

PAEDIATRIC GUIDELINES 2006

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APLS - cardio-respiratory arrest	
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Apparent life threatening events (ALTE)	
Anaphylaxis	
Pain assessment	
Analgesia	
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Fasting pre-operative	

B: BREATHING (RESPIRATORY DISEASE)

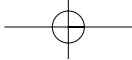
Asthma - acute management	
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Cystic Fibrosis – Admission	
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H: HAEMATOLOGY

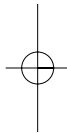
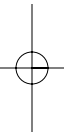
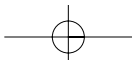
Blood and platelet transfusions
 Febrile neutropenia
 Henoch-Schönlein purpura
 Idiopathic thrombocytopenic purpura
 Haemophilia

I: INFECTION

Hepatitis
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 Septicaemia (including meningococcal)
 Osteomyelitis and septic arthritis
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 Petechial rashes
 Tuberculosis

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Bell's palsy
 Epilepsy
 Status epilepticus
 Glasgow coma score



P: PROTECTION

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Child sexual abuse

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Glomerulonephritis
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Nephrotic syndrome
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Limping child

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).

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

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

See the accompanying Supporting Information folder. Where possible the guidelines are based on evidence from the published literature. It is intended that the evidence relating to statements made in the guidelines and its quality will be made explicit.

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 (ward-based copies only). The evidence summaries are developed on a rolling programme which will be updated as each guideline is reviewed.

PREFACE • 2/2

Level of evidence	Strength of evidence
I	Strong evidence from at least one systematic review of multiple well-designed randomized controlled trials
II	Strong evidence from at least one properly designed randomized controlled trial of appropriate size
III	Evidence from well-designed trials without randomization, single group pre-post, cohort, time series or matched case-control studies
IV	Evidence from well-designed non-experimental studies from more than one centre or research group
V	Opinions of respected authorities, based on clinical evidence, descriptive studies or reports of expert committees

JA Muir-Gray from Evidence Based Healthcare, Churchill Livingstone London 1997

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 that 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

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ACKNOWLEDGEMENTS • 1/1

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APLS-CARDIO-RESPIRATORY ARREST • 1/4

MANAGEMENT

- Call 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
- Change person performing chest compressions every few minutes

Airway (A)

- Inspect mouth + apply suction if necessary
- Head tilt/chin lift or jaw thrust
- Oro- or nasopharyngeal airway
- Intubation:
 - endotracheal tube sizes
 - term newborns 3-3.5 mm
 - 1-yr-old 4.5 mm
 - > 1-yr-old – use formula [(age/4) + 4] mm
- Cricothyrotomy
 - if airway cannot be achieved by other means

Breathing (B)

- Self-inflating bag and mask with 100% O₂
- Ventilation rate 2 for every 15 compressions (unintubated)
- Ventilation rate 10/min – non-synchronous with compressions (intubated)
- Consider foreign body, pneumothorax, etc

Circulation (C)

- Cardiac compression rate: 100/min
- Peripheral venous access: one to two attempts (< 30 sec)
- Intraosseous access: 2-3 cm below tibial tuberosity
- Use ECG monitor to decide between:
 - a non-shockable rhythm: asystole or pulseless electrical activity (electromechanical dissociation)
 - OR
 - a shockable rhythm: ventricular fibrillation or pulseless ventricular tachycardia

The algorithms for managing these rhythms follow – if arrest rhythm changes, restart algorithm; if organised electrical activity seen, check pulse

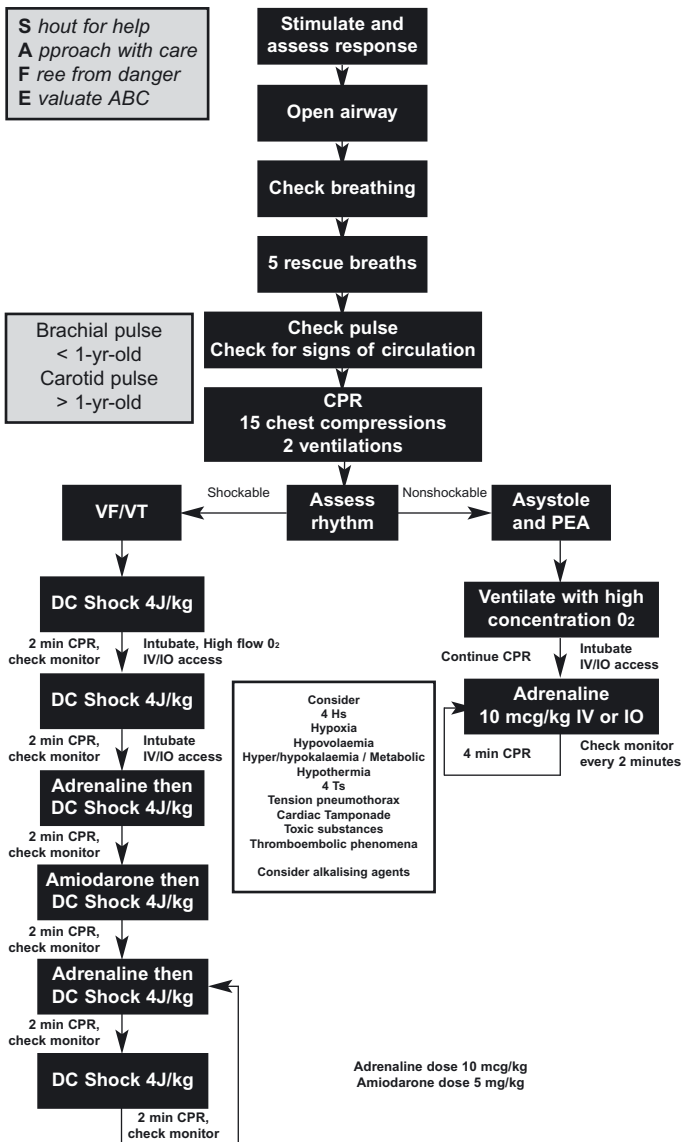
Parental presence

Evidence suggests that presence at child's side during resuscitation enables parents to gain a realistic understanding of the efforts made to save their child. They may subsequently show less anxiety and depression

Important points:

- Designate one staff member to be the parents' support and interpreter of events at all times
- The team leader, not the parents, must decide when it is appropriate to stop the resuscitation
- Hold a team debriefing session to support staff and reflect on practice

APLS-CARDIO-RESPIRATORY ARREST • 2/4



APLS-CARDIO-RESPIRATORY ARREST • 3/4

- Use paediatric paddles in children weighing less than 10 kg
- Resume two minutes 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 before the DC shock, but take effect in time for the subsequent shock
- Automatic external defibrillators (AEDs) cannot detect tachyarrhythmias in infants
- AEDs can be used in 1-8 year olds with paediatric pads or paddles, which attenuate the dose to 50-80 J, or > 8 yr with unattenuated energy
- Both monophasic and biphasic defibrillators are suitable for use in children

Adrenaline		< 12-yrs-old	12 to adult	Notes	
Cardio-pulmonary resuscitation (CPR)	IV rapid bolus/ intraosseous	10 mcg/kg (0.1 mL/kg of 1 in 10,000)	1 mg (10 mL of 1 in 10,000)	Initial and usual subsequent dose	If given by intraosseous route flush with sodium chloride 0.9%
		100 mcg/kg (0.1 mL/kg of 1 in 1000 or 1 mL/kg of 1 in 10,000)	5 mg (5 mL of 1 in 1000)	Exceptional circumstances e.g. beta-blocker overdose	Maximum dose is 5 mL of 1 in 1000.
	Endotracheal tube (ETT)	100 mcg/kg (0.1 mL/kg of 1 in 1000 or 1 mL/kg of 1 in 10,000)	5 mg (5 mL of 1 in 1000)		
Acute anaphylaxis	Deep IM	10 mcg/kg (0.01 mL/kg of 1 in 1000)	0.5-1 mg (0.5-1 mL of 1 in 1000)	Single dose	Repeat at 5 min intervals if necessary according to clinical response

WHEN TO STOP RESUSCITATION

- It is reasonable to stop if, after 30 min of CPR, you find:
 - no detectable signs of cardiac output **and**
 - no evidence of cerebral activity
- Exceptions include:
 - hypothermia (< 32°C)
 - overdoses of cerebral depressant drugs
- Discuss difficult cases with consultant before abandoning resuscitation

APLS-CARDIO-RESPIRATORY ARREST • 4/4

POST-RESUSCITATION MANAGEMENT

Monitor

- Pulse rate and rhythm
- O₂ saturation
- CO₂ monitoring
- Core and skin temperatures
- BP
- Urine output
- Arterial blood gas
- Central venous pressure

Request

- Chest X-ray
- 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

APLS-RECOGNITION AND ASSESSMENT OF THE SICK CHILD • 1/4

RAPID CLINICAL ASSESSMENT OF AN INFANT/CHILD

Airway (A) and Breathing (B)

- Effort of breathing
- Respiratory rate/rhythm
- Stridor/wheeze
- Auscultation
- Skin colour

Circulation (C)

- Heart rate
- Pulse volume
- Capillary refill
- Skin temperature

Disability (D)

- Mental status/conscious level
- Posture
- Pupils
- The complete assessment should take < 1 min
- Once airway (A), breathing (B) and circulation (C) are clearly recognized as being stable or have been stabilized, definitive management of the underlying condition can proceed
- Reassessment of ABCD at frequent intervals will be necessary to assess progress and detect deterioration

Other

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

RECOGNITION AND ASSESSMENT OF THE SICK CHILD

Weight

Anticipated weight in relation to age

Age	Weight
Birth	3.5 kg
5-months-old	7 kg
1-yr-old	10 kg

Weight can be estimated in children 1-10 -yr-old using the formula:

$$\text{Weight (kg)} = 2 \times (\text{age in yrs} + 4)$$

Airway

Primary assessment of airway

- Vocalizations (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

Reassess after any airway opening manoeuvres

- Infants – a neutral head position; other children – ‘sniffing the morning air’
- Other signs that may suggest upper airway obstruction:
 - stridor
 - intercostal/subcostal/sternal recession

APLS-RECOGNITION AND ASSESSMENT OF THE SICK CHILD • 2/4

Breathing

Primary assessment of breathing

- Assess (see below):
 - effort of breathing
 - exceptions
 - efficacy of breathing
 - effects of respiratory failure

Effort of breathing

Respiratory rates 'at rest' at different ages

Age (yr)	Resp rate (breaths/min)
< 1	30-40
1-2	25-35
3-5	25-30
6-12	20-25
> 12	15-20

- 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:
 - is 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 alae nasi

Exceptions

- Increased effort of breathing **DOES NOT** occur in three circumstances:
 - exhaustion
 - central respiratory depression (e.g. from raised intracranial pressure, 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 and, more importantly in infants, abdominal 'see-sawing'
- Pulse oximetry

APLS-RECOGNITION AND ASSESSMENT OF THE SICK CHILD • 3/4

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 O₂ may have little effect
- Mental status:
 - hypoxic or hypercapnic child will be agitated first, subsequently drowsy and then unconscious
 - pulse oximetry can be difficult to achieve in the agitated child due to movement artefact

Circulation

Heart rates 'at rest' at different ages

Age (yrs)	Heart rate (beats/min)
< 1	110-160
1-2	100-150
3-5	95-140
6-12	80-120
> 12	60-100

- Pulse volume:
 - absent peripheral pulses or reduced central pulses indicate shock
- Capillary refill:
 - pressure on centre of the sternum or a digit for 5 sec should be followed by return of

circulation in the skin within 2 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:
 - cuff should cover > 80% of the length of upper arm and bladder > 40% of the arm's circumference
 - hypotension is a late and pre-terminal sign of circulatory failure
 - expected systolic BP = 80 + (age in years x 2)

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 per hr (< 2 mL/kg per hr in infants) indicates inadequate renal perfusion

Features suggesting cardiac cause of respiratory inadequacy

- Cyanosis, not relieved by O₂ therapy
- Tachycardia out of proportion to respiratory difficulty

APLS-RECOGNITION AND ASSESSMENT OF THE SICK CHILD • 4/4

- 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 will have central neurological effects
- central neurological conditions (e.g. meningitis, raised intracranial pressure, status epilepticus) will have both respiratory and circulatory consequences

Neurological function

- Conscious level: **AVPU** (Figure 1) a painful central stimulus may be applied by sternal pressure or by pulling frontal hair

- Posture:
 - hypotonia
 - decorticate or decerebrate postures may only be elicited by a painful stimulus
- Pupils – look for:
 - pupil size, reactivity and symmetry
 - dilatation, un-reactivity or inequality indicate serious brain disorders

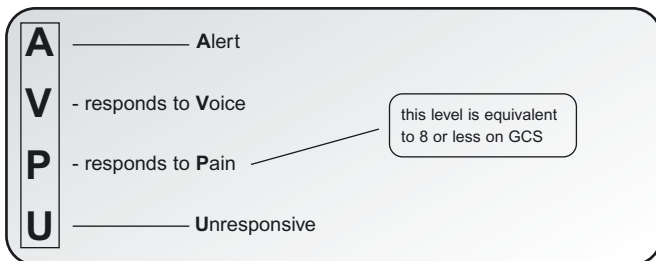
Respiratory effects

- Raised intracranial pressure may induce:
 - hyperventilation
 - Cheyne-Stokes breathing
 - slow, sighing respiration
 - apnoea

Circulatory effects

- Raised intracranial pressure may induce
 - systemic hypertension
 - sinus bradycardia

Figure 1: Rapid assessment of level of consciousness



INTRAOSSUEOUS INFUSION • 1/2

INDICATIONS

- Profound shock, normally secondary to profound dehydration when siting an IV line may prove very difficult
- Allows rapid expansion of the circulating volume
- Gives time to obtain IV access and facilitates the procedure by increasing venous filling

EQUIPMENT

- Intraosseous infusion needles are available in the resuscitation trolleys on each of the paediatric wards
- Alcohol swabs to clean skin
- 5 mL syringe to aspirate and confirm correct position
- 20 mL syringe to administer fluid boluses
- Infusion fluid

Procedure is extremely painful. Use local anaesthetic unless patient unconscious. Infiltrate with lidocaine 1% 1-2 mL 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 caudally from the epiphyseal plate at approx 60° to the long axis of the tibia
- Needle entry into the marrow cavity is 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 mL syringe to deliver bolus of resuscitation fluid

INTRASOSEOUS INFUSION • 2/2

Figure 1: Access site on proximal tibia – lateral view

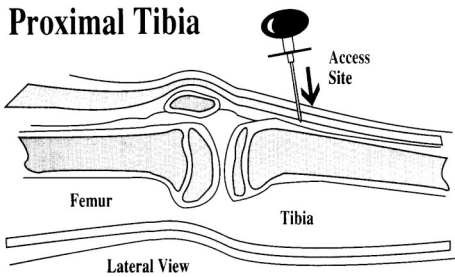


Figure 2: Access site on proximal tibia – oblique view

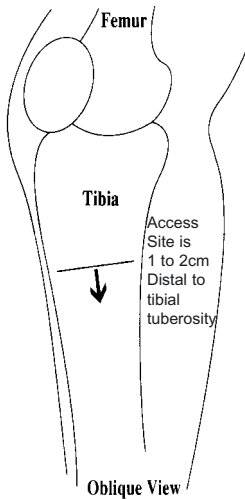
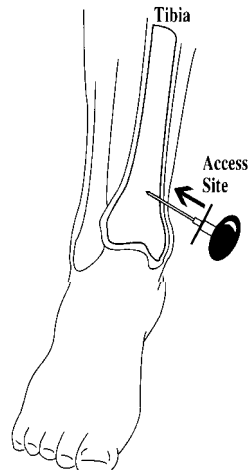


Figure 3: Access site on distal tibia



Distal tibia

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

Distal femur

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

APPARENT LIFE THREATENING EVENT (ALTE) • 1/2

Investigation of first ALTE, if diagnosis not apparent from general clinical history or examination

ASSESSMENT

- Include SpO₂
- Fundoscopy by paediatric ophthalmologist if:
 - severe events (e.g. received CPR)
 - recurrent events
 - history or examination raises concern of child protection issues (e.g. inconsistent history, blood in nose/mouth, bruising or petechiae, history of possible trauma)
 - or when anaemia found - because of intracranial bleed.

