	<ul style="list-style-type: none"> <li>• Abdominal pain</li> <li>• Jaundice</li> <li>• Haematuria</li> <li>• Offensive urine</li> </ul>
Infants ≥3 months and children	Pre-verbal	<ul style="list-style-type: none"> <li>• Fever</li> </ul>	<ul style="list-style-type: none"> <li>• Abdominal pain</li> <li>• Loin tenderness</li> <li>• Vomiting</li> <li>• Poor feeding</li> </ul>	<ul style="list-style-type: none"> <li>• Lethargy</li> <li>• Irritability</li> <li>• Haematuria</li> <li>• Offensive urine</li> <li>• Failure to thrive</li> </ul>
	Verbal	<ul style="list-style-type: none"> <li>• Frequency</li> <li>• Dysuria</li> </ul>	<ul style="list-style-type: none"> <li>• Dysfunctional voiding</li> <li>• Changes to continence</li> <li>• Abdominal pain</li> <li>• Loin tenderness</li> </ul>	<ul style="list-style-type: none"> <li>• Fever</li> <li>• Malaise</li> <li>• Vomiting</li> <li>• Haematuria</li> <li>• Offensive urine</li> <li>• Cloudy urine</li> </ul>

### Risk factors for UTI and serious underlying pathology

- The following should always be recorded in suspected cases of UTI:
  - poor urine flow in males
  - history suggesting recurrent UTI
  - recurrent fever of uncertain origin
  - antenatally diagnosed renal or urinary tract abnormality
  - family history of vesico-ureteric reflux (VUR)
  - constipation
  - dysfunctional voiding (i.e. any of: frequency, urgency, urge incontinence)
  - enlarged bladder
  - abdominal mass
  - evidence of spinal lesion
  - poor growth
  - high blood pressure

### Investigations

- Dipstick test fresh urine for leukocytes and nitrites in:
  - all symptomatic children (see **Table** above)
  - all unexplained febrile admissions with temp >38°C
  - with an alternate site of infection but who remain unwell
- Culture urine if:
  - aged <3 yr
  - a single positive result for leukocyte esterase or nitrite
  - recurrent UTI
  - infection that does not respond to treatment within 24–48 hr
  - clinical symptoms and dipstick tests do not correlate
  - suspected pyelonephritis
- If child seriously unwell, measure serum electrolytes, take blood cultures and insert cannula

### Collection of specimens

- Collect urine before antibiotics unless severe sepsis – see **Sepsis (including meningococcal)** guideline
- **Clean catch** in sterile container is recommended method:
  - in babies too young to co-operate, eliciting lateral abdominal reflex may provoke micturition
- Collect mid-stream urine in those old enough to co-operate
- Pad urine specimens can be used in babies and young children (only useful if negative)
  - make sure nappy area thoroughly cleaned before applying pad
  - urine extracted from specially designed pads with a syringe

# URINARY TRACT INFECTION • 2/4

- always follow manufacturer's instructions
- do not use cotton wool balls or 'home made' equipment
- for urinalysis (do not send for culture: if +ve nitrites and +ve leukocytes collect another urine sample by clean method)
- In severe sepsis, catheterise for diagnostic urine collection

## **Handling specimens**

- Use plain, white top, sterile bottles for hospital-collected samples
- Use borate only when child large enough to fill bottle
- During working hours, transfer specimens to laboratory within 2 hr
- out-of-hours, keep specimen in fridge at 4°C until laboratory open
- State date and time of collection on specimen bottle

## **Interpretation of results**

Always take clinical symptoms into account when interpreting results

- **Children aged  $\geq 3$  yr:** use dipstick to diagnose UTI
- **Both leukocyte esterase and nitrite positive:** start antibiotic treatment for UTI
- **Leukocyte esterase negative and nitrite positive:** start antibiotic treatment, if fresh sample was tested. Send urine sample for culture
- **Leukocyte esterase positive and nitrite negative:** only start antibiotic treatment for UTI if there is good clinical evidence of UTI. Send urine sample for microscopy and culture
- **Both leukocyte esterase and nitrite negative:** do not send urine sample for culture unless recommended in indications for culture. Do not start treatment for UTI

## **Microscopy of fresh sample**

- Indications:
  - aged <3 yr with fever
  - aged >3 yr, fever with:
    - specific urinary symptoms
    - history of recurrent UTI
    - seriously ill
    - leukocyte esterase or nitrite on urinalysis (see **Interpretation of results**)
- Very useful method of confirming acute infection
- bacteria and leukocytes (UTI)
- bacteria only (UTI when symptomatic or contaminant)
- leukocytes only (treat if symptomatic)
- no bacteria or leukocytes (no UTI if culture results also negative)
- Pyuria
  - normal  $<10 \times 10^6/L$
  - vulvitis, vaginitis or balanitis can also give rise to high counts
  - viruses (echovirus, adenovirus and CMV) can cause sterile pyuria
- Colony counts
  - organism count  $>10^5$  organisms/mL pure growth of single organism confirms infection in properly collected and stored mid-stream sample
  - certainty reduced to 80% with pad urine
  - low counts do not exclude infection

## **IMMEDIATE TREATMENT**

If child systemically unwell, do not delay treatment while trying to obtain urine specimen