Investigations

As soon after the event as possible

- Full blood count
- Blood glucose
- Serum lactate
- Blood gases

Less urgent

- Nasopharyngeal aspirate for viral immunofluorescence and viral culture
- Pernasal swab for pertussis
- Urinalysis (and culture if nitrites and leucocytes detected) – store urine for possible further tests
- Chest X-ray
- ECG
- Save blood (as well as urine) – if events recur during

admission, send for metabolic and toxicology investigations

MANAGEMENT

Admit for observation

- SpO₂ ECG monitoring
- Liaise with health visitor (direct or with liaison HV on wards)
- Check child protection register

After 24 hr observation

- If event brief and child completely well:
 - reassure parents and offer resuscitation training
 - discharge (no follow up appointment)
- Offer CONI Plus (Care of next infant) programme
 - if parents remain concerned despite reassurance
 - siblings of sudden unexplained death (SUD) victims and ALTEs
 - family history of sudden death
 - recurrent ALTE
 - severe ALTE (e.g. needing cardiopulmonary resuscitation/PICU)

If significant (e.g. CPR given) or repeated events:

- Event recording
- Further investigation should exclude the following disorders:
 - gastro-oesophageal reflux
 - pH study
 - seizures
 - EEG

APPARENT LIFE THREATENING EVENT (ALTE) • 2/2

- intracranial abnormalities
CT or MRI scan
- cardiac arrhythmias
24 hr ECG
- upper airway disorder
sleep study
- hypocalcaemia
Ca and bone screen
- metabolic assessment
urinary amino and organic acids
plasma amino acids and
carnitine metabolites (e.g.
MCAD)
skeletal survey
- abuse
blood and urine toxicology
event recording – physiological
or video (for Fabricated and
Induced Illness)

ANAPHYLAXIS • 1/2

DEFINITION

Life-threatening allergic reaction to food/sting/latex causing collapse owing to hypotensive shock, and difficulty in breathing because of one or more of the following:

- Stridor (croup)
- Bronchospasm (asthma)
- Rapid swelling of the tongue causing difficulty in swallowing or speaking

IMMEDIATE TREATMENT

See algorithm next page

IM adrenaline dose by age if weight not available

Age	Dose	Volume of adrenaline 1:1000 (1 mg/mL)
< 6 months	50 mcg	0.05 mL
6 months–5-yrs-old	120 mcg	0.12 mL
6–12-yrs-old	250 mcg	0.25 mL
> 12-yrs-old	500 mcg	0.5 mL

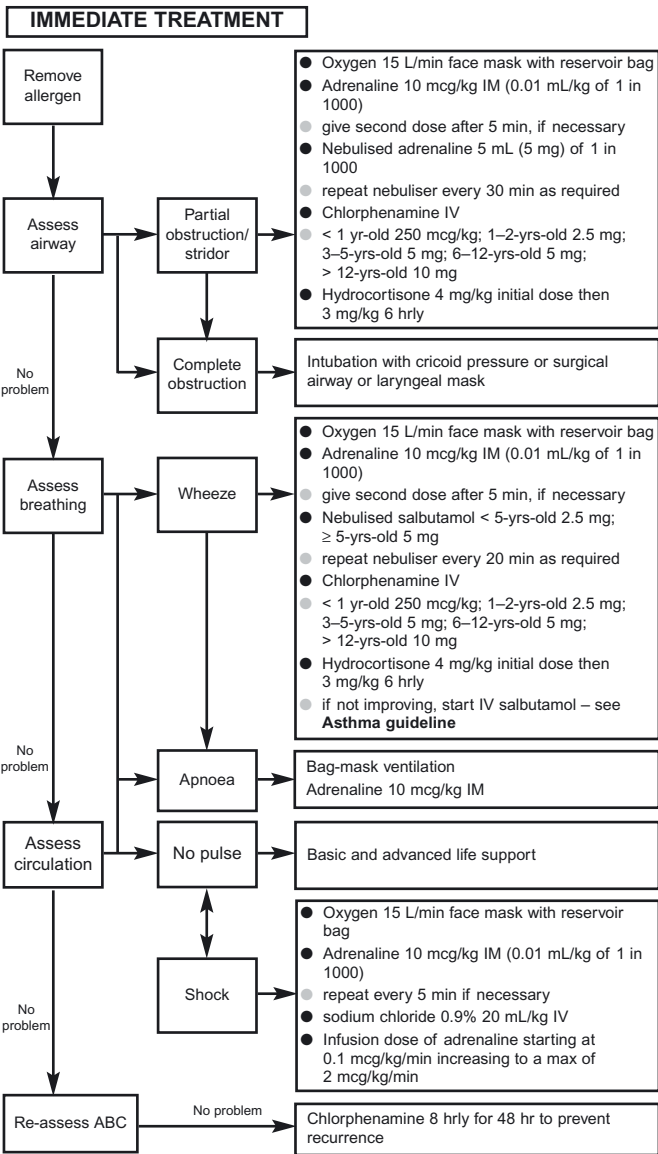
Do not give adrenaline intravenously except in resistant shock (no response to 2 IM doses) and with senior support

- Even if widespread, facial or peripheral oedema with a rash in the absence of the symptoms mentioned above do not justify adrenaline or hydrocortisone. Give chlorphenamine orally

SUBSEQUENT MANAGEMENT

- Urgently discuss and refer all children with anaphylaxis to a paediatrician with an interest in allergy
- Discharge with an emergency plan, including 2 adrenaline pen auto-injectors after appropriate training

ANAPHYLAXIS • 2/2



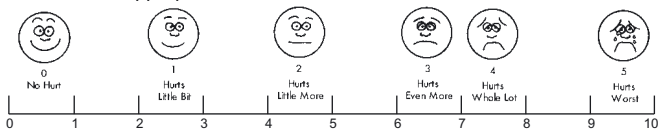
PAIN ASSESSMENT • 1/1

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

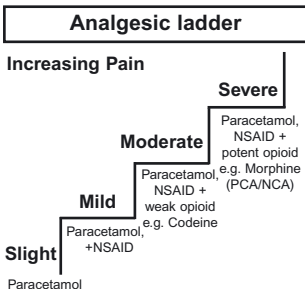
WONG AND BAKER PAIN ASSESSMENT – SELF REPORT

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



From Wong D.L., Hockenberry-Eaton M., Wilson D., Winkelstein M.L., Schwartz P: Wong's Essentials of Pediatric Nursing, ed. 6, St. Louis, 2001, p. 1301. Copyrighted by Mosby, Inc. Reprinted by permission

Analgesic interventions



Play Specialist

Intervention by play staff

Preparation aid used: doll, verbal

Explanation, photos

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

Refer all in need of analgesia and with behavioural concerns

NB: Check BNFC for contraindications/interactions/precautions etc © Pain Control Service, GOSH NHS Trust April 2003

ANALGESIA • 1/6

- For combination of analgesics to use, see **Analgesic Ladder in Pain Assessment**

TOPICAL

Age Group	Preparation	Time to onset	Comments
< 1 month	Glucose syrup on pacifier	during procedure	For venepuncture, IV cannulation
1 month -1 yr-old	Ametop	30 min	Causes itch, lasts 4 hrs
> 1 yr-old	EMLA	1 hr	
> 5 yrs-old	Ethyl chloride	Immediately	If can not wait for EMLA

MILD PAIN

Drug and preparation	Dose	Maximum dose	Comments
Paracetamol [oral/nasogastric (NG)] <ul style="list-style-type: none"> ● Suspensions: <ul style="list-style-type: none"> ● 120 mg/5 mL ● 250 mg/5 mL ● Tablets/soluble 500 mg 	<ul style="list-style-type: none"> ● First dose 20 mg/kg THEN <ul style="list-style-type: none"> ● 15-20 mg/kg per dose 4-6 hrly: <ul style="list-style-type: none"> ● 3-12-months-old: 60-120 mg/dose ● 1-5-yrs-old: 120-250 mg/dose ● 6-12-yrs-old: 250-500 mg/dose ● > 12-yrs-old: 500 mg-1 g/dose 	<ul style="list-style-type: none"> ● Max total dose in 24 hr ● < 3-months-old: 60 mg/kg ● > 3-months-old: 80 mg/kg ● > 12-yrs-old: 4 g ● reduce after 48 hr 	<ul style="list-style-type: none"> ● For mild pain ● Increase dose interval in renal impairment ● Avoid large doses in hepatic impairment or when patient taking other drugs affecting liver
Paracetamol (rectal) <ul style="list-style-type: none"> ● Suppositories <ul style="list-style-type: none"> ● 60 mg ● 125 mg ● 250 mg ● 500 mg ● 1 g 	<ul style="list-style-type: none"> ● First dose 30 mg/kg THEN <ul style="list-style-type: none"> ● birth-12-yrs-old: 20 mg/kg 4 hrly ● > 12-yrs-old: 500 mg-1 g 4 hrly 	<ul style="list-style-type: none"> ● Maximum total dose in 24 hr ● < 3-months-old: 60 mg/kg ● > 3-months-old: 90 mg/kg ● > 12 yrs old: 4 g 	<ul style="list-style-type: none"> ● As for oral paracetamol ● For mild pain when oral/NG route not possible
Paracetamol (IV) 10 mg/mL	Body weight 10-50 kg <ul style="list-style-type: none"> ● 15 mg/kg 4-6 hrly over 15 min Body weight > 50 kg <ul style="list-style-type: none"> ● 1 g 4-6 hrly 	<ul style="list-style-type: none"> ● Max total dose 60 mg/kg/day ● Up to 4 g daily 	<ul style="list-style-type: none"> ● As for oral paracetamol ● For mild pain when oral/NG/PR route not possible

ANALGESIA • 2/6

MILD TO MODERATE PAIN

Drug and preparation	Dose	Maximum dose	Comments
Ibuprofen <ul style="list-style-type: none"> ● Liquid 100 mg/5 mL ● Tablets 200 mg and 400 mg 	Given 3-4-times/day <ul style="list-style-type: none"> ● < 12-yr-old: 5 mg/kg per dose ● > 12-yr-old: 200-600 mg/dose 	<ul style="list-style-type: none"> ● < 12-yr-old: max 20 mg/kg/day ● > 12-yr-old: max 2.4 g/day 	<ul style="list-style-type: none"> ● If < 6-months-old or < 7 kg use only if recommended by consultant ● Avoid in renal dysfunction ● Contraindications: <ul style="list-style-type: none"> ● shock ● bleeding disorders ● hypersensitive to aspirin or other NSAID ● In stable asthmatics, can be given if no history of NSAID induced wheeze and chest clear on auscultation
Diclofenac <ul style="list-style-type: none"> ● Tablets <ul style="list-style-type: none"> ● dispersible 50 mg (can be used to give smaller doses) ● enteric coated 25 mg and 50 mg ● Suppositories 12.5 mg, 25 mg, 50 mg and 100 mg 	<ul style="list-style-type: none"> ● > 6-months-old <ul style="list-style-type: none"> ● 300 mcg-1 mg/kg three-times/day 	<ul style="list-style-type: none"> ● Maximum 150 mg/day 	<ul style="list-style-type: none"> ● As Ibuprofen
Codeine <ul style="list-style-type: none"> ● Liquid 25 mg/5 mL ● Tablets 15 mg, 30 mg and 60 mg 	<ul style="list-style-type: none"> ● Up to 12-yrs-old <ul style="list-style-type: none"> ● 500 mcg - 1 mg/kg four to six-times/day ● > 12-yrs-old <ul style="list-style-type: none"> ● 30-60 mg four to six-times/day 	<ul style="list-style-type: none"> ● Maximum 240 mg/day 	<ul style="list-style-type: none"> ● For moderate pain ● Caution in hepatic impairment ● If < 1-yr-old, use only if recommended by consultant ● Repeated doses increase risk of respiratory depression ● Caution if renal impairment ● Contraindications: <ul style="list-style-type: none"> ● acute respiratory depression ● paralytic ileus ● Not to be given with other opioids

ANALGESIA • 3/6

SEVERE PAIN IN CHILDREN > 1-YR-OLD

*In head injuries/respiratory difficulties/lupper airway obstruction, use opioids only on consultant advice.
Monitor children requiring O₂ and parenteral opioids with SpO₂ +/- TcCO₂ in an HDU setting*

Analgesic method and technique	Dose	Monitoring
<p>Oral morphine</p> <ul style="list-style-type: none"> ● Single dose prior to painful procedure may be useful ● Use if no IV access or for weaning from IV opiate ● Consider use of prophylactic laxative if to be taken regularly 	<ul style="list-style-type: none"> ● < 1 yr-old: <ul style="list-style-type: none"> ● 80 mcg/kg 4 hrly ● 1-2-yrs-old: <ul style="list-style-type: none"> ● 200-400 mcg/kg 4 hrly ● 2-12-yrs-old: <ul style="list-style-type: none"> ● 200-500 mcg/kg 4 hrly ● > 12-yrs-old: <ul style="list-style-type: none"> ● 10-15 mg 4 hrly 	<ul style="list-style-type: none"> ● Respiratory rate: maintain <ul style="list-style-type: none"> ● if 1-2-yrs-old, > 16 breaths/min ● if 2-10-yrs-old, > 14 breaths/min ● if 10-16-yrs-old, > 12 breaths/min ● if reduced rate, contact medical staff
<p>Morphine patient/nurse-controlled analgesia (PCA/NCA)</p> <ul style="list-style-type: none"> ● PCA is suitable for children > 5 yrs old (understand and will press button); NCA otherwise ● Nurses must be certified competent in use of PCA/NCA ● Use anti-reflux valve unless dedicated cannula ● Use morphine 1 mg/kg made up to 50 mL with sodium chloride 0.9% <ul style="list-style-type: none"> ● thus 1 mL = 20 mcg/kg ● maximum of 50 mg/50 mL 	<ul style="list-style-type: none"> ● If loading dose required <ul style="list-style-type: none"> ● experienced staff only ● 50-100 mcg/kg ● Background infusion if used <ul style="list-style-type: none"> ● 4-10 mcg/kg per hr ● Bolus dose <ul style="list-style-type: none"> ● 10-20 mcg/kg (0.5-1 mL) ● Lockout time <ul style="list-style-type: none"> ● 5-30 min ● Maximum dose in 4 hr of 400 mcg/kg 	<p>Hrly observations</p> <ul style="list-style-type: none"> ● Pain score ● Sedation score ● Pump displays ● Syringe movement ● Respiratory rate ● SpO₂ if needed ● TcCO₂ if needed <p>4 hrly observations</p> <ul style="list-style-type: none"> ● Vomiting/itching ● Urinary retention ● Inspection of IV site