- Ensure good hydration with maintenance fluids
- Empiric antibiotics (narrow spectrum as soon as organism and sensitivities known)
- If pyelophlephritis: systemic illness (fever  $>38^\circ C$  or loin pain/tenderness)
  - aged <3 months: cefotaxime or ceftriaxone
  - aged >3 months: co-amoxiclav oral if tolerated or IV for 7 days
    - if penicillin allergy give high dose cefuroxime IV 8-hrly (unless severe type 1 allergic reaction), or gentamicin IV (once daily dosage regimen) over 30 min for 48 hr minimum (follow local antibiotic guidelines)
    - if shocked refer to **Sepsis (including meningococcal)** guideline
    - ongoing treatment depends on response
- if cystitis: minor systemic disturbance, give cefalexin oral for 3 days
- high rates of trimethoprim resistance (no longer empiric first line)

# URINARY TRACT INFECTION • 3/4

- when child on prophylaxis already, always give an alternative antibiotic for acute infection
- Imaging: urgent ultrasound imaging is only indicated in 'atypical' cases with:
  - seriously ill child
  - poor urine flow
  - abdominal or bladder mass
  - raised creatinine
  - septicaemia
  - failure to respond to treatment within 48 hr
  - infection with organisms other than *E. coli*

## SUBSEQUENT MANAGEMENT

### Imaging

#### Dependent on age and type of infection

- Simple UTI: responds within 48 hr
- Atypical UTI:
  - seriously ill child
  - poor urine flow
  - abdominal or bladder mass
  - raised creatinine
  - septicaemia
  - failure to respond to treatment within 48 hr
  - infection with organisms other than *E. Coli*
- Recurrent UTI:
  - 2 or more episodes of UTI with acute pyelonephritis/upper urinary tract infection
  - one episode of UTI with acute pyelonephritis/upper urinary tract infection **plus** one or more episode or UTI with cystitis/lower urinary tract infection
  - 3 or more episodes or UTI with cystitis/lower urinary tract infection

Test	Simple UTI	Atypical UTI	Recurrent UTI
<b>Aged 0–6 months</b>			
US during acute infection	No	Yes	Yes
US within 6 weeks	Yes	No	No
DMSA	No	Yes	Yes
MCUG	No	Yes	Yes
<b>Aged 6 months–3 yr</b>			
US during acute infection	No	Yes	No
US within 6 weeks	No	No	Yes
DMSA	No	Yes	Yes
MCUG	No	No	No
<b>Aged &gt;3 yr</b>			
US during acute infection	No	Yes	No
US within 6 weeks	No	No	Yes
DMSA	No	No	Yes
MCUG	No	No	No

- Renal and bladder USS 6 weeks after infection when not indicated urgently (see above)
- Bladder scan pre/post micturition helpful to exclude incomplete bladder emptying
- DMSA (dimercaptosuccinic acid) scan 4–6 months after infection
- If child has subsequent UTI while awaiting DMSA, review timing of test and consider doing it sooner
- MCUG (micturating cysto-urethrography) after infection is treated
- also required where there are voiding problems or abnormalities on US scan requiring further investigation (discuss with consultant)
- requires 3 days of prophylactic antibiotics, usually nitrofurantoin aged >3 months 1 mg/kg (max 100 mg, avoid in G6PD deficiency or renal impairment) or cefalexin aged <3 months 12.5 mg/kg at night according to previous culture sensitivities, with test on middle day or following MCUG
- MCUG for neonates with hydronephrosis give a single dose of IV gentamicin 5 mg/kg over 3–5 min just before MCUG (avoid MCUG in neonates with UTI)

# URINARY TRACT INFECTION • 4/4

## DISCHARGE AND FOLLOW-UP

- Home when:
  - symptoms mild, or severe symptoms controlled
  - taking oral antibiotics and tolerating them
  - discuss and advise to avoid risk factors at discharge:
    - constipation
    - poor perineal hygiene
    - low fluid intake
    - infrequent bladder emptying
- Repeat urine test not required on asymptomatic children
- Prompt treatment of recurrences with co-amoxiclav (check previous culture sensitivities)
- Out-patient review
  - check BP
  - not required for simple UTI
  - in 8–10 weeks where ultrasound imaging has been indicated
- **Prophylactic antibiotics**
  - not required following first simple UTI
  - Required for:
    - proven grade 3+ reflux until out of nappies during the day (provided infections well controlled)
    - urinary tract obstruction pending surgical management
    - any child with frequent symptomatic infections (>3 urinary tract infections per year)
    - aged >3 months: prophylaxis as above
- Surgical management
  - Antireflux surgery not routinely indicated in VUR
  - refer for antireflux surgery for obstructive mega-ureters with reflux
  - refer for antireflux surgery if failure to control infections with prophylaxis in grade 3+ reflux
  - refer all neuropathic bladder patients
- Circumcision may be considered for recurrent UTI in children with structurally abnormal urinary tracts

## Management of children with renal scars

- No follow-up for minor unilateral parenchymal defect unless recurrent UTI or family history or lifestyle risk factors for hypertension
- In cases of significant scarring:
  - annual BP measurement
  - females must book early when pregnant and inform obstetric team
- Where scarring bilateral:
  - annual BP measurement
  - assessment of urinary protein excretion and renal function every 3–4 yr
  - long-term follow-up in the renal clinic
  - transfer to adult service

# ARTHRITIS • 1/2

## RECOGNITION AND ASSESSMENT

### Definition

- Acute, chronic ( $\geq 6$  weeks) or recurrent inflammation of  $\geq 1$  joints

*Acute arthritis associated with fever needs urgent assessment to rule out septic arthritis/osteomyelitis - see Osteomyelitis and septic arthritis guideline*

### Symptoms and signs

- $\geq 1$  swollen joint(s), which may be:
  - warm
  - stiff +/- painful
  - tender
  - reduced in range of movement

### Differential diagnosis

#### **Acute septic arthritis**

- See **Osteomyelitis and septic arthritis** guideline

#### **Malignancy**

- Malignancy, particularly leukaemia and neuroblastoma, can present with joint pain +/- swelling
- Cytopaenia and hepatosplenomegaly may be absent at presentation

#### **Non-accidental injury (NAI)**

- See **Child protection** guideline

#### **Reactive arthritis**

- 7–14 days following acute infection
- Self-limiting
- Human leukocyte antigen (HLA)-B27 associated pathogens:
  - campylobacter, shigella, salmonella, chlamydia, *Clostridium difficile*
  - Classic Reiter's triad of arthritis, conjunctivitis and sterile urethritis rare in children
- Non HLA-B27 associated pathogens:
  - *H. influenzae*, mycobacteria, *N.gonorrhoeae*, *N.meningitidis*, *Staph.aureus*, streptococci
  - some viral, fungal and parasitic infections

#### **Inflammatory bowel disease associated arthritis**

- Monoarthritis in a large joint or peripheral arthritis associated with disease activity

#### **Juvenile idiopathic arthritis (JIA)**

- Arthritis of unknown aetiology before age 16 yr (peak aged 1–5 yr)
- Persisting for  $\geq 6$  weeks
- Stiffness especially after rest (e.g. mornings), gradual refusal to participate in usual activities
- Reported pain can be surprisingly minimal (but not always)
- Any or multiple joints

#### **Systemic rheumatic diseases**

- Juvenile systemic lupus erythematosus (SLE), juvenile dermatomyositis
- Vasculitis, including Henoch-Schonlein purpura and Kawasaki's disease – see **Henoch-Schonlein** guideline and **Kawasaki disease** guideline

#### **Rarer causes**

- Infectious causes - tuberculosis, Lyme disease
- Rheumatic fever – migratory arthritis, erythema marginatum, chorea, history of tonsillitis
- Inherited metabolic disorders e.g. mucopolysaccharidoses
- Haemophilia
- Chronic recurrent multifocal osteomyelitis
- Chronic infantile neurological, cutaneous, and articular (CINCA) syndrome

# ARTHRITIS • 2/2

## INVESTIGATIONS

- X-ray if monoarthritis and NAI/osteomyelitis/malignancy suspected
- Bloods including:
  - FBC and film, ESR, CRP, ASOT
  - coagulation studies if prolonged bleeding
  - ANA if SLE suspected
- Synovial aspiration with microscopy and culture if septic arthritis suspected (monoarthritis and fever)
- Further imaging e.g. US may be indicated (seek advice)

## MANAGEMENT

### Primary care

#### *Acute*

- Contact local paediatric team for advice on assessment and management of acute musculoskeletal symptoms and pyrexia of unknown origin
- Provide adequate analgesia/anti-inflammatory medications
- anti-inflammatories contraindicated in gastrointestinal (GI) ulceration/bleeding
- use with caution in asthma, angioedema, urticaria, coagulation defects, cardiac, hepatic or renal impairment
- if taking other medicines that increase risk of upper GI side-effects, or with serious co-morbidity – give ranitidine or proton pump inhibitor as gastro protection

#### *Chronic*

- **Refer all** children with suspected JIA, autoimmune connective tissue diseases (e.g. juvenile SLE, juvenile dermatomyositis, scleroderma and sarcoidosis) to nearest paediatric rheumatology service without delay

***If JIA suspected, arrange early referral to local ophthalmologist to start screening programme for uveitis***

***Chronic anterior uveitis can be asymptomatic initially, and can progress to irreversible loss of vision if referral delayed***

### Secondary care

- Explore possible differential diagnoses and manage/refer as appropriate
- If septic arthritis suspected discuss urgently with local orthopaedic team
  - requires urgent joint aspiration, microscopy and culture, followed by intravenous antibiotics
- Suspected JIA requires prompt onward referral to paediatric rheumatology
- If systemic JIA or autoimmune connective tissue disease suspected, discuss with paediatric rheumatology without delay

### Tertiary care

- Management includes:
  - exploring differential diagnoses
  - optimising medical treatment including:
    - corticosteroid injections
    - disease modifying agents such as oral steroids, methotrexate, etanercept and other biological therapies
  - disease education
  - physiotherapy, occupational therapy and rehabilitation
  - involvement of other paediatric/surgical specialties as indicated

# LIMPING CHILD • 1/5

## DEFINITION

- Abnormal gait usually caused by:
  - pain
  - weakness
  - deformity
- Typically due to shortened 'stance phase' in gait cycle
- Parents/carers may use the term 'limping' to describe any abnormality of gait