ANALGESIA • 4/6

Analgesic method and technique	Dose	Monitoring
<p>Morphine infusion</p> <p>Use anti-reflux valve unless dedicated cannula</p> <ul style="list-style-type: none"> ● Use anti-syphon valve on line ● Use morphine 1 mg/kg made up to 50 mL with sodium chloride 0.9% ● 1 mL/hr = 20 mcg/kg/hr ● 2 mL/hr = 40 mcg/kg/hr ● maximum of 50 mg/50 mL ● use for severe pain when not able to use PCA/NCA 	<ul style="list-style-type: none"> ● Loading dose of 100-200 mcg/kg given over 5-20 min ● Continuous infusion of 10-50 mcg/kg per hr ● Start at 1 mL/hr (=20 mcg/kg/hr) except after major surgery when start at 2 mL/hr (= 40 mcg/kg per hr) and adjust according to pain and sedation scores 	<p>Hrly observations</p> <ul style="list-style-type: none"> ● Pain score ● Sedation score ● Respiratory rate: maintain <ul style="list-style-type: none"> ● if 1-2-yrs-old, > 16 breaths/min ● if 2-10-yrs-old, > 14 breaths/min ● if 10-16-yrs-old, > 12 breaths/min ● if reduced rate, contact medical staff ● SpO₂ monitoring ● Syringe movement ● IV site for infection ● Urinary retention
<p>IV intermittent morphine</p> <ul style="list-style-type: none"> ● Infusion preferable 	<ul style="list-style-type: none"> ● Give slowly over 10 min ● 1-12-yrs-old: <ul style="list-style-type: none"> ● 100-200 mcg/kg 4 hrly ● > 12-yrs-old: <ul style="list-style-type: none"> ● 2.5-10 mg 4 hrly 	<p>Hrly observations</p> <ul style="list-style-type: none"> ● Pain score ● Sedation score ● Respiratory rate: maintain <ul style="list-style-type: none"> ● if 1-2-yrs-old, > 16 breaths/min ● if 2-10-yrs-old, > 14 breaths/min ● if 10-16-yrs-old, > 12 breaths/min ● if reduced rate, contact medical staff ● SpO₂ monitoring
<p>SC intermittent opioid</p> <ul style="list-style-type: none"> ● 22/24 g SC cannula can be sited at time of surgery or using EMLA cream ● suitable sites: uppermost arm, abdominal skin ● IV preferable 	<ul style="list-style-type: none"> ● Give slowly over 5 min ● Flush with 0.3 mL sodium chloride 0.9% - usually prime cannula with morphine solution ● Morphine <ul style="list-style-type: none"> ● 100-200 mcg/kg 3 hrly ● maximum six-times in 24 hr 	<ul style="list-style-type: none"> ● Pain score ● Sedation score ● Respiratory rate: maintain <ul style="list-style-type: none"> ● if 1-2-yrs-old, > 16 breaths/min ● if 2-10-yrs-old, > 14 breaths/min ● if 10-16-yrs-old, > 12 breaths/min ● if reduced rate, contact medical staff

ANALGESIA • 5/6**SEVERE PAIN IN CHILDREN < 1-YR-OLD**

In head injuries/respiratory difficulties/lupper airway obstruction, use opioids only on consultant advice. Monitor children requiring O₂ and parenteral opioids with SpO₂ +/- TcCO₂ in an HDU setting

Analgesic method and technique	Dose	Monitoring
Oral morphine <ul style="list-style-type: none"> ● Use if no IV access or for weaning from IV opiate 	<ul style="list-style-type: none"> ● 1-12-months-old ● 100 mcg/kg 4 hrly ● maximum five doses in 24 hr 	<ul style="list-style-type: none"> ● Pain score ● Sedation score ● Respiratory rate: maintain <ul style="list-style-type: none"> ● if < 6-months-old, > 20 breaths/min ● if > 6-months-old, > 16 breaths/min ● if reduced rate, contact medical staff ● SpO₂ as appropriate
Morphine infusion <ul style="list-style-type: none"> ● Use anti-reflux valve unless dedicated cannula ● Use anti-syphon valve on line ● Use morphine 1 mg/kg made up to 50 mL with sodium chloride 0.9% ● thus 1 mL/hr = 20 mcg/kg per hr use for severe pain 	<ul style="list-style-type: none"> ● 1-6-months-old <ul style="list-style-type: none"> ● Loading dose 25-50 mcg/kg over 30-60 min ● Continuous infusion of 10-30 mcg/kg per hr (0.5 mL/hr) ● 7-12-months-old <ul style="list-style-type: none"> ● loading dose 100 mcg/kg over 30-60 min ● continuous infusion of 10-40 mcg/kg per hr (1 mL/hr) ● Increase with caution in 5 mcg/kg per hr intervals 	Hrly observations <ul style="list-style-type: none"> ● Pain score ● Sedation score ● Respiratory rate: maintain <ul style="list-style-type: none"> ● if < 6-months-old, > 20 breaths/min ● if > 6-months-old, > 16 breaths/min ● if reduced rate, contact medical staff ● SpO₂ monitoring ● Syringe movement ● Site for infection ● Urinary retention

ANALGESIA • 6/6

Analgesic method and technique	Dose	Monitoring
<p>IV intermittent morphine</p> <ul style="list-style-type: none"> ● Infusion preferable 	<ul style="list-style-type: none"> ● 1-3-months-old ● 25 mcg/kg 6 hrly ● 3-6-months-old ● 50 mcg/kg 6 hrly ● 6-12-months-old ● 100 mcg/kg 4 hrly 	<ul style="list-style-type: none"> ● Hrly observations for 24 hr then 4 hrly if stable ● Pain score ● Sedation score ● Respiratory rate: maintain <ul style="list-style-type: none"> ● if < 6-months-old, > 20 breaths/min ● if > 6-months-old, > 16 breaths/min ● if reduced rate, contact medical staff ● SpO₂ monitoring
<p>SC intermittent opiate</p> <ul style="list-style-type: none"> ● 24 g SC cannula can be sited at time of surgery or using EMLA cream ● suitable sites: uppermost arm, abdominal skin ● IV preferable 	<ul style="list-style-type: none"> ● Give slowly over 5 min ● Flush with 0.3 mL sodium chloride 0.9% ● Morphine <ul style="list-style-type: none"> ● 3-12-months-old 150 mcg/kg ● < 6 months 6 hrly maximum ● > 6 months 4 hrly maximum 	<ul style="list-style-type: none"> ● Pain score ● Sedation score ● Respiratory rate: maintain <ul style="list-style-type: none"> ● if < 6-months-old, > 20 breaths/min ● if > 6-months-old, > 16 breaths/min ● if reduced rate, contact medical staff ● SpO₂ monitoring

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:
 - respiration
 - protection of airway, swallowing, cough reflex
 - cardiovascular stability
- **Do not sedate without discussion with anaesthetist if:**
 - 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
- **Sedation can be difficult in children:**
 - taking antiepileptics (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 is 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)
 - oversedation (maintaining airway, aspiration)

Fasting for moderate – heavy sedation

If interval before procedure is:

- 6 hrs – allow full meal
- 4 hrs – allow milk
- 2 hrs – allow clear fluids only

EQUIPMENT

- Portable oxygen
- Portable suction
- Appropriately sized face mask and resuscitation bag

SEDATION • 2/3

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

DRUG CHOICE

Sedation drugs

Drug	Route	Onset	Duration	Dose	Comments
Chloral hydrate	<ul style="list-style-type: none"> ● Oral ● Rectal 	30 min-1 hr	1-2 hr	<ul style="list-style-type: none"> ● Night sedation 30 mg/kg ● Pre-anaesthesia 50 mg/kg ● Scans 70 mg/kg ● Maximum dose 1 g 	<ul style="list-style-type: none"> ● More efficacious for babies < 15 kg or < 18-months-old ● Use for sedation prior to EEG
Temazepam	● Oral	45-90 min	Up to 4 hr	<ul style="list-style-type: none"> ● 0.5 mg/kg ● Up to 1 mg/kg for scans ● Maximum 30 mg 	● CT, MAG3
Midazolam	<ul style="list-style-type: none"> ● Oral ● Rectal ● Intranasal ● Nebulizer ● IV 	15-30 min	1-2 hr	<ul style="list-style-type: none"> ● oral: 500 mcg/kg (max 15 mg); 6 to 12 yr 10 mg ● rectal: 300-500 mcg/kg ● intranasal: 100-150 mcg/kg each nostril ● IV: 50-100 mcg /kg (< 6 years max 6 mg) 	<ul style="list-style-type: none"> ● IV cannulation (+EMLA or local anaesthetic) ● more suitable for older children ● Not so useful for CT scan ● Repeat 100 mcg/kg IV if necessary up to maximum 5 mg
Morphine sulphate	● Oral	15 min	2-3 hr	<ul style="list-style-type: none"> ● 200-400 mcg/kg for children > 1-yr old ● Maximum 20 mg 	● For painful procedures may be useful combined with midazolam 500 mcg/kg

SEDATION • 3/3

MONITORING

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

SUBSEQUENT MANAGEMENT

Failed sedation

- Repeat maximum dose of initial drug used after expected period of onset
- Call anaesthetist – if available to help in event of second dose failing
- Apply EMLA cream
- If repeat dose fails:
 - IV sedation by anaesthetist or
 - reschedule procedure for later date under general anaesthetic

Paradoxical excitement

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

INSERTION OF LONG LINES • 1/3

INDICATIONS

- Use peripherally sited long lines in patients requiring prolonged (> five day) courses of IV antibiotic therapy either in hospital or at home (e.g. patients with cystic fibrosis or bronchiectasis)
- Long line with tip in a central vein for drugs that have to be given centrally (e.g. if they cause phlebitis) or if risk of infection high (e.g. parenteral nutrition)
- in patients with difficult venous access, or as a compromise between a standard cannula and a long line, it may be easier to insert a shorter Leaderflex line. These can last as long as standard long lines

CONTRAINDICATIONS

- No suitable veins for insertion of catheter

EQUIPMENT

- Assistant
- Long line. There are several types in common use:
 - Nutraline PIC line (preferred) 2 Fr (for small veins) or 3 Fr 30 cm
 - Leaderflex line 8 cm or 20 cm (for lines to last up to 1 week)
 - Vygon silastic lines (20 cm) require continuous infusion to maintain patency and are not recommended except in neonates

DO NOT ATTEMPT INSERTION UNLESS YOU ARE FULLY TRAINED

Use whichever line you have been trained to use

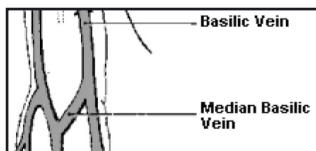
- Flush solution: 4 mL Canusal (100 units heparin/mL)
- Single dressing pack
- Sterile gloves
- Sterile scissors
- Two extra sterile towels
- 5 mL syringe, green needle
- Tape measure
- Sterile clear dressing e.g. Opsite/Tegaderm
- Incontinence pad
- Two extra packs gauze swabs
- Alcoholic chlorhexidine (or other skin antiseptic)
- One injectable bung
- Three wide Steristrips (optional to secure line)
- Sterile untoothed forceps (to feed line up butterfly)

PROCEDURE

PIC Line Preparation

- 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 the arm to avoid hair plucking when dressing is removed

INSERTION OF LONG LINES • 2/3



- Specify exactly where you would like EMLA sited – the basilic vein (medial) is usually best – and apply EMLA cream to chosen veins (three 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 patient's notes for comments about previous line insertions. Some veins can be particularly difficult and the patient can often provide guidance
- 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)
- ensure patient in position and comfortable, and lighting optimal
- Measure distance from site of insertion to sternal notch (if

inserting in arm) or xiphisternum (if inserting in leg) so catheter tip is placed outside heart

Aseptic technique

- Wash hands, and put on apron/gown and sterile gloves
- Clean patient's skin thoroughly with 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
- Assemble line fully and flush with Canusal to ensure patency
- Place everything you will need onto sterile sheet within reach
- Ask assistant to apply tourniquet (or squeeze the patient's arm), but remain ready to release
- Check patient is ready for you to start
- Be careful – introducer for the PIC 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 the assistant to release tourniquet to reduce blood flow
- Taking the PIC 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

INSERTION OF LONG LINES • 3/3

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 4 mL Canusal
- 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 steristrips
- Cover entry site, connections and all exposed line with one piece of clear dressing (e.g. Opsite)
- X-ray line with 0.5 mL of contrast 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

- Aim to insert to 20 cm and tape the remaining silastic length to the skin with an adhesive dressing e.g. Steristrip
- Place a folded half gauze swab under the blue hub before taping down with adhesive, then cover with transparent dressing, minimizing contact between gauze and transparent dressing in case removal is required for trouble-shooting
- Flush after each use with 4 mL Canusal

MONITORING EX-PREMATURE INFANTS FOLLOWING GENERAL ANAESTHESIA • 1/1

BACKGROUND

- If born at ≤ 35 weeks' gestation, ex-preterm infants undergoing general anaesthesia have a 1% risk of post-anaesthetic apnoea for the first year of life
- Perioperative anaemia increases this risk

PATIENT SELECTION

- All infants:
 - born before 36 weeks' gestation < 1 year old at the time of operation
 - with chronic lung disease who have required O_2 treatment within the last six months

MANAGEMENT

Pre-operative

- Check haemoglobin (Hb)
 - if $Hb < 9$ g/dL, arrange transfusion
- Arrange overnight stay for post-operative monitoring

Immediate post-operative period

- Transfer patient with O_2 supply, continuous SpO_2 monitoring and full resuscitative equipment
- Admit patient to a designated HDU ward area

Subsequent post-operative management

- High dependency nursing care
- Monitoring to include:
 - continuous pulse oximetry
 - continuous ECG
 - continuous respiratory rate
 - transcutaneous CO_2
- If apnoea > 15 sec:
 - immediate respiratory support by nurse (airway manoeuvres, bag and mask ventilation)
 - contact on-call SpR
 - liaise with anaesthetist responsible for patient
 - review period of HDU care

DISCHARGE POLICY

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

PRE-OPERATIVE FASTING • 1/1

PRINCIPLES

- Do not fast patients for longer than is 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 < 2-yr-old) clear fluids up to 2 hr pre-operatively
Liaise closely with theatre to discover approximate time of patient's operation*

POLICY

- Patients may take solid food and milk up to 6 hr before elective surgery
- Patients may take clear oral fluids up to 2 hr before surgery. Thereafter, sips of water may be taken to enable tablets to be swallowed
- clear fluids do **not** include fizzy drinks

PROCEDURE

ALL children > 1-yr-old

- **Morning operating lists**
 - no solid food after midnight
 - clear fluids (e.g. water or fruit

juice) should be allowed according to appetite to finish before 0700 hr

● **Afternoon operating lists**

- light breakfast (including toast, continental breakfast, or small bowl of cereal) to finish before 0730 hr
- clear fluids (e.g. water or fruit juice) should be allowed according to thirst to finish before 1130 hr

Infants/children < 1-yr-old

● **Morning operating lists**

- last formula milk feed before 0300 hr
- last breast milk feed before 0500 hr
- fruit juice (diluted as necessary) to finish before 0700 hr

● **Afternoon operating lists**

- last formula milk feed before 0730 hr
- last breast milk feed before 0930 hr
- fruit juice (diluted as necessary) to finish before 1130 hr