## RECOGNITION AND ASSESSMENT

### History

- Trauma
- Weight loss
- Tiredness
- Birth history including:
  - presentation at delivery **and**
  - hip screening
- Development disorders, e.g. cerebral palsy
- Fever
- Recent viral infection
- Joint swelling
- Joint stiffness (particularly early morning if considering inflammatory causes)
- Sickle cell status
- Duration of symptoms
- if delay in presentation consider non-accidental injury (NAI) – see **Child protection** guideline

### Examination

- Observations including:
  - temperature
  - weight
- Look for:
  - rashes
  - pallor
  - lymphadenopathy
  - hepatosplenomegaly
- Torsion can present as limp – examine testes

### **pGALS screening**

- Gait – is it antalgic/Trendelenberg?
- Toe and heel walking
- Arms
  - look for:
    - restricted range of motion
    - stiffness
    - swelling
    - erythema
- Legs
  - look for:
    - bruising
    - deformity
    - erythema
    - is the pelvis level, and leg lengths equal?
  - feel for:
    - knee effusion and warmth
    - passive and active knee flexion with internal and external rotation of hip – compare internal rotation of both hips, restricted internal rotation is a sensitive sign of hip pathology
- Spine
  - observe from side and behind
  - ask child to touch toes and observe curve
- If joint abnormality found on screening examination: more detailed **LOOK, FEEL, MOVE** approach may be needed



# LIMPING CHILD • 2/5

- Interaction between child and parents
- in non-accidental injury mechanism may not fit injury found – see **Child protection** guideline

## DIFFERENTIAL DIAGNOSIS

*Always consider septic arthritis, malignancy and non-accidental injury as possible causes of a limp in childhood*

### Primary differentials of atraumatic limp by age

<b>0–3 years</b>	<ul style="list-style-type: none"> <li>• Septic arthritis/osteomyelitis</li> <li>• Developmental hip dysplasia</li> <li>• Fracture/soft tissue injury (toddler's fractures/NAI)</li> </ul>
<b>3–10 years</b>	<ul style="list-style-type: none"> <li>• Transient synovitis/irritable hip</li> <li>• Septic arthritis/osteomyelitis</li> <li>• Perthes' disease</li> <li>• Fracture/soft tissue injury (stress fracture)</li> </ul>
<b>10–15 years</b>	<ul style="list-style-type: none"> <li>• Slipped upper femoral epiphysis (SUFE)</li> <li>• Septic arthritis/osteomyelitis</li> <li>• Perthes' disease</li> <li>• Fracture/soft tissue injury (stress fracture)</li> </ul>
<b>Other important differential diagnoses</b>	<ul style="list-style-type: none"> <li>• <b>In all age groups consider non-accidental injury</b></li> <li>• Neoplastic disease, e.g. acute lymphoblastic leukaemia</li> <li>• Haematological disease, e.g. sickle cell anaemia</li> <li>• Infective disease, e.g. pyomyositis or discitis</li> <li>• Metabolic disease, e.g. rickets</li> <li>• Neuromuscular disease, e.g. cerebral palsy or muscular dystrophy</li> <li>• Primary anatomical abnormality, e.g. limb length inequality</li> <li>• Rheumatological disease, e.g. juvenile idiopathic arthritis (see <b>Arthritis</b> guideline)</li> </ul>

### Transient synovitis

- Commonest atraumatic cause of limp – usually occurring in children aged 3–8 yr
- Male predominance
- Diagnose with caution in aged <3 yr due to increased risk of NAI/septic arthritis
- Recent history of URTI (not always)
- Child able to walk but in pain
- Otherwise well – afebrile and with normal systemic examination
- Mild reduction of internal rotation of hip
- Diagnosis of exclusion – always consider septic arthritis
- Symptoms <48 hr and following brief period of observation child systemically well, afebrile and able to bear weight: no further investigations necessary
- Follow-up in 48 hr and investigate if symptoms persist
- Aged >8 yr and risk factors for SUFE: further investigations including AP and frog lateral X-rays of pelvis

### Septic arthritis

- If not treated urgently joint destruction and growth arrest may occur
- Predominantly due to haematogenous spread
  - blood cultures +ve in majority of cases
- Particularly prone joints:
  - hip
  - ankle
  - shoulder
  - elbow
- *Staph. aureus* most common cause (can be caused by Group B Streptococcus in neonates)
- Aged <18 months more vulnerable as physis does not prevent blood entering epiphysis

*Children aged <3 yr are vulnerable to septic arthritis and NAI, with transient synovitis being a rare diagnosis  
Investigate all aged <3 yr*

# LIMPING CHILD • 3/5

## Perthes

- Idiopathic avascular necrosis of capital femoral epiphysis
- More common in boys aged 4–8 yr
- Diagnosed on plain AP pelvis X-ray showing sclerosis, fragmentation and flattening of capital femoral epiphysis – may need bone scan/MRI
- Symptoms >2 weeks
- 20% bilateral