Nursing and medical staff should ensure that all children are encouraged to drink clear fluids until 2 hr before anaesthesia/surgery

ASTHMA - ACUTE MANAGEMENT • 1/4

RECOGNITION AND ASSESSMENT

Definition

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

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

Moderate/severe

- Too breathless to talk/feed
- Tachypnoea (> 50 breaths/min if < 5-yrs-old; > 40 breaths/min if ≥ 5-yrs-old)
- Tachycardia (> 140 beats/min if < 5-yrs-old; > 120 beats/min if ≥ 5-yrs-old)
- Use of accessory muscles – subcostal, intercostals, sternomastoids, alae nasi
- O₂ saturation < 92% in air
- Peak expiratory flow (PEF) < 50% expected (if > 7-yrs-old)

Life threatening

- Cyanosis/pallor
- Decreased air entry/silent chest
- Poor respiratory effort
- Decreased conscious level
- Irritable/exhausted
- O₂ saturation < 85% in air

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

Differential diagnosis

- Foreign body
- Pneumonia
- Pneumothorax
- Aspiration
- Cystic fibrosis
- Tracheobronchomalacia
- Gastro-oesophageal reflux

Investigations

- Record:
 - respiratory rate
 - heart rate
 - air entry
 - O₂ saturation – is it > 92% in air?
 - Peak expiratory flow (PEF) - if > 7-yrs-old
 - conscious level

Do not do any routine bloods or routine blood gas. They do not alter the initial management. Routine chest X-ray is unnecessary in a child with asthma

ASTHMA - ACUTE MANAGEMENT • 2/4

IMMEDIATE MANAGEMENT

- Follow algorithm **Management of acute wheezing**
- **Call senior doctors for further assessment if:**
 - you are worried about the child's conscious level or
 - there is no response to nebulized salbutamol or
 - there is poor respiratory effort
- Site an IV line
- IV salbutamol 5 mcg/kg/min for 5 min then 2 mcg/kg/min continuous infusion. Alter dose within range 1-4 mcg/kg/min according to response
- Use TcCO₂ monitor
- Continue with high flow O₂ and continuous salbutamol nebulizer while waiting

SUBSEQUENT MANAGEMENT

Follow the algorithm **Management of acute wheezing**

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 the child)
 - days off school because of asthma
 - number of courses of prednisolone used in the last year

- pets
- drug history (device and dose) especially any bronchodilators/inhaled corticosteroids, particularly the need to use beta agonists and response

DISCHARGE POLICY

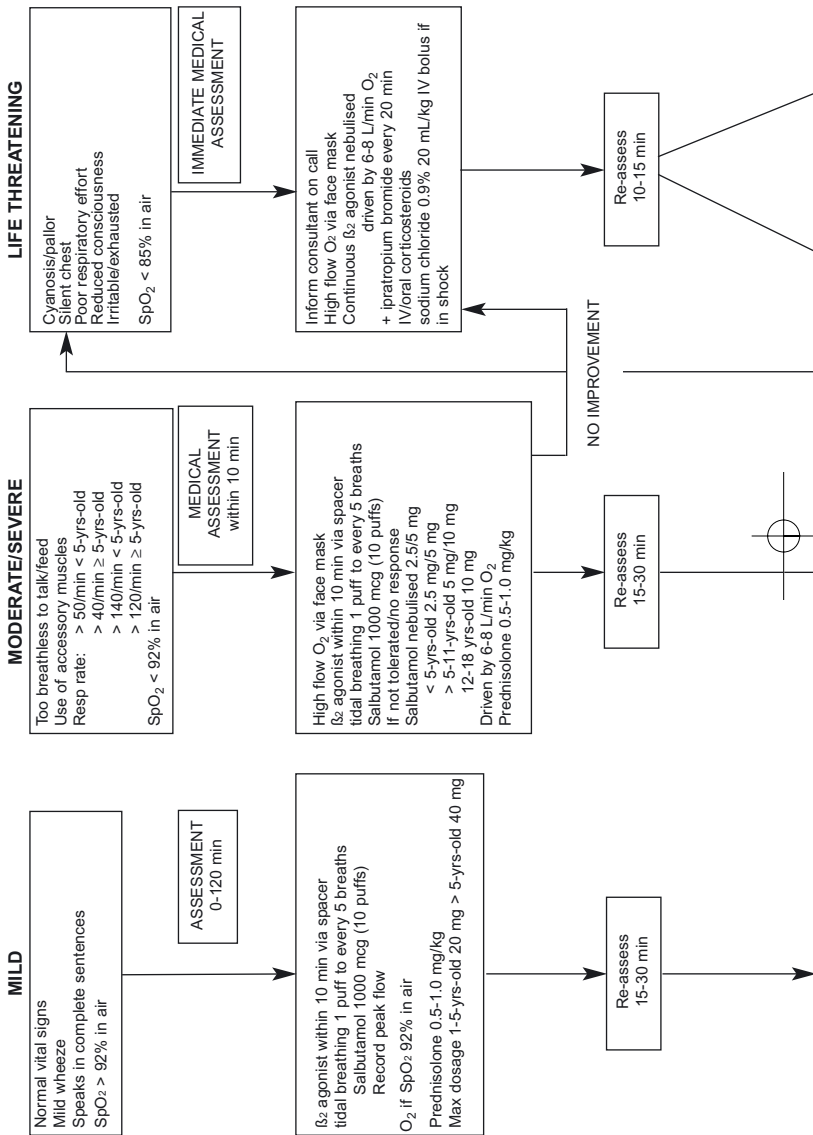
- Discharge home same day if:
 - child has made a significant improvement and has remained stable for 4 hr
- Parents:
 - understand use of inhalers
 - have a written plan
 - know how to recognize signs of deterioration
- Prescribe beta-agonist with spacer
- Give prednisolone 0.5 mg/kg daily for three to five days
- Educate on use of PEF meter if > 6-yrs-old (not if child has never used it before)
- Follow-up in either nurse-led asthma clinic (if available) or consultant clinic

Chronic management

- Give inhaled corticosteroid if any of the following:
 - frequent episodes
 - bronchodilators used most days
 - 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 decongestant/steroid nasal spray

ASTHMA - ACUTE MANAGEMENT • 3/4

Management of acute wheezing

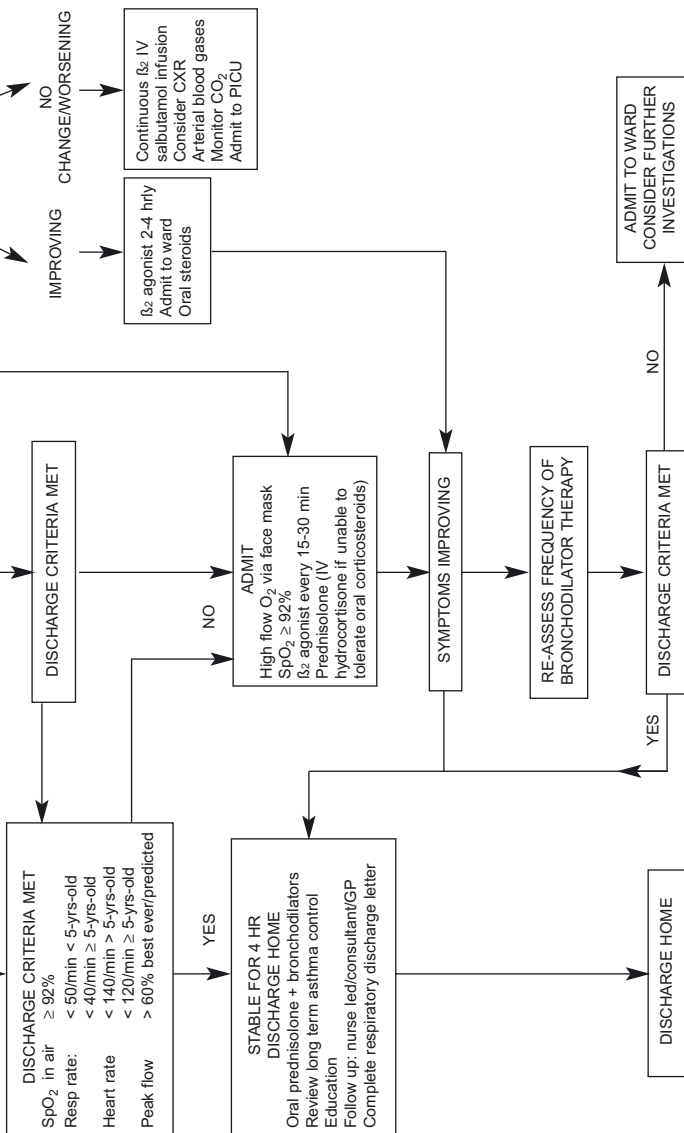


Issue 02

Issued: September 2006

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ASTHMA - ACUTE MANAGEMENT • 4/4



BRONCHIOLITIS • 1/3

RECOGNITION AND ASSESSMENT

Definition

- Acute inflammatory illness of the small airways that occurs in winter epidemics and affects children < 2-yrs-old, with a peak incidence at around 6-months-old
- Respiratory syncytial virus (RSV) is causative agent in > 50% of cases, with parainfluenza 3, influenza and adenovirus types 3, 7 and 21 causing the remainder

Symptoms and signs

- Coryzal symptoms for two to five days before presentation
- Cough (often 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 virus-induced wheeze
- Early asthma
- Cystic fibrosis
- Pertussis

- Recurrent aspiration
- Foreign body in trachea
- Congenital lung anomaly

Investigations

- SaO₂ while breathing air
- If respiratory rate > 80 breaths/min, transcutaneous PCO₂ > 6 kPa, SpO₂ < 92% in > 50% inspired oxygen or severe respiratory distress, measure arterial or capillary blood gases
- Avoid tests that do not contribute to immediate management. Perform the following only for specific indications:
 - RSV quick test in severely immunocompromised patient to plan antiviral treatment
 - chest X-ray if there are localising signs, cardiac murmur or atypical presentation (e.g. older child)
 - U&E if there is a plan for IV fluids
 - blood cultures with sepsis or temperature > 38.5°C

IMMEDIATE TREATMENT

- Nurse head up to reduce splinting of diaphragm
- Clear airway by suction of nares and mouth
- Use sodium chloride 0.9% nose drops before suction
- If O₂ saturation ≥ 93% in air, give O₂ via facemask with a reservoir bag
- humidify oxygen

BRONCHIOLITIS • 2/3

- if mask not tolerated, use nasal prongs for oxygen flow up to 1 L/min in children \leq 5 kg body weight, (up to 2.0 L/min in children $>$ 5 kg)
- In patients with impending respiratory failure, review hourly. Consider additional respiratory support with CPAP if two or more of following are present:
 - respiratory rate $>$ 60 breaths/min
 - bradypnoea or cyanotic episodes (with or without bradycardia) despite supplemental O_2
 - severe intercostal recession and indrawing
 - need for $>$ 2 L/min O_2 via nasal prongs
 - rising $PaCO_2$ ($>$ 3 kPa from baseline)
 - respiratory acidosis (pH $<$ 7.20)
- Assess circulation and treat shock if present
- Correct dehydration with oral fluids
- If oral fluids not tolerated, use IV fluids
- once rehydrated, restrict intake to 80% of estimated maintenance requirements using sodium chloride 0.45% / glucose 5% with 10 mmol KCl per 500 mL
- monitor U&E while giving intravenous fluids, 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 (sodium chloride 0.45% and glucose 5%) at 80% maintenance if:
 - persistent respiratory rate $>$ 80 breaths/min
 - persistent vomiting
 - O_2 saturation $<$ 92% despite supplemental O_2
 - deterioration of respiratory status during nasogastric feeding
 - marked increase in work of breathing with poor co-ordination of sucking, swallowing and breathing

Drug treatment

- In immunocompetent patients, drug treatment and physiotherapy (in the acute phase) are ineffective. **DO NOT ROUTINELY PRESCRIBE** bronchodilators, antibiotics or steroids
- In the severely immunocompromised patient, **request consultant approval** before prescribing ribavirin
- For babies aged under 6 weeks or patients with temperature more than $39^\circ C$, discuss antibiotics with consultant

BRONCHIOLITIS • 3/3

Criteria for admission

- Absolute:
 - apnoea
 - underlying cardiac defects, especially large left to right shunt
 - SpO₂ < 92% in air in a child in the early phase of the illness
 - inadequate feeding
 - dehydration
 - diagnostic uncertainty
- Relative:
 - re-attends A&E in < 48 hrs
 - age < 6 weeks (corrected gestational age)
 - unsatisfactory family circumstances and impaired ability to care for the unwell child
 - younger children (i.e. < 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 – for example neurodegenerative

MONITORING TREATMENT

- Standard nursing observations
- If patient requires supplemental O₂, continuous O₂ saturation monitoring
- If patient using O₂ via nasal prongs at ≥ 2 L/min (approximately ≥ 60% O₂) or has history of apnoea or colour changes, transcutaneous CO₂

monitoring

- If patient requires additional respiratory support, continuous heart and respiratory rate monitoring

SUBSEQUENT MANAGEMENT

- Nurse in a cubicle, or in a bay with children with the same proven diagnosis
- Strict hand washing to support infection control; apron and gloves for patient contact
- Fluid balance
- Oxygen support:
 - test the need for support 6 hrly
 - keep oxygen saturation ≥ 92% in the recovery phase
 - wean from nasal prongs to air as tolerated

DISCHARGE POLICY

- Discharge home when:
 - fully fed orally
 - SaO₂ > 92% in air

OUT-PATIENT MANAGEMENT

- Hospital follow-up if:
 - ventilated on PICU
 - consolidation on chest X-ray (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 stridor
- Causative agent is parainfluenza virus (sometimes influenza, respiratory syncytial virus, rhinovirus)

ASSESSMENT

- **STRIDOR**
 - none
 - on crying/exertion
 - at rest
 - severe/biphasic

Differential diagnosis

- Acute:
 - croup
 - epiglottitis (rare since immunisation against *Haemophilus influenzae* type B)
 - bacterial tracheitis
 - foreign body
- Chronic:
 - congenital abnormality
 - laryngomalacia
 - foreign body

Aetiology

- Age: 6 months to 6 yrs (peak age 2 yrs)
- Seasonal peak: late autumn
- Transmission: contact with secretion usually in droplet form
- Incubation period 2-6 days

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 **C.R.O.UP.** score
 - C – Cyanosis
 - R – Recession/Respiratory rate
 - O – Oxygen saturations (keep > 92%)
 - UP – Upper airway obstruction e.g. stridor
- Record level of consciousness – AVPU
- **Do not examine throat**
- Do not distress child

Severity

Mild croup

- Barking cough
- Nil/intermittent stridor
- No recession
- No cyanosis

Moderate croup

- 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
- If diagnosis unclear, discuss with senior regarding investigations

IMMEDIATE MANAGEMENT

Mild to moderate croup

- Antipyretics
- Adequate fluid intake
- Leaflet on croup and reassurance
- Oral dexamethasone 150 mcg/kg, can be repeated 12 hr later
- If unable to take corticosteroid orally, give nebulised budesonide 2 mg
- Admit/observe for 4 hrs and reassess
- If better, discharge with oral dexamethasone 150 mcg/kg to take if needed 12 hr later

Severe croup

- Nebulised adrenaline 400 mcg/kg to max 5mL 1:1000 (relieves symptoms, but short duration of action)
- Oral dexamethasone 150 mcg/kg or nebulised budesonide 2 mg

- Oxygen
- Inform consultant paediatrician on call
- discuss whether to involve on call anaesthetist
- If there is no sustained improvement with adrenaline and dexamethasone:
 - secure airway in theatre by experienced anaesthetist
 - transfer to PICU

DISCHARGE POLICY

- Leaflet on croup
- Advise paracetamol to control fever and encourage oral fluid intake
- Advise parents to seek help if:
 - drooling
 - laboured breathing
 - persistent fever
 - biphasic/worsening stridor
 - cyanosis
 - reduced level of consciousness/confusion
- No follow up

CYSTIC FIBROSIS – ADMISSION • 1/3

INDICATIONS FOR ADMISSION

- Requiring IV antibiotics and not suitable for home IV antibiotics:
 - respiratory exacerbation
 - > 5% weight loss (despite supplemental feeds)
 - preparation for an operation under general anaesthetic
- Distal intestinal obstruction syndrome (DIOS)
- Intractable feeding problems
- Insertion of a permanent IV line
- Insertion of a feeding gastrostomy
- Liver biopsy
- Other complication of cystic fibrosis (CF)
- Admission for non-CF reason

ARRANGING ADMISSION

- Via the CF nurse specialist with the ward sister
- Refer to admission plan in notes or clinic letter
- Admit to cubicle

ADMISSION PROCEDURE

- Plot baseline weight, height
- Perform flow volume loop spirometry on admission day (> 6–7-yrs-old)
- Write up drug chart before parents leave
- Check whether annual bloods could conveniently be taken now (see **Annual bloods**)
- Ask nursing staff to inform physiotherapist and dietician on day of admission

- Check specific aspects of management or investigations, as described by CF team
- for IV antibiotics, see **Exacerbations in child with cystic fibrosis**
- for bowel blockage, see **Distal intestinal obstructive syndrome**

INVESTIGATIONS

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
 - when taking tobramycin levels
- All ages:
 - FBC and film
 - vitamin A, D, E
 - parathyroid hormone
 - U&E, creatinine, chloride, calcium, magnesium, phosphate, albumin, total protein, alkaline phosphatase, bilirubin, AST/ALT, GGT, CRP
 - glucose
- ≥ 5-yrs-old all of the above plus:
 - total IgE
 - IgE specific to aspergillus
 - aspergillus precipitins
 - glucose tolerance test (at 0, 60 and 120 min)
 - HbA_{1c} (if diabetic)
 - baseline DEXA scan at age 10 yrs (repeated every 2-3 yrs)

CYSTIC FIBROSIS – ADMISSION • 2/3

Chest X-ray

- Most children have chest X-ray every 6-12 months so another may not be necessary
- Check when latest was taken and, if in doubt, discuss with consultant

Lung function and O₂ saturations

- Measure FVC and FEV₁ using the ward spirometer (the physiotherapist can take these measurements if requested):
 - in all children who can blow reliably (usually from 6-7-yr-old)
 - on admission and at least weekly, preferably before ward rounds
 - towards the end or after completion of a course of IV antibiotics, take measurements before and after inhalation of salbutamol MDI 4-8 puffs via a spacer
- Monitor O₂ saturations overnight for the first 2 nights after admission
- if saturations < 91% give O₂ via nasal cannulae or facemask

Microbiology

- In hospital, request twice weekly sputum/cough swab
- usually performed by physiotherapist but **check this has been done**

- If new pathogen found, see **Microbiology and cross-infection**

Screening for hyperglycaemia

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

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

NUTRITION

- Involve dieticians closely
- Weigh twice weekly, **in nightwear and before breakfast**
- Continue normal supplements

Pancreatic enzyme supplements

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

CYSTIC FIBROSIS – ADMISSION • 3/3

Starting dosage for newly-diagnosed child

● **Infants**

- Creon 10,000 one-quarter to one-half capsule/120 mL milk

● **Children**

- two capsules with main meals, one with snacks
- Dose is titrated with fat content of meals and snacks to control symptoms of malabsorption
- maximum 10,000 iu lipase /kg per 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

H₂-receptor antagonists

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

Vitamins A, D and E

- Continue dose as prescribed in CF clinic

Oral sodium chloride

- Only if prescribed by CF team

CYSTIC FIBROSIS – EXACERBATION • 1/3

RECOGNITION AND ASSESSMENT

The usual cause of admission in a known child with cystic fibrosis (CF) is a respiratory infection/exacerbation. If patient presents with unusual symptoms, such as haemoptysis, abdominal pain (distal intestinal obstruction syndrome), or bleeding varices, discuss with **CF consultant**

Symptoms and signs

- Increasing cough and sputum
- Increasing dyspnoea
- Weight loss with loss of appetite
- Thick, tenacious sputum
- Clubbing
- Coarse crepitations
- Haemoptysis
- Signs of right heart failure

Investigations

- See investigations in **Cystic Fibrosis – Admission**

Differential diagnosis

- Pneumothorax

ADDITIONAL ADMISSION PROCEDURE

- If long line needed, apply EMLA cream to **your** chosen sites
- Check latest sputum culture (usually from last clinic visit) and antibiotic sensitivities
- Most experienced SpR to insert long line-see **Insertion of long lines**

- Do not give sedation for long line insertion without anaesthetic review
- Trained nursing staff to needle Port-a-cath

IMMEDIATE TREATMENT

- Use IV antibiotic regimen suggested in the latest out-patient entry in patient notes
- If no recommendation, stop oral antibiotics and give first-line regimen (see below)
- Take into account any past allergic reactions **and current sputum sensitivities**
- If in any doubt, contact CF Team

First-line regimen

- Sputum culture
- *Pseudomonas aeruginosa*: ceftazidime (50 mg/kg 8 hrly max 9 g/day) + tobramycin (4 mg/kg 8 hrly or 10 mg/kg once daily)
- *Pseudomonas aeruginosa*: cefuroxime (50 mg/kg 8 hrly) +/- tobramycin (4 mg/kg 8 hrly or 10 mg/kg once daily)
- Tobramycin can be given tds or once daily: discuss with CF team
- Courses usually last two weeks
- For cephalosporins, (but not tobramycin), aim to use whole vials by rounding doses +10% considering vial size
- After satisfactory tobramycin blood levels established, teach parents to give antibiotics at home. Discuss with Pharmacy and CF nurses

CYSTIC FIBROSIS – EXACERBATION • 2/3

Nebulized antibiotics

- Give children colonized with *Pseudomonas* colomycin 1 x MU, made up to 4 mL with sodium chloride 0.9%, nebulised 12 hrly

Oral antibiotics

- Children are rarely given oral antibiotics during admission but may resume an oral agent on discharge

Bronchodilators

- Prescribe salbutamol by MDI and spacer 8-hrly before chest physiotherapy in hospital

Inhaled corticosteroids

- Continue any regular treatment with inhaled beclomethasone, budesonide or fluticasone
- Take opportunity to check inhaler technique

TOBRAMYCIN MONITORING

- Take sample at time of third dose (**not via Port-a-cath or Nutriline catheter**), aiming for:

- pre-dose: < 2 mg/L

Multiple dose regimens:

- 1 hr post bolus dose start of 30 min infusion : 8-12 mg/L
- Weekend assays require prior arrangement with the Lab
- high trough – increase interval (e.g. 12 hrly)
- high peak – decrease dose
- low peak – increase dose

Once daily regimen:

- Trough level 8-14 hrs after first and 7th dose
- No need to determine peak
- Discuss dose changes with CF team

SUBSEQUENT MANAGEMENT

- Do not change antibiotics without discussing with CF team

Oral corticosteroids

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

DNase

- Consider if:
 - FEV₁ < 80% predicted for height
 - cough productive of sputum or sputum difficult to expectorate
 - requiring IV antibiotics more than every 3 months
- Only with CF consultant advice once funding agreed
- Give DNase (2.5 mg/daily) via nebuliser after morning physiotherapy
- Patients should bring their own nebuliser (usually a modified Sidestream®) and compressor into hospital

CYSTIC FIBROSIS – EXACERBATION • 3/3

DISCHARGE

- On advice of CF team

- feedback any concerns to CF Team

Self-administration of IV antibiotics – home IV therapy

- 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 from hospital
 - 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, it is important that the parent/carer also has adequate instruction and guidance
 - 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

CYSTIC FIBROSIS – MICROBIOLOGY • 1/2

Management of microbiology and cross-infection

- In addition to standard precautions and hand hygiene, the following precautions are required for patients infected/colonized with transmissible pathogens
- do not share equipment between patients
- nurse children with CF in a cubicle
- limit contact between CF patients

Patient newly diagnosed with CF

- Prophylaxis with flucloxacillin until 2-yrs-old
- If newly diagnosed CF patient has chest infection (no pathogens)
 - cefuroxime IV for two weeks, then co-amoxiclav orally for 3-4 weeks
- Subsequent treatment depends on microbiology

First isolation in sputum or cough/throat swabs of *Pseudomonas aeruginosa*

- If asymptomatic with first isolation from sputum/cough swab:
 - ciprofloxacin 1 month–5 yrs 15 mg/kg , > 5 yrs 20 mg/kg (max 750 mg) 12 hrly orally and colomycin 1 MU BD via nebuliser for 3 months in the first instance

- If asymptomatic with recurrent isolation from sputum/cough swab:
 - ciprofloxacin 1 month–5 yrs 15 mg/kg , > 5 yrs 20 mg/kg (max 750 mg) 12 hrly orally
 - and colomycin < 2 yrs: 1MU BD and ≥ 2 yrs 2 MU BD via nebuliser for 3 months
- **If symptomatic:**
 - tobramycin and ceftazidime (according to sensitivities) IV for 2 weeks, and on discharge from hospital:
 - ciprofloxacin orally for 3 months
 - colomycin 1 MU nebulised 12-hrly for at least 3 months

Pseudomonas colonization

- Three or more isolations in six months in sputa taken at least one month apart

Nebulized antibiotics

- All children colonized with *Pseudomonas* should receive colomycin 1 x MU made up to 4 mL with sodium chloride 0.9%, nebulized 12-hrly

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

CYSTIC FIBROSIS – MICROBIOLOGY • 2/2

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 6 mL heparinized saline 100 units/mL (e.g. Canusal, **not** Hepsal), withdrawing needle while injecting last mL

Burkholderia cepacia colonization

- **Report any new cases to CF Team**
- Nurse children with *B. cepacia* colonization in a cubicle on a separate ward to other CF children
- Use **separate spirometer with disposable filters**

MRSA colonization

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

Chickenpox and CF

- Varicella infection can have serious consequences in immunosuppressed children
- CF patients taking oral steroids are at high risk
- Vaccinate if no history of chickenpox and no antibodies
- 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 prior to steroids)
- If non-immune and taking a high dose of **oral** corticosteroid (prednisolone 1 mg/kg per day for one month or 2 mg/kg per day for 1 week), and exposure occurred < 1 week earlier, give varicella-zoster immunoglobulin (VZIG) < 6 yrs-old 250 mg; 6-10 yrs-old 500 mg; 11-14 yrs-old 750 mg; > 15 yrs-old 1g, or IV immunoglobulin 0.4 g/kg
- If non-immune and taking a modest dose of **oral** corticosteroid (prednisolone < 1 mg/kg per day), give aciclovir prophylaxis (6 hrly: < 2 yrs 200 mg; 2-6 yrs 400 mg; > 6 yrs 800 mg) from 7-21 days after exposure
- If chickenpox appears in a child not taking oral corticosteroid, give oral aciclovir (20 mg/kg per dose < 12 yrs-old 6-hrly, > 12 yrs-old 5 times/day, max 800 mg/dose) for 5 days and a course of oral antibiotics (e.g. amoxicillin and flucloxacillin) as for acute exacerbation

Flu and pneumococcal vaccine

- For all children with CF
- Usually prescribed by patient's own GP but obtainable from Pharmacy

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

RECOGNITION AND ASSESSMENT

- Faeces can accumulate in the distal ileum and caecum causing varying degrees of intestinal obstruction
- Patients present with intermittent abdominal pain, constipation and faecal masses, usually in the right or left iliac fossae

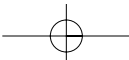
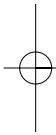
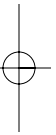
MANAGEMENT

- If symptoms very mild, prescribe daily laxative (e.g. Movicol) and encourage fluids
- Consider adjusting pancreatic enzymes
- If unresponsive, or symptoms more severe, proceed in order as follows:
 1. Acetylcysteine (Fluimucil, unlicensed) oral 1 m–2-yrs-old 100 mg (0.5 sachet) 8 hrly
2-12 yrs-old 200 mg (one sachet) 8 hrly
> 12-yrs-old 400 mg (two sachets) 8 hrly
OR if Fluimucil not available, single dose of Gastrografin
1 m–2-yrs-old 15-30 mL
15-25 kg 50 mL
> 25 kg 100 mL

- repeat dose after 12-18 hr, encourage drinks, monitor fluid balance and allow food
- 2. Balanced electrolyte solution
- bowel lavage with Kleen-Prep or Golytely (usually requires a nasogastric tube)
- start early in the morning and continue until the stools are yellow, watery and free of solid matter
- 2 litres in the first instance, increasing to 3 or 4 litres depending on response and age and size of the child (most children with DIOS will be teenagers)
- withhold food but, if success is not achieved after 12 hr, stop, give an evening meal and resume the following morning
- monitor effectiveness with pre- or post-plain abdominal X-rays before and after lavage
- if there are signs of complete intestinal obstruction, stop lavage, give IV fluids and discuss contrast enema with CF Team

Dosage of Kleen-Prep or Golytely

Body weight	< 15 kg	15-30 kg	> 30 kg
First hr	50 mL/h	100 mL/h	200 mL/h
Second hr	100 mL/h	200 mL/h	400 mL/h
Thereafter	200 mL/h	400 mL/h	600 mL/h



PNEUMONIA • 1/5

COMMUNITY ACQUIRED PNEUMONIA (CAP)

If < 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 chest X-ray makes pneumonia unlikely
- Up to 35% of lower respiratory tract infections have a single virus as causative organism
- Can be presenting illness in cystic fibrosis, immunodeficiency states

Symptoms and signs

- Cough
- Fever
- Irritability
- Poor feeding
- Vomiting
- Tachypnoea at rest (most useful sign)
- Beware – awake or unsettled infants can have high respiratory rate on a single measurement; measure at rest/repeat

Table 1: WHO definition of tachypnoea

Age	Counted breath rate
< 2-months-old	≥ 60/min
2–12-months-old	≥ 50/min
1–5-yrs-old	≥ 40/min

- Bronchial breathing, inspiratory crackles
- Recession
- Abdominal pain (referred pleural pain)
- Age > 5-yrs-old, headache, arthralgia, sore throat (suggests mycoplasma)

Investigations

- Pulse oximetry
- Chest X-ray
- Full blood count, blood culture
- Serum electrolytes (may have hyponatraemia due to SIADH), CRP
- Mycoplasma titre (indicate date of onset on request form) if pneumonia suspected
- Sputum, if able to provide good quality specimen
- Nasopharyngeal aspirate for respiratory viruses
- Pernasal swab in charcoal transport medium if pertussis suspected
- Pleural fluid culture if aspirated
- Pneumococcal antigen in urine if severe pneumonia

PNEUMONIA • 2/5

Differential diagnosis

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

IMMEDIATE TREATMENT

Also refer to flowchart 1

Allow home on oral antibiotics if:

- Not in respiratory distress
- Previously well
- ≥ 3-months-old
- Family have easy access to GP or hospital

Admit to hospital if any of the following:

- < 3-months-old
- SpO₂ < 92% in air
- Intermittent apnoea/grunting
- Poor feeding/dehydrated
- Drowsy/lethargic
- Tachypnoeic (see Table 1 WHO definition)
- Pleural effusion

PICU referral if:

- Respiratory failure – hypoxia, hypercapnia, acidosis
- Poor perfusion
- Altered conscious level

Supportive treatment

- O₂ to maintain SpO₂ > 92%
- Gentle suctioning to clear nasal secretions
- Paracetamol for pyrexia
- Maintain hydration
 - oral fluids if tolerated
 - if unable to take oral fluids, sodium chloride 0.45% with glucose 5% via IV infusion
 - restrict IV fluid replacement to 80% maintenance
 - monitor electrolytes

Antibiotic therapy

Oral is preferable to IV

- Oral:
 - amoxicillin
 - erythromycin if mycoplasma suspected (e.g. subacute onset, prominent cough, headache, sore throat, > 5 yrs old) or penicillin allergy suspected
 - flucloxacillin if *Staph. aureus* suspected on chest X-ray findings (e.g. bullae) or from preliminary microbiology results
- If vomiting or unable to take oral drugs, give antibiotic IV:
 - cefuroxime
 - flucloxacillin for *Staph aureus*

Pleural effusion

- See **Pleural effusion**

PNEUMONIA • 3/5

SUBSEQUENT MANAGEMENT

- Change route of amoxicillin from IV to oral within 24-48 hr
- Total antibiotic course five to seven days
- If atypical or staphylococcal pneumonia, treat for 14 days uncomplicated CAP and 14-21 days for severe CAP
- Physiotherapy once cough is productive
- important if neuromuscular impairment results in poor clearance

MONITORING TREATMENT

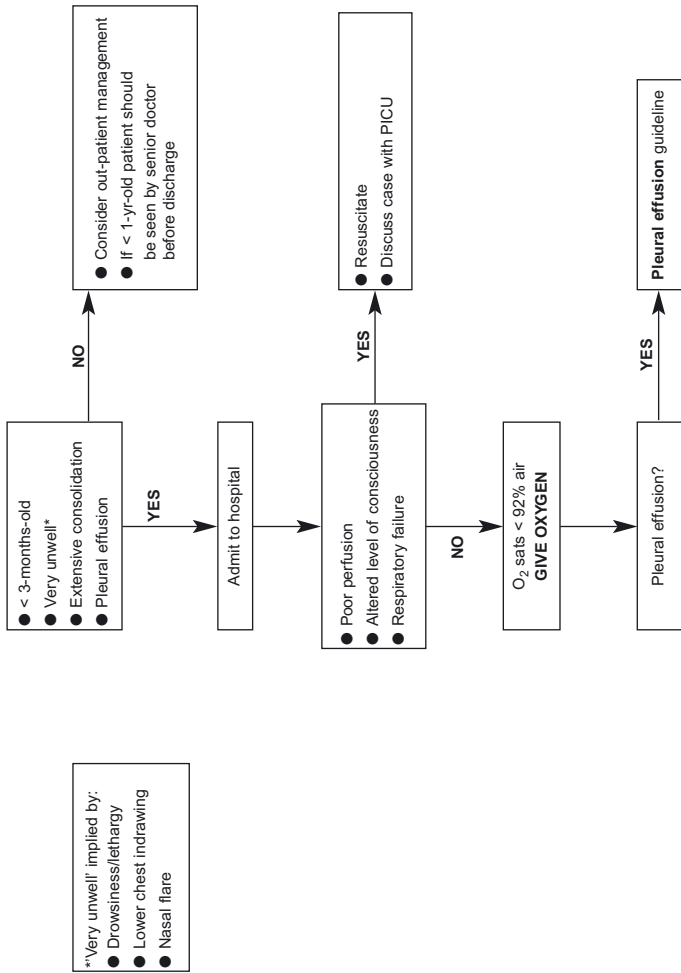
- Continuous SpO₂ monitoring if needing O₂
- 1-4 hrly observation depending on severity of illness
- Review diagnosis (repeat chest X-ray) or treatment if no improvement in 24-48 hr

DISCHARGE POLICY

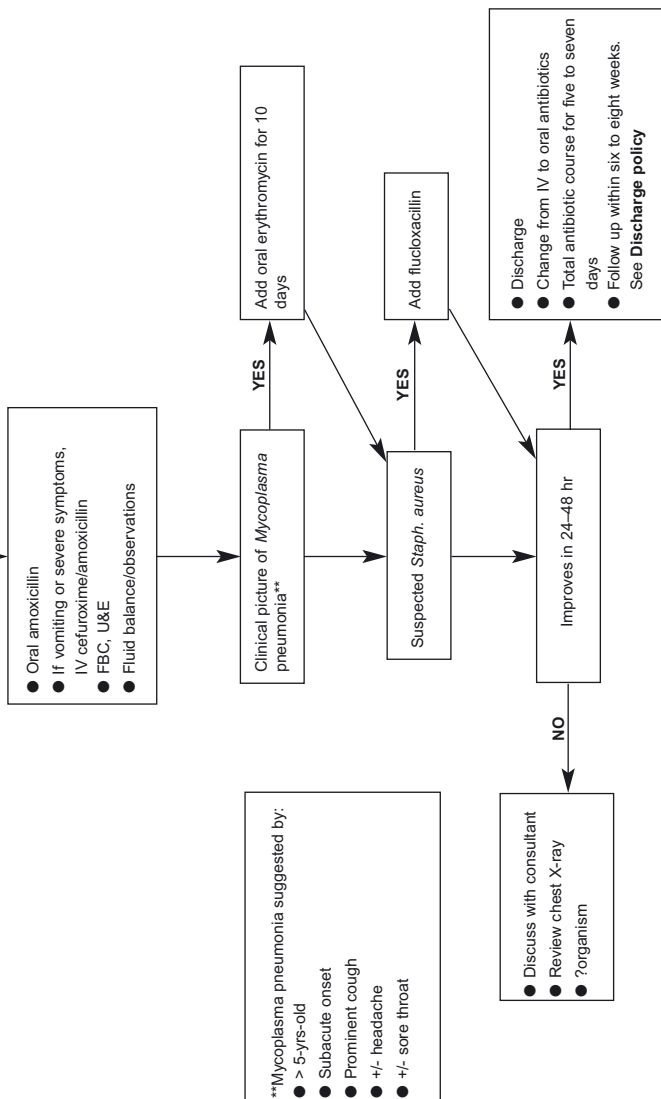
- Follow up within six to eight weeks with chest X-ray if there is:
 - lobar collapse
 - significant pleural effusion
 - 'round' pneumonia on chest X-ray
 - previous lower respiratory tract infections
 - failure to thrive
- GP follow-up for all others within six to eight weeks
- Convalescent mycoplasma titre can be obtained at this visit (indicate date of onset on request form)

PNEUMONIA • 4/5

Flowchart 1: Management of pneumonia in a previously well patient > 1-month-old



PNEUMONIA • 5/5



PLEURAL EFFUSION • 1/3

RECOGNITION AND ASSESSMENT

Definition

- A collection of fluid in the pleural space, for example:
 - parapneumonic effusion – pleural fluid collection in association with underlying pneumonia
 - empyema – the presence of pus in the pleural cavity

Symptoms and Signs

- Persistent pyrexia 48 hours after treatment started for pneumonia
- Fever
- Cough
- Breathlessness
- Pleuritic chest pain
- Unilateral chest signs – decreased expansion and breath sounds, dullness to percussion
- Positional splinting

Differential Diagnosis

- Uncomplicated pneumonia
- Malignancy
- Effusion with alternative cause (e.g. congestive cardiac failure, pancreatitis)
- Pulmonary embolism

Investigations

- Chest X-ray – AP film
- Ultrasound (US) scan to:
 - confirm presence
 - ascertain size
 - indicate optimal position for chest drain
 - differentiate between simple and complicated effusion
- If history, chest X-ray or US suggestive of malignancy or hydatid cyst, request CT chest
- Pleural fluid analysis for:
 - microbiology (including PCR and AAFB if patient recently in contact with TB or from TB endemic area)
 - biochemical analysis (LDH, protein, glucose) and pH (via ABG analyser)
 - **at same time**, blood samples for FBC, U&E, LDH, albumin and glucose
- CRP
- Blood cultures
- Sputum culture, if possible

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

PLEURAL EFFUSION • 2/3

Table: Fluid/serum protein and LDH ratios are best discriminators between transudate and exudate

	Transudate	Exudate
Appearance	Serous	Cloudy, bloody
Leucocyte count	< 10,000 /mm ³	> 50,000/ mm ³
Protein	< 30 g/L	> 30 g/L
Fluid/serum protein ratio	≤ 0.5	> 0.5
LDH	≤ 200 IU	> 200 IU or > 2/3 local upper limit of serum LDH
Fluid/serum LDH ratio	≤ 0.6	> 0.6
Glucose	≥ 3.3 mmol/L	< 3.3 mmol/L
pH	≥ 7.4	≤ 7.3
Gram stain/culture	No organisms	Organisms on stain or culture

IMMEDIATE TREATMENT

Supportive

- ABC
- O₂ and fluid resuscitation as indicated
- Analgesia

Antibiotic therapy

Type of Effusion suspected	Choice of antibiotics
Effusion following community-acquired pneumonia	IV cefuroxime
Effusion following hospital-acquired pneumonia	IV ceftazidime and IV vancomycin pending culture and sensitivity results (24-48 hr), then adjust according to microbiological findings ± advice
Effusion possibly tuberculous	discuss with specialist

Chest drain insertion

- Seek advice from paediatric anaesthetist about appropriate sedation/need for general anaesthesia
- If known risk factors for haemorrhage, check clotting studies prior to insertion
- Obtain consent
- Consider simultaneous insertion of long line during general anaesthetic, if possible
- Ensure vascular access before starting procedure
- Consider support of interventional radiologist
- If required, engage paediatric anaesthetist to give general anaesthetic
- Insert pigtail drain using Seldinger technique at site suggested and marked during ultrasound scan (usually mid-axillary line)
- Send pleural fluid for culture and sensitivities (including AAFBs), differential cell count, and pneumococcal PCR

PLEURAL EFFUSION • 3/3

Chest drain management

- Ensure nursing staff trained in care of children with chest drains
- Attach chest drain to low level suction (5-10 cm H₂O) via underwater seal
- After 10 mL/kg 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
- Ensure adequate analgesia (see **Analgesia** guideline) and encourage patient to move freely when well enough

Intrapleural fibrinolytics

- Instill urokinase in all patients, as follows:
 - age ≥ 1 yr, urokinase 40,000 units in 40 mL sodium chloride 0.9%
 - age < 1yr, 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 leave 8 hr before next dose instilled
- Give further courses of 6 doses if ultrasound scan confirms presence of persistent loculations after 6 doses

SUBSEQUENT MANAGEMENT

Act on response to treatment and clinical assessment of the patient

- Monitor symptoms and re-examine patient to assess progress
- Repeat CRP

- 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 in accordance with antibiotic sensitivities
 - if differential cell count shows lymphocytosis, exclude TB (Mantoux test) and malignancy (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 draining < 2 mL/kg/day for 2 days: apose skin with Steristrips rather than sutures
- Continue IV antibiotics until afebrile and chest drain removed, then change to oral antibiotics
- Complete 14-day course of antibiotics
- If effusion has not resolved after 7 days or further complications occur:
 - request CT scan of chest
 - discuss referral for thoracotomy with lead respiratory physician

FOLLOW-UP

- Arrange review by respiratory paediatrician, initial appointment 6 weeks after discharge
- Repeat chest X-rays until complete clinical and radiological resolution occur
 - if symptoms persist or recur, arrange baseline immunodeficiency screen (see **Immunodeficiency**) and tests for cystic fibrosis

CYANOTIC CONGENITAL HEART DISEASE • 1/3

RECOGNITION AND ASSESSMENT

Symptoms and signs

- Cyanosis occurs when level of deoxygenated haemoglobin is > 5 g/dL
- Main causes are either respiratory or cardiac disease
- Respiratory illness producing cyanosis will usually have signs of respiratory distress (e.g. cough, tachypnoea, recession, and added respiratory sounds)
- Cyanosis with mild or no respiratory distress is likely to be cardiac disease

Causes of cardiac cyanosis

Significant right-to-left shunt

- Transposition with inadequate mixing, pulmonary or tricuspid atresia
- poor response to high concentrations of inspiratory O₂
- cyanosis worsened by crying, pain or upset
- Fallot's tetralogy: hypercyanotic episodes follow emotional or painful upset

- clubbing when longstanding

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

Acute pulmonary outflow obstruction (cyanotic episodes)

- Fallot's tetralogy or other complex congenital cyanotic heart disease
- very pale
- lose consciousness
- convulse

Respiratory distress

- Respiratory distress may be triggered in a cardiac patient by an intercurrent infection. The following may help identify when respiratory distress is due to the underlying cardiac problem:
- low SpO₂ despite supplemental O₂
- marked tachycardia
- enlarged heart (clinically or on CXR)
- gallop rhythm/murmur
- enlarged liver/raised JVP
- basal crackles
- absent femoral pulses

Physical examination

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

CYANOTIC CONGENITAL HEART DISEASE • 2/3

Investigations

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

SpO₂

- Check in all 4 limbs
- when breathing air before O₂ given
- after giving 15 L/min O₂ 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 the right main bronchus on the right?)
- Cardiac size and configuration
- Size of pulmonary vessels and pulmonary vascular markings

Electrocardiogram (see section on reading the normal ECG)

- Axis of QRS complex
- P-wave
- R-S pattern in chest leads
- P-R, QRS and Q-T intervals
- P- and T-wave configuration
- Size of QRS in chest leads

Nitrogen washout in cyanosed babies

- Monitor SpO₂ in air then in headbox 100% O₂ for 10 min
- Cyanotic congenital heart disease PaO₂ will remain below 20 kPa with SpO₂ unchanged
- Not as reliable as echocardiogram

Echocardiogram

Discuss urgency with consultant before referral to local paediatric cardiac centre

IMMEDIATE TREATMENT

If the infant is 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 the duct with prostaglandin E₂ (Dinoprostone, Prostin E₂)
 - 5-10 nanograms/kg per min IV infusion to start
 - increasing if necessary to 40 nanograms/kg per min
 - add 0.5 mL of Dinoprostone 1 mg/mL to 500 mL 10% glucose
 - 0.6 mL/kg/hr is 10 nanograms/kg per min

CYANOTIC CONGENITAL HEART DISEASE • 3/3

- prostaglandin E1 (Alprostadil) is an alternative if dinoprostone not available
- 50-100 nanograms/kg per min IV infusion to start
- then lowest dose required for response: 5-20 nanograms/kg per min maintenance
- May cause apnoea and patients usually need ventilation (PICU)
- **Do not give prostacyclin (PGI)**
- Beware of giving high concentrations of O₂ 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 0.1-0.2 mg/kg IV over 5 min or IM
 - provide high concentration facemask O₂ (15 L/min with reservoir bag)
 - if Fallot's tetralogy has been diagnosed by echocardiography, discuss with cardiologist the use of propranolol starting at 15-20 mcg/kg gradually increasing, if necessary, to 100 mcg/kg IV with cardiologist