## Slipped capital femoral epiphysis

- Typically affects children aged >10 yr
- Male predominance
- Often overweight
- Associated with hypothyroidism and growth hormone deficiency
- May present with knee pain
- Hip can appear shortened and externally rotated
- Plain AP films may be normal – lateral projection required if suspected
- Urgent fixation improves outcome
- Can be bilateral
- If aged >9 yr consider slipped capital femoral epiphysis – request AP and lateral X-rays/pelvis

## RED FLAGS

- Child aged <3 yr
- Unable to bear weight
- Pseudoparesis
- Fever
- Systemically unwell
- Lymphadenopathy/hepatosplenomegally
- Night pain/night sweats
- Multiple joints affected/symptoms lasting >6 weeks
- Child aged >9 yr with pain/restricted hip movement

## INVESTIGATIONS

- FBC and blood film
- ESR
- CRP
- If febrile, blood cultures
- X-ray 2 views; site of pain and pelvis
- If SUFE is suspected obtain AP and frog lateral views of pelvis
- Effusion can be confirmed on ultrasound, but will not identify underlying pathology
- Further investigations may be needed if no clear diagnosis or symptoms persist; may include bone scan, MRI (with/without contrast), CK, sickle screen

## SEPTIC ARTHRITIS

- Fever >38.5°C
- Unable to weight bear
- ESR >40 mm in first hour
- CRP >20 mg/L
- White cell count >12x10<sup>9</sup>/L

*Septic arthritis can still be present in the absence of these criteria*

## MANAGEMENT

- If any features consistent with septic arthritis:
  - severe pain
  - range of movement <75% normal
  - fever >38.5°C
  - unable to weight bear
  - ESR >40 mm/first hr

## LIMPING CHILD • 4/5

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- CRP >20 mg/L
- WBC >12x10<sup>9</sup>/L

Or

- X-ray abnormal or suggests orthopaedic problem (e.g. Perthe's, SUFE)
- Refer to orthopaedics for diagnostic aspiration/washout – **before** starting antibiotics (see **Osteomyelitis and septic arthritis** guideline)

### DISCHARGE AND FOLLOW-UP

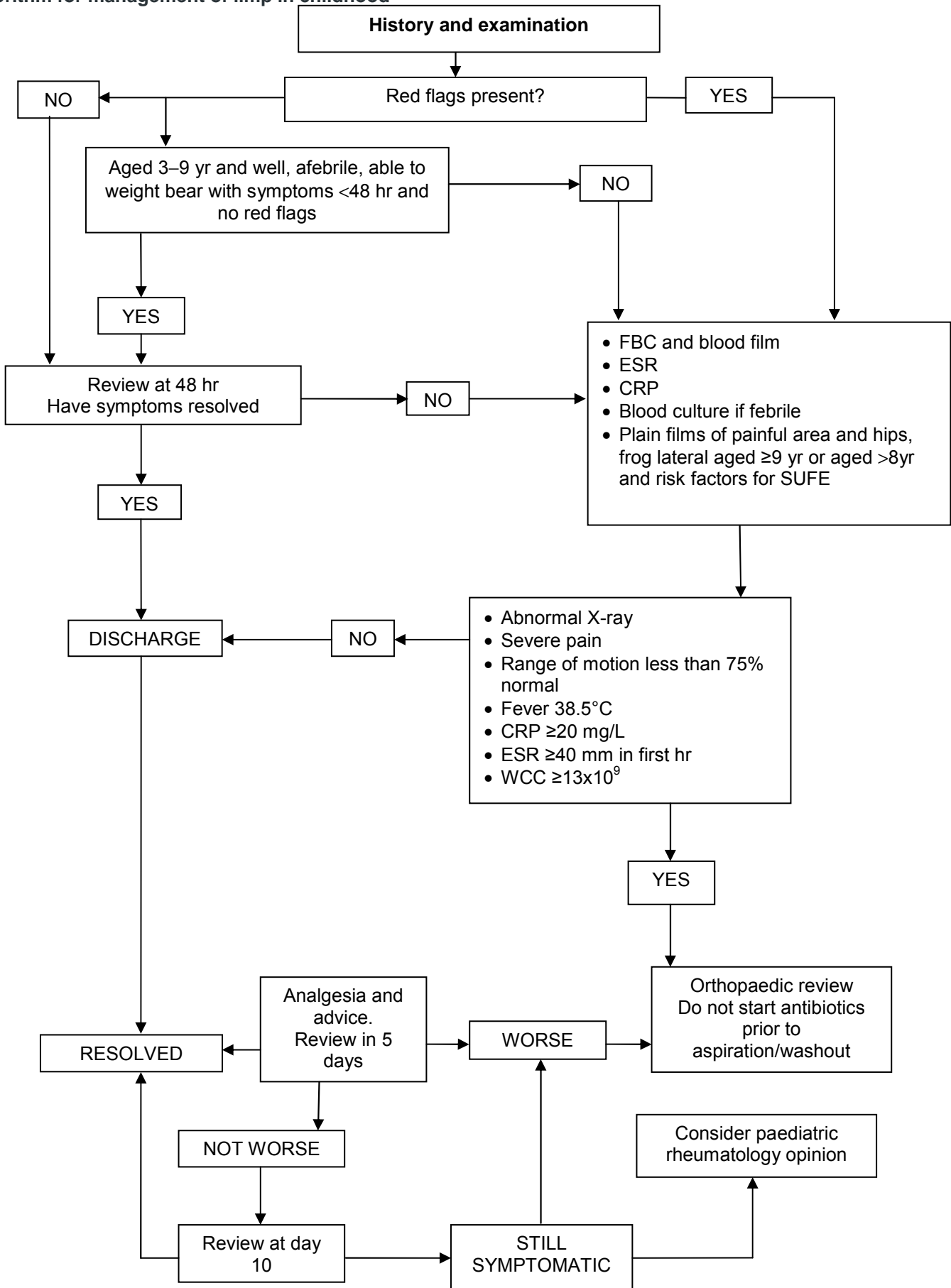
- If blood tests and X-ray normal, irritable hip (reactive arthritis) likely
- discharge with analgesia, information leaflet and reassurance
- advise return if fever occurs or problem becomes worse