SUBSEQUENT MANAGEMENT

- On advice of consultant and Paediatric Cardiac Centre

HEART FAILURE AND WEAK PULSES • 1/3

COMMON DIFFERENTIAL DIAGNOSES

- Aortic stenosis
- Coarctation of the aorta
- Hypoplastic left heart
- Pericardial effusion

RECOGNITION AND ASSESSMENT

Presentation

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

Symptoms and signs

- Failure to thrive
- Rapid weight gain
- Sweating
- Breathlessness, particularly during feeding
- Rapid respiratory rate
- Tachycardia
- Absent or low volume peripheral or central pulses
- Enlarged heart
- Prominent cardiac impulses
- Thrill
- Gallop rhythm
- Enlarged liver

INVESTIGATIONS

- Check BP in all four limbs (Dinomapp: normal < 15 mmHg difference)

SpO₂

- Check pre- (right arm) and post-ductal (lower limbs)
- In air before and after giving O₂

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 the right main bronchus on the right?)
 - cardiac size and configuration
 - size of pulmonary vessels and pulmonary vascular markings

Electrocardiogram (see ECG interpretation guideline)

- Axis of QRS complex
- P wave
- R-S pattern in chest leads
- P-R, QRS and Q-T intervals
- P and T wave configuration
- Size of QRS in chest leads

Echocardiogram

- Discuss urgency with consultant before referral to local paediatric cardiac centre

HEART FAILURE AND CARDIOGENIC SHOCK

Causes

- Congenital heart malformations
- Cardiomyopathies
- Myocarditis
- Arrhythmias
- Hypoxia
- Acidosis
- Toxins

HEART FAILURE AND WEAK PULSES • 2/3

Recognition of cardiogenic shock

- For definition of shock see **Septicaemia**
- Following cardio-pulmonary resuscitation with adequate fluid replacement in patients with:
 - septic shock that fails to improve after adequate fluid replacement (e.g. ≥ 40 mL/kg)
 - a known heart condition and shock
 - a large heart on chest X-ray but previously well
 - with shock who have a history of poisoning
 - with a murmur or pulmonary oedema, or both

MONITORING

- ECG monitor
- Non-invasive BP
- Pulse oximetry
- Core-skin temperature difference
- Daily weights
- Intra-arterial BP for continuous pressure monitoring and arterial blood gas sampling
- CVP: if shocked or ≥ 40 mL/kg fluid resuscitation has been needed
- Urine output (≥ 1 mL/kg per hr)

THERAPEUTIC MEASURES

Progressive measures: 1-8 for all patients; 9-11 if there is cardiogenic shock

1. If breathless, elevate head and

trunk

2. If an infant not feeding well, give nasogastric feeds
3. In moderate-to-severe failure or if the patient is hypoxic or distressed, give O₂ therapy via nasal cannulae (up to 2 L/min) or via a facemask with reservoir bag (up to 15 L/min)
4. Diuretics: furosemide 1-3 mg/kg orally (consider giving IV initially) twice daily with amiloride 0.1-0.2 mg/kg orally twice daily
5. If serum K < 4.5 mmol/L, give additional potassium chloride 1 mmol/kg orally twice daily
6. Correct acidosis, hypoglycaemia and electrolyte imbalance
7. Relieve pain with morphine: loading dose 0.1-0.2 mg/kg IV, followed by 0.05-0.1 mg/kg IV 4-6 hrly or 10-20 mcg/kg/hr via IV infusion
8. If anaemic (Hb < 10 g/dL), correct with slow infusion of packed cells to bring Hb to 12-14 g/dL
9. Monitor CVP and ensure adequate pre-load: give bolus 10 mL/kg 4.5% Human Albumin Solution or if HAS not available, bolus 10 mL/kg sodium chloride 0.9%
10. If shock severe (see **Septicaemia**), start mechanical ventilation with positive end-expiratory pressure early; if pulmonary oedema present, start this urgently
11. If shock severe, give early inotropic drug support: dopamine, dobutamine, adrenaline or noradrenaline as per NNU/PICU protocols

HEART FAILURE AND WEAK PULSES • 3/3

DUCT-DEPENDENT CONGENITAL HEART DISEASE

- May present in first two 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 • 1/5

PAPER SPEED

- ECG is 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

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 to 1-months-old	0 to 12-months-old	1 to 12-yrs-old	12 to 16-yrs-old
< 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
 - Lown-Ganong-Levine syndrome
 - glycogen storage disease
- Variable interval
 - wandering atrial pacemaker
 - Wenckebach phenomenon

Right atrial hypertrophy (RAH)

- Increased P wave amplitude in leads II, V1, and V4R
- Occurs in:
 - pulmonary hypertension
 - pulmonary stenosis
 - pulmonary atresia
 - tricuspid atresia

Left atrial hypertrophy (LAH)

- Biphasic P wave (later depolarization of LA)
- Occurs in:
 - mitral valve disease
 - LV obstruction and disease

ECG INTERPRETATION • 2/5

QRS COMPLEX

- Ventricular activity
- Duration: 0.06-0.08 sec
- Prolonged
 - ventricular hypertrophy
 - bundle branch block
 - electrolyte disturbance
 - metabolic disease
 - drugs, (e.g. digoxin)

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)

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 to 12-months-old	2-7	3-17	1-25	10-28	5-25	0-10
1 to 10-yrs-old	0-7	2-16	1-12	5-30	5-25	0-7
> 10-yrs-old	0-6	1-12	1-25	5-40	5-30	0-5

Jordan S.C., Scott O. In: Heart Disease in Paediatrics. 2nd Edition. London: Butterworths; 1989.

Q-T INTERVAL

Inversely proportional to the rate

- Calculate the 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
- Short interval
 - hypercalcaemia
 - digitalis effect
- Prolonged interval
 - hypocalcaemia
 - myocarditis
 - Jervell and Lange-Nielsen syndrome
 - Romano-Ward syndrome
 - head injuries or cerebrovascular episodes
 - diffuse myocardial disease
 - antiarrhythmics

ECG INTERPRETATION • 3/5

T WAVE

- Ventricular repolarization
- Normal
 - T inversion V4R/V1 (from third day of life until 10 yr)
 - amplitude is 25-30% of R-wave
 - < 1-yr-old: V5 ≤ 11 mm; V6 ≤ 7 mm
 - > 1-yr-old: V5 ≤ 14 mm; V6 ≤ 9 mm
 - adolescence reduces amplitude
- Peaked T wave
 - hyperkalaemia
 - LVH
 - 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°)
 - 1-yr-old +10° to +100° (av +60°)
 - 10-yrs-old +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)

ECG INTERPRETATION • 4/5

LEFT VENTRICULAR HYPERTROPHY

Diagnosis

- SV1 + RV5 \geq 40 mm (30 mm < 1-yr-old)
- +/- 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 (> 1-yr-old)
- SV6 above maximum for age:
 - (0 to 6-months-old) 15 mm
 - (> 6-months-old) 10 mm
 - (> 12-months-old) 7 mm
 - (10-yrs-old) 5 mm
- R waves in V4R/V1 > normal
- T wave changes
 - upright in V1/V4R (from 3 days to 10 years)

- 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

ECG INTERPRETATION • 5/5

TYPICAL CARDIOLOGICAL ECG ABNORMALITIES

Typical ECG abnormalities

Heart lesion	ECG abnormalities
PDA	LVH > RVH; LAH
VSD	LVH > RVH; ± RBBB; T inv LV leads
ASD	Secundum RAD; RBBB; ± increased PR; 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

TACHYCARDIA AND BRADYCARDIA • 1/6

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

Investigations

- If known to suffer from episodes of supraventricular tachycardia:
 - confirm diagnosis with 12-lead ECG
 - continuous ECG monitoring is essential
 - assess for cardiac failure

Differential diagnosis

- Sinus tachycardia, particularly in infants, can be > 220 bpm: more likely if other features (e.g. of sepsis)
- If first presentation, check for any other cause of cardiac failure
- Failure to respond to adenosine can be used to distinguish the origin of a tachycardia in a stable patient

Treat unstable patients with SVT as for ventricular tachycardia

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 following 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 antegrade 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)

TACHYCARDIA AND BRADYCARDIA • 2/6

Older children

- Nodal tachycardias become more common with increasing age
- characterized by fast, regular, narrow QRS complexes without visible P waves
- Wide QRS complex or bundle branch block in childhood is rare
- changes are 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

Vagal manoeuvres

These may include:

- The diving reflex
 - wrap infants in a towel and immerse their whole face into iced water for about 5–10 sec
 - in children, place a bag or rubber glove containing iced water over the face
- One side carotid massage
- Valsalva manoeuvre
- Do NOT use eyeball pressure because of the risk of ocular damage
- Where possible, maintain ECG monitoring and recording throughout all procedures

Adenosine

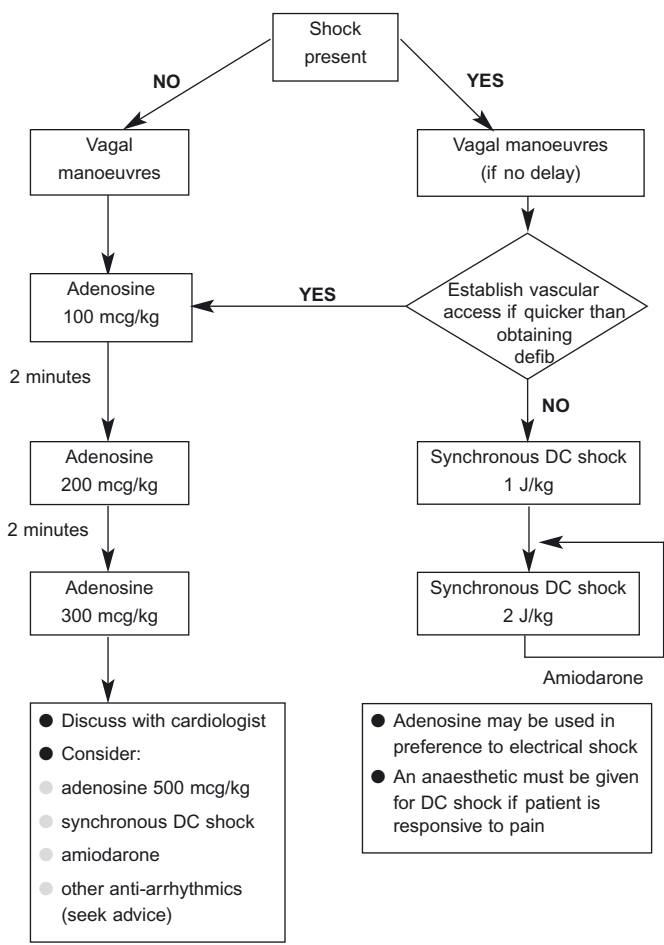
- Drug of choice as it has a rapid onset of action and is not negatively inotropic
- Very short half-life (10-15 sec) giving short-lived side-effects (flushing, nausea, dyspnoea, chest tightness)
- Effective in > 80% of junctional tachycardias and will not precipitate ventricular tachycardias into ventricular 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
- Max dose 3 mg, 6 mg then 12 mg

Other drugs

- If adenosine ineffective, seek advice from a paediatric cardiologist
- Do not use verapamil and propranolol in the same patient as both have negative inotropic effects
 - do not use verapamil in children < 1-yr-old
- In refractory Wolff-Parkinson-White type tachycardia, flecainide is particularly useful
- In refractory atrial tachycardia amiodarone is useful

TACHYCARDIA AND BRADYCARDIA • 3/6

SUPRAVENTRICULAR TACHYCARDIA



TACHYCARDIA AND BRADYCARDIA • 4/6

WIDE COMPLEX TACHYCARDIA

RECOGNITION AND ASSESSMENT

Definition

- Ventricular tachycardia
- ≥ 3 successive ectopic ventricular beats
- sustained if it continues > 30 sec

Causes

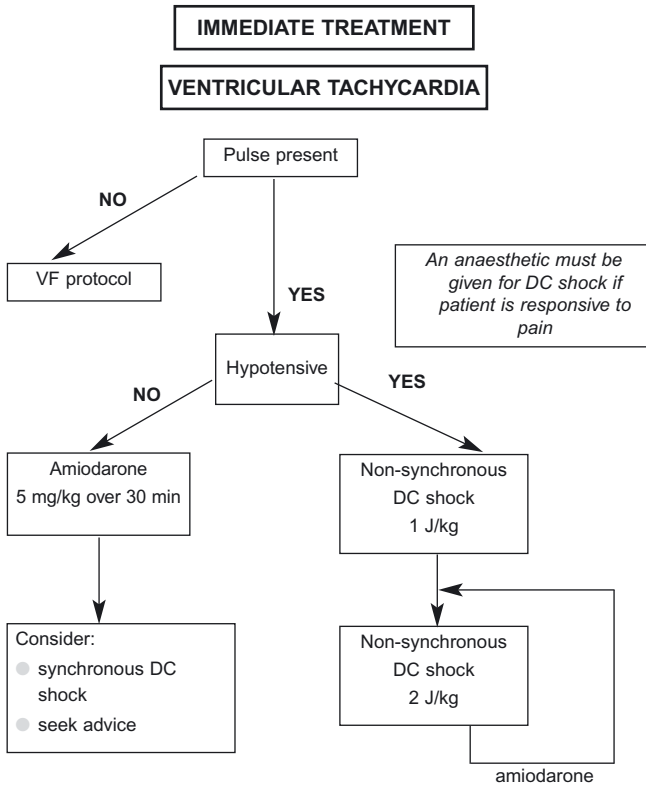
- Underlying cause (e.g. myocarditis, cardiomyopathy, or in a patient with congenital heart disease)
- Poisoning (e.g. phenothiazines, tricyclic antidepressants, quinidine and procainamide)
- Electrolyte disturbance (e.g. hypokalaemia, hypomagnesaemia)
- Ventricular tachycardia can degenerate into ventricular 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
- Assess the patient and obtain a family history to identify the presence of an underlying condition predisposing to stable ventricular tachycardia

- SVT or VT can cause haemodynamic instability: the response to adenosine can help identify the 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 the 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 > 6 months is $< + 90^\circ$)
 - no preceding P wave, or A-V dissociation
 - fusion beats (normally conducted QRS complex merges with an abnormal discharge)

TACHYCARDIA AND BRADYCARDIA • 5/6



- The treatment of the haemodynamically stable child with ventricular tachycardia should always include early consultation with a paediatric cardiologist. They may suggest amiodarone (5 mg/kg over 60 min): this can cause hypotension, which should be treated with volume expansion
- Use synchronous shocks initially, as these are less likely to produce ventricular fibrillation than an asynchronous shock. If

synchronous shocks are ineffectual, subsequent attempts will have to be asynchronous if child profoundly hypotensive

- The treatment of torsade de pointes ventricular tachycardia is magnesium sulphate 25–50 mg/kg (up to 2 g) in a rapid IV infusion (10 mg/kg/min)
- Amiodarone 5 mg/kg may be given over 3 min in ventricular tachycardia if the child is in severe shock

TACHYCARDIA AND BRADYCARDIA • 6/6

BRADYARRHYTHMIAS

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

Investigations

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

Management

- Contact cardiologist for advice
 - fax ECG to cardiologist

ENDOCARDITIS PROPHYLAXIS • 1/2

Obtain individual patient advice from the Cardiology Team at local paediatric cardiac surgical centre