#### Review after 5 days

- If worse, refer for orthopaedic opinion
- If no worse, review after a further 5 days
- If still no better, arrange joint orthopaedic/paediatric review, and consider referral for paediatric rheumatology opinion
- If normal at 5 or 10 days, discharge

# LIMPING CHILD • 5/5

Algorithm for management of limp in childhood



***Always follow the Child Safeguarding Policy and Procedures in your Trust.  
It is everyone's responsibility***

More comprehensive guidance – the child protection companion can be found on the RCPCH website:  
<http://www.rcpch.ac.uk/index.php?q=child-protection-companion>

4 recognised categories of abuse (rarely seen in isolation)

- physical abuse (non-accidental injury)
- emotional abuse
- neglect
- sexual abuse

## **NON-ACCIDENTAL INJURY (NAI)**

### **Definition**

Physical abuse may involve hitting, shaking, throwing, poisoning, burning or scalding, drowning, suffocating or otherwise causing physical harm to a child. Physical harm may also be caused when a parent fabricates the symptoms of, or deliberately induces, illness in a child

### **Recognition and assessment**

***Assessment of the child should be carried out by a paediatrician with Level 3 competences as per 'Safeguarding Children and Young people: roles and competences for health care staff'. Where a trainee carries out the assessment, they should be supervised by a consultant or senior paediatrician***

There may be direct information from the child or carer. The following presentations need to be considered

- Delay in seeking medical attention following an injury
- History incompatible with injury seen
- Numerous explanations suggested for injury
- Changes in the history
- Parents 'shopping around' for medical help (e.g. from GP, A&E, different hospitals)
- History of domestic violence
- Odd or aggressive parental behaviour
- Any fracture in an infant without a satisfactory explanation
- Any bruise on a child aged <6 months old or pre-mobile
- Patterns of bruising, injury or explanation not compatible with child's development
- Recurrent injuries
- Evidence of other forms of abuse (e.g. failure to thrive, neglect)
- Previous evidence of injury or neglect (check if child known to local authority children's social care or is the subject of a child protection plan)

### **Referrals**

- Most referrals for medical assessment will come through children's social care teams or the police
- Discuss referrals from GP with consultant before arranging medical assessment by on-call team
- consultant will review whether referral should be made to the child protection agencies first/as well
- Referrals from A&E or surgical wards should be taken by a registrar or above
- discuss with a consultant first to determine who should carry out initial examination and whether social care or police should be present

***Always discuss referrals with the on-call consultant for child protection duties***

### **Immediate action**

- If there is an urgent or life-threatening situation, start necessary emergency treatment
- Refer to your Trust on-call child protection arrangements
- if you suspect harm, refer to social care, and police if they are not already involved
- Keep any social worker or police officer involved informed
- Always consider potential risks to siblings or other children

### **History**

- Where a referral is made from social care and/or the police, the child may have given a full history of events, often a visual recording

## CHILD PROTECTION • 2/6

- ask for this information from social worker or police officer at beginning of examination. It may not be necessary to repeat this information unless further detail is required
- If child first presents in a health setting, registrar or consultant should take history and examine child before discussing with social care or police

### **How**

- Record findings accurately during or immediately after examination, using a dedicated child protection proforma with body charts if available
- Complete and sign each page and include:
  - full family history
  - persons present at interview
  - source of your information (including the child)
  - person giving consent
  - date and time of start and finish

***Take care when talking to the child not to ask leading questions or make suggestions that could contaminate evidence in a subsequent trial, document clearly what is said in child's own words***

### **Examination**

- Ideally there should be only one examination. It can be useful to do further examinations as injuries such as bruises may evolve and the picture becomes clearer
- Keep your immediate senior informed
- All child protection examinations should be carried out within appropriate timescales, for physical abuse: within 24 hr

***If this is a planned medical assessment at the request of child protection agencies, carers with parental responsibility and the child (depending on age and understanding) must give their consent (usually written) for examination to take place. If consent not forthcoming, social care may obtain a legal order giving permission for the child to be examined. This does not apply where a child needs urgent assessment and treatment***

- Must include:
  - state of child: cleanliness, appropriate clothing, etc
  - **all** body areas
  - accurate description of all injuries (size, colour, position and pattern) on body charts
  - mouth (torn frenulum of lip and tongue especially)
  - fundi: look particularly for haemorrhages. With small children, especially where head injuries are suspected, this is usually the role of the paediatric ophthalmologist
  - a note of any birth marks, scars etc.
  - a full paediatric systemic examination
  - plotting height and weight and head circumference on growth charts – note centiles
  - child's emotional state, demeanour and degree of co-operation
  - a comment on the developmental state (or school progress)
  - observations on relationships or behaviour between parents and child

### **Investigations**

A selection of the following tests will usually be necessary; seek advice from consultant as to which are appropriate:

- If personal history of abnormal bleeding or concerning family history, discuss with a paediatric haematologist first as other tests may be indicated
- Bone biochemistry [including vitamin D, PTH (EDTA specimen)] if there are unexplained fractures
- Investigations into other suspected abuse (e.g. failure to thrive)
- Skeletal survey in children aged <2 yr with unexplained injuries, repeat views after 11–14 days are required. Head CT scan in children aged <12 months and in older children if focal encephalopathic features, focal neurology or haemorrhagic retinopathy
- Further neuroimaging according to RCR/RCPCH guidelines
- Document in notes if decision made not to proceed with imaging
- Photographs (often a police photographer is used)

### **Haematological investigations**

When a bleeding diathesis suspected or needs to be ruled out, perform following:

# CHILD PROTECTION • 3/6

- Initial baseline investigations
- FBC and film (EDTA up to 1 mL)
- APTT and PT (not INR)
- thrombin time
- fibrinogen levels
- if thrombocytopenic, mean platelet volume
- von Willebrand Factor antigen and activity (ristocetin cofactor/ricoff)
- Factor 8 and 9 assay if male
- blood group
- send 2 or 3 sodium citrate bottles, filled to appropriate fill line level

## **Subsequent investigations**

- Identify all requests as NAI investigations
- Interpret all test results with age appropriate reference values
- If significant bruises, before further investigations, discuss with a paediatric haematologist:
- von Willebrand Factor antigen and activity
- Factor 8, 9 if not already done
- Factor 13 assay
- child aged <2 yr: platelet function assay

## **EMOTIONAL ABUSE**

### **Recognition and assessment**

#### **Definition**

- Habitual harassment of a child by disparagement, criticism, threat and ridicule
- Present in most cases of physical and sexual abuse, and neglect
- presents difficulties in definition, recognition and management
- long-term consequences upon social, emotional and cognitive development can be more harmful than other forms of abuse

#### **Presentation**

- Part of the differential diagnosis if a child presents with the following non-specific behaviours:
- unhappy
- disturbed
- poor concentration leading to learning difficulties/school failure
- poor social interactions
- unable to play
- problems with attachment to parents or caretakers
- over-friendly or craving affection from strangers

#### **Assessment**

- Assessment is complex and requires a multidisciplinary approach
- Social care take the investigative lead
- may need to rule out mental health difficulties

## **NEGLECT**

***Neglect may not always be intentional (e.g. parental mental health problems)***

### **Recognition and assessment**

#### **Definition**

- Neglect is persistent failure to meet a child's physical and/or psychological needs
- Lack of care of physical needs that can result in failure to thrive
- important to eliminate organic causes
- neglect of physical care most likely to come to Child Health attention along with developmental delay

#### **Presentation**

- Child's appearance
- note condition of clothing, hair, skin
- Growth
- height, weight, serial measurements to check growth rate
- head circumference

# CHILD PROTECTION • 4/6

- mid-upper arm circumference
- Non attendance (or repeat alterations) of appointments

## **Physical examination**

- Signs of medical problem not appropriately treated
- Evidence of other forms of abuse
- Development
- gross motor skills, fine motor skills, vision, hearing, language, behaviour, play

## **SEXUAL ABUSE**

### **Recognition and assessment**

#### **Definition**

- Forcing or enticing a child or young person to participate in sexual activities, whether or not the child is aware of what is happening
- may involve physical contact, including penetrative (e.g. rape or buggery) or non-penetrative acts
- may include non-contact activities (e.g. involving children in looking at, or in production of, pornographic material, watching sexual activities, or encouraging them to behave in sexually inappropriate ways)

#### **Presentation**

- Information given by child
- Symptoms resulting from local trauma or infection (e.g. bruises, bleeding, discharge)
- Symptoms resulting from emotional effects (e.g. behavioural changes, enuresis, encopresis, self-harming, eating disorders or psychosomatic symptoms)
- Sexualized behaviour or sexual knowledge inappropriate to age
- Under-age pregnancy
- Sexually transmitted infections

#### **Referrals**

- Referrals usually come from local authority children's social care or the police
- refer to your departmental child protection rota

***If a child presents in a medical setting and there are concerns about sexual abuse, call the on-call consultant for child protection immediately. Depending on any urgent medical needs e.g. bleeding; child protection agencies may need to be involved before medical assessment***

## **IMMEDIATE ACTION – HISTORY AND EXAMINATION**

### **Preparation**

- Where sexual abuse suspected, whoever examines the child **MUST** have training and experience in this field and the examination must take place in an appropriate location e.g. sexual assault referral centre (SARC)
- In exceptional cases, particularly where there is acute trauma and bleeding that may require surgical management, it may be appropriate for the examination to be carried out under anaesthetic by a gynaecologist after discussion with the FME

### **Examination**

- Purpose of medical examination is to:
  - detect traumatic or infective conditions that may require treatment
  - evaluate the nature of any abuse
  - secure forensic evidence
  - reassure the child
  - start process of recovery

### **Initial management**

- If penetration and/or passage of bodily fluids are suspected consider sexually transmitted diseases and pregnancy
  - pregnancy test
  - if assault within 72 hr, offer post-coital contraception (ideally <12 hr) – usually levonorgestrel 1.5 mg stat dose
- Contact genito-urinary medicine department
- Post exposure prophylaxis should be started within 1 hr of assault if indicated (can be given up to 72 hr after assault). See **HIV and hepatitis B post-exposure prophylaxis PEP** guideline



# CHILD PROTECTION • 5/6

- If ano-genital warts found, discuss with a senior/safeguarding lead (though usually spread non-sexually)

## Investigations

- Mid-stream urine
- Forensic tests (FME to determine)
- Photos/video recordings obtained with a colposcope, stored in accordance with local policy

***Always follow the Child Safeguarding Policy and Procedures in your Trust***

## SUBSEQUENT MANAGEMENT

- Majority of children seen will be allowed home if it is safe and after discussion with social care and police
- some children who have been abused will be admitted while problems are investigated
- Always keep parents and children informed of concerns and what next actions will be
- Be open and honest with parents where possible unless this could put child (or others) at risk of further harm

## Keeping children safe

- If there is clear evidence of child abuse and parents attempt to remove child there are two courses of action:
  - in an emergency, dial 999, the police can use police protection powers to keep child safe
  - if there is time, a social worker can obtain an Emergency Protection Order from Court (Section 44, Children Act 1989)
- Put the child's safety first
- Communicate with other staff involved (e.g. nursing staff) so that situation can be supervised
- Consider the safety of siblings
- usual for siblings to be examined at same time as index child

## DISCHARGE AND FOLLOW-UP

***Only a consultant may allow child to go home***

- Consultant should make decision regarding discharge, usually after discussion with the police and social care

***Communication is vital***

- Send written report to GP without delay, with a copy for social care and the police
- If child referred from A&E, send copy of report to them for feedback
- Ensure notes and dictation is available to secretary, marked 'for urgent attention'
- Ensure report is signed in a timely manner
- Complete ward discharge forms
- Check with consultant if follow-up is required

## Child protection conference

- May be convened following a child protection investigation to consider:
  - whether child needs to be the subject of a child protection plan
- Medical and nursing staff will be invited if child has been admitted
  - expected to contribute, usually in person, or via a written report
  - ensure reports are available for future reference

*Always follow the Child Safeguarding Policy and Procedures in your Trust.  
It is everyone's responsibility*

- Self-harm can take a number of forms, including:
  - cutting or burning
  - self poisoning with medicines or tablets
  - punching
  - self strangulation
  - pulling out hair or eyelashes
  - scratching or picking at skin
  - inhaling or sniffing harmful substances
  - swallowing non-food substances
  - inserting objects into the body either through orifices or the skin
  - head banging

## ASSESSMENT

- Identifying behaviour, intended behaviour or self-harming thoughts
- Who knows about the behaviour
- How often this occurred
- If at risk from others
- Stressors e.g. bullying, bereavement, relationships
- Difficulties, abuse, sexuality issues
- General health
- Use of drugs and alcohol
- Education
- Family and social issues
- Support network available
- Child protection issues

## MANAGEMENT

- Patients who have self-harmed, admit overnight
- contact CAMHS crisis team for advice, if available in your trust
- See **Poisoning** guidelines
- Advise carers to remove all medications or other means of self-harm
- Manage child protection issues according to local policy and procedures. On-call consultant available 24 hr for child protection advice
- Assess risk/need for ongoing psychological treatment or support and psychiatric observation levels required whilst on ward
- Obtain valid consent for a referral to CAMHS from parent/other adult with parental responsibility or the young person if they are deemed to have capacity (Gillick competence). Clearly document in medical records who obtained consent, who consent was taken from and when it was obtained i.e. date and time

### **Documentation**

- Clearly document assessment in notes with any decisions made and reasons

## REFERRALS

### **Criteria for referral to priority referral team (PRT)**

- Deliberate self-harm (e.g. overdose, self strangulation, serious cuts)
- Deliberate harm from substance misuse (e.g. poisoning from excessive alcohol and/or illicit drugs if **intention** was to self-harm)
- Mental health symptoms:
  - depression/low or elevated mood with active suicidality
  - psychotic symptoms
  - low weight anorexia nervosa i.e. BMI <15 or accompanied by rapid weight loss
- Check time referrals must be phoned through to PRT to be seen that day

## DISCHARGE AND FOLLOW-UP

- Discharge when medically fit **and** have been assessed by PRT
- Discuss with CAMHS to ensure child has an agreed plan in place
- If there are safety concerns, refer to children's social care
- Ensure health professionals i.e. GP and school nurse are aware of admission and management plan

# **Paediatric Guidelines 2016–18**

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These guidelines are advisory, not mandatory. Every effort has been made to ensure accuracy. The authors cannot accept any responsibility for adverse outcomes.

Suggestions for improvement and additional guidelines would be most welcome by Partners in Paediatrics, please contact [www.partnersinpaediatrics.org](http://www.partnersinpaediatrics.org)

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