INDICATIONS

High-risk cardiac factors requiring antibiotic prophylaxis

- Previous infective endocarditis
- Cardiac valve replacement surgery (i.e. mechanical or biological prosthetic valves)
- Surgically constructed systemic or pulmonary shunt, or conduit
- give antibiotic prophylaxis for all dental procedures involving dento-gingival manipulation and other potentially bacteraemic procedures

Low risk: structural cardiac conditions before surgical repair

- No prophylaxis required for dental procedures
- give prophylaxis for other potentially bacteraemic procedures

No prophylaxis required

- Septal defects
- Coarctation of the aorta
- Patent ductus arteriosus

DENTAL PROCEDURES

- All procedures likely to cause gingival bleeding require prophylaxis:
 - scalings, extractions and oral surgery
- Procedures that do not require prophylaxis:
 - spontaneous shedding of deciduous teeth
 - polishing
 - routine fillings
- Orthodontic treatment on cardiac patients:
 - inform cardiologist
 - high standard of oral hygiene
 - local anaesthetic solution should not contain adrenaline
 - give general anaesthetic in hospital

OTHER PROCEDURES REQUIRING PROPHYLAXIS

- Surgical procedures involving intestinal mucosa
- Hepato-biliary operations
- Cystoscopy
- Tonsillectomy/adenoidectomy
- Surgical procedures on upper respiratory tract
- Nasal packing and nasal intubation

ENDOCARDITIS PROPHYLAXIS • 2/2

Antibiotic prophylaxis for dental, oral and upper respiratory tract procedures

Population	> 5 yrs	≥ 5 - < 10 yrs	≥ 10 yrs	Timing of dose before procedure
General	amoxicillin 750 mg orally	amoxicillin 1.5 g orally	amoxicillin 3 g orally	1 hr
Allergic to penicillin	clindamycin 150 mg orally	clindamycin 300 mg orally	clindamycin 600 mg orally	1 hr
Allergic to penicillin and unable to swallow capsules	azithromycin 200 mg orally	azithromycin 300 mg orally	azithromycin 500 mg orally	1 hr
Unable to take oral	amoxicillin 250 mg IV	amoxicillin 500 mg IV	amoxicillin 1 g IV	Just before procedure or at induction of anaesthesia
Unable to take oral and allergic to penicillin	clindamycin 75 mg IV over 10 min	clindamycin 150 mg IV over 10 min	clindamycin 300 mg IV over 10 min	Just before procedure or at induction of anaesthesia

Antibiotic prophylaxis for genitourinary, gastrointestinal or obstetric/gynaecological procedures

Antibiotics	Dose/route	Comment
Amoxicillin plus gentamicin	Single IV dose < 5 yrs-old: 250 mg ≥ 5 - < 10 yrs: 500 mg ≥ 10 yrs-old: 1 g plus 1.5 mg/kg IV single dose	Give just before procedure or at induction of anaesthesia
If allergic to penicillin teicoplanin plus gentamicin	Single dose IV < 14 yrs: 6 mg/kg (max 400 mg) ≥ 14 yrs: 400 mg plus 1.5 mg/kg IV single dose	Give just before procedure or at induction of anaesthesia

NOTES:

- For dental procedures, supplement antibacterial prophylaxis with chlorhexidine gluconate 0.2% (10 mL for 1 min) mouth rinse 5 min before procedure
- Multistage dental procedures should ideally be scheduled at intervals of at least 14 days to allow mucosal healing. If further dental procedures cannot be delayed, antibacterial prophylaxis should alternate between amoxicillin and clindamycin; expert advice should be sought if child is penicillin allergic

POISONING AND DRUG OVERDOSE • 1/3

The poisoned

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

The poisoners

- Most children poison themselves accidentally or intentionally
- May be poisoned deliberately by parents or inadvertently by doctors

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

Identify likely poison(s)/drug(s)

- Ask patient, relatives, GP, ambulance crew. Retain any containers found
- send parents home for poison if identification doubtful
- 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 be
- assume child has ingested something even if found with a few tablets and an empty bottle

Investigations

- U&E
- Blood gases and acid-base
- Save blood and urine for toxicological analysis. Urgent measurement of plasma/serum concentrations essential in the diagnosis and management of poisoning with ethylene glycol, iron, lithium, methanol, paracetamol, theophylline, and salicylate. With the exception of paracetamol there is no need to measure the concentrations of these substances unless there is a clear history of ingestion

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

POISONING AND DRUG OVERDOSE • 2/3

Seek advice

- Use Toxbase on the internet: site address
<http://www.spib.axl.co.uk> access and password available on A&E
- if further information required, contact National Poisons Information Service (0870 600 6266)

Always admit a child who is symptomatic or who has ingested iron, digoxin, aspirin or a tricyclic antidepressant. If child is not admitted always consult the paediatric SpR on call before sending home

IMMEDIATE TREATMENT

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

- Assess airway, breathing, circulation
- Maintain airway
 - if airway not protected, may need intubation and ventilation
 - if cyanosed or rate and depth of respiration obviously low, arterial blood gases indicated
 - if PaCO₂ high or rising, mechanical ventilation indicated
- Correct hypotension
 - raise foot of bed
 - if in 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
- Control convulsions
 - if unconscious, treat as head injury until proved otherwise
- Give antidote if appropriate
- Decrease absorption. Consider gastric lavage **only** in patients whose airway can be protected and who have ingested life-threatening amounts of a toxic agent up to **1 hr** previously, provided they are co-operative and have not ingested petroleum distillates or corrosives
- If gastric lavage contraindicated, consider activated charcoal in patients who have ingested life-threatening amounts of a toxic agent up to 1 hr previously, provided patient is conscious or airway can be protected. Give 1 g/kg (max 50 g) orally (disguised with soft drink/fruit juice) or via nasogastric tube. Activated charcoal does not affect absorption of acids, alkalis, alcohols, cyanide, ethylene glycol, iron or lithium
- Do not give ipecacuanha - it does not empty the stomach reliably and can be dangerous
- Stop any regular medication that might enhance the effect of substance taken in overdose

POISONING AND DRUG OVERDOSE • 3/3

SUBSEQUENT MANAGEMENT

- If unconscious admit to a high-dependency nursing area and attach an ECG monitor
- Supportive care alone is required for the majority of acutely poisoned patients

MONITORING TREATMENT

- Monitor conscious level, temperature, respiration, pulse and BP until these return to normal
- There is no need to monitor drug concentrations other than to guide the 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 hrly for at least 4 hr then increase interval if stable

Psychiatric review

- All patients admitted after deliberate acute self-poisoning or drug overdose should be offered an interview with a member of the Psychiatric Priority Referral Team within 24 hr of admission or regaining consciousness

DISCHARGE POLICY

- **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 Psychiatry 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

RECOGNITION AND ASSESSMENT

For advice contact National Poisons Information Service (0870 600 6266)

Symptoms and signs

Table 1: Assessment of alcohol poisoning

Mild toxicity	<ul style="list-style-type: none"> ● Impaired visual acuity and co-ordination ● Emotional lability
Moderate toxicity	<ul style="list-style-type: none"> ● Slurred speech, diplopia, blurred vision, ataxia, lack of co-ordination, blackouts, sweating, tachycardia, nausea, vomiting, incontinence ● Acidosis, hypoglycaemia, hypokalaemia
Severe toxicity	<ul style="list-style-type: none"> ● Cold clammy skin, hypothermia, hypotension, stupor, coma, dilated pupils, depressed or absent tendon reflexes ● Severe hypoglycaemia, convulsions, respiratory depression, metabolic acidosis ● Cardiac arrhythmias (e.g. atrial fibrillation, atrio-ventricular block)
Potentially fatal	<ul style="list-style-type: none"> ● Deep coma, respiratory depression or arrest, circulatory failure

Alcoholic drinks/preparations

- Spirits are particularly dangerous
- Beware of alcopops

Investigations

- Blood glucose
 - in moderate to severe toxicity
- U&E
- arterial blood gases
- blood ethanol concentration
- 12-lead ECG

Assessment of severity

- Blood ethanol level is a guide to severity of poisoning
 - < 1.8 g/L (39 mmol/L) – mild toxicity
 - 1.8–3.5 g/L (39–76 mmol/L) – moderate toxicity
 - 3.5–4.5 g/L (76–98 mmol/L) – severe toxicity
 - > 4.5 g/L (98 mmol/L) – potentially fatal
- fatal dose in children is approximately 3 g/kg (4 mL/kg absolute ethanol)
- fatal dose in adults is approximately 5–8 g/kg (6–10 mL/kg absolute ethanol)
- See Table 2
- 800 mg alcohol = 1 mL absolute ethanol

ALCOHOL POISONING • 2/2

Table 2

Beverage	Alcohol by volume (approximate)	Alcohol (mg/mL)	Alcohol (g/100 mL)	Serving	Alcohol (g) per serving
Spirits	40%	316	31.6	25 mL/35 mL	7.9/11
Beer	5%	39.5	3.9	545 mL	21.5
Wine	13%	103	10.3	175 mL/250 mL	17.9/25.6

IMMEDIATE TREATMENT

- Ensure clear airway and adequate ventilation
- Gut decontamination is unlikely to be of benefit
- activated charcoal does not significantly reduce rate of absorption
- Correct hypoglycaemia as quickly as possible
 - if awake give oral glucose
 - If drowsy or unconscious give 5 mL/kg IV glucose 10%
 - check blood glucose hrly until consciousness regained
- Correct hypotension (see **Acute poisoning/Drug overdose**)
- Correct acid-base and metabolic disturbance
- Correct hypothermia using conventional means (e.g. Bair Hugger, blankets)
- Control convulsions with IV lorazepam
- Consider haemodialysis if blood ethanol > 5 g/L (108.5 mmol/L) or if arterial pH < 7.0
- discuss with National Poisons Information Service (0870 600 6266)

SUBSEQUENT MANAGEMENT

- See **Acute poisoning/Drug overdose**

IRON POISONING • 1/2

RECOGNITION AND ASSESSMENT

For advice contact National Poisons Information Service (0870 600 6266)

Symptoms and signs

Time	Symptoms and signs
< 6 hr after ingestion	<ul style="list-style-type: none"> ● Nausea, vomiting, abdominal pain and diarrhoea ● Vomitus and stools are often grey or black ● Polymorph leucocytosis and hyperglycaemia suggest toxicity but their absence does not exclude it
6–12 hr after ingestion	<ul style="list-style-type: none"> ● Early features improve in mild cases ● Possibly persistent hyperglycaemia/metabolic acidosis in more serious cases
> 12 hr after ingestion	<ul style="list-style-type: none"> ● In serious cases, evidence of hepatocellular necrosis appears with jaundice, bleeding, hypoglycaemia, encephalopathy and metabolic acidosis. Hypotension may occur
2–5 weeks after ingestion	<ul style="list-style-type: none"> ● Gastric stricture or pyloric stenosis may start to cause obstructive symptoms

Investigations

- If ingested dose > 20 mg/kg elemental iron, measure serum iron 4 hr after ingestion
- U&E, creatinine
- INR
- Blood glucose
- If presenting within 2 hr of ingestion, request plain abdominal X-ray
- tablets are sometimes visible in the stomach or small bowel
- do **NOT** X-ray if patient could be pregnant
- Estimate ingested dose of elemental iron – the BNFC lists the quantity of elemental iron in various preparations
 - < 20 mg/kg – mild or no toxicity
 - > 20 mg/kg – toxicity likely
 - 150-300 mg/kg – severe toxicity, possibly fatal
- Coma and shock indicate severe poisoning – urgent treatment required
- Serum iron taken at 4 hr after ingestion is best laboratory measure
 - < 3 mg/L (55 µmol/L) – mild toxicity
 - 3-5 mg/L (55 – 90 µmol/L) – moderate toxicity
 - > 5 mg/L (> 90 µmol/L) – severe toxicity

Assessment of severity

- Review both clinical and laboratory features

IRON POISONING • 2/2

- Absence of visible tablets on X-ray does not eliminate possibility of ingestion
- If clinical features and/or serum iron concentration suggest severe toxicity, contact National Poisons Information Service (0870 600 6266) for advice
- if concentration falling, no further treatment required
- if concentration rising and child symptomatic, give desferrioxamine IV (**see below**)
- Severe poisoning: > 5 mg/L
- If asymptomatic, repeat after 2 hr: if concentration falling treatment is unlikely to be required

IMMEDIATE TREATMENT

- **If unconscious or in shock:**
 - assess airway, breathing, circulation
 - secure airway, treat shock, control seizures
 - IV fluids to replace losses
 - commence desferrioxamine IV (**see below**)
 - if this is prior to the time when serum iron should be taken (4 hr), take serum iron immediately before commencing desferrioxamine – do **not** delay starting desferrioxamine IV
 - gastric lavage only if ingested dose > 60 mg/kg and/or tablets seen on X-ray and child presents **within 1 hr**
 - do not use activated charcoal as it does not adsorb iron
- **If conscious and not in shock:**
 - check serum iron concentration at 4 hr
 - interpret serum iron concentration in view of child's clinical condition and history
- Moderate poisoning: 3-5 mg/L
 - repeat measurement after further 2 hr, even if asymptomatic

Desferrioxamine

- Before starting treatment, contact National Poisons Information Service (0870 600 6266) for advice
- Starting dose is 15 mg/kg per hr
- Reduce after 4-6 hr
 - maximum 80 mg/kg in 24 hr
 - desferrioxamine commonly causes hypotension if infused more rapidly than recommended rate and turns urine red/orange but rarely causes rashes or anaphylactic reactions

SUBSEQUENT MANAGEMENT

- See **Acute poisoning/Drug overdose**
- If slow release preparations ingested repeat serum iron level after further 6-8 hr
- In patients with severe toxicity:
 - request arterial blood gases and correct any acidosis
 - monitor renal and liver function
 - be alert for evidence of gut perforation or infarction

PARACETAMOL POISONING • 1/5

For advice contact National Poisons Information Service (0870 600 6266)

RECOGNITION AND ASSESSMENT

Symptoms and signs

- Usually none
- Nausea and vomiting occur within a few hours of ingestion of hepatotoxic dose

Investigations

- Plasma paracetamol 4-16 hr after overdose (but not before or after this interval) is a reliable guide to the need for treatment
- If patient presents > 8 hr after overdose, request baseline:
 - FBC, INR
 - U&E, liver function, phosphate
 - Acid-base (venous sample)

Acetylcysteine dosage

Table 1: Administration of acetylcysteine

Weight < 20 kg	<ul style="list-style-type: none"> ● 150 mg/kg IV in 3 mL/kg glucose 5% over 15 min then ● 50 mg/kg IV in 7 mL/kg glucose 5% over 4 hr then ● 100 mg/kg IV in 14 mL/kg glucose 5% over 16 hr
< 12-yrs-old with weight > 20 kg	<ul style="list-style-type: none"> ● 150 mg/kg IV in 100 mL glucose 5% over 15 min then ● 50 mg/kg IV in 250 mL glucose 5% over 4 hr then ● 100 mg/kg IV in 500 mL glucose 5% over 16 hr
≥ 12-yrs-old	<ul style="list-style-type: none"> ● 150 mg/kg IV in 200 mL glucose 5% over 15 min then ● 50 mg/kg IV in 500 mL glucose 5% over 4 hr then ● 100 mg/kg IV in 1000 mL glucose 5% over 16 hr

IMMEDIATE TREATMENT

- Compare plasma paracetamol with treatment graph (Figure 1)
- use high risk 'treatment line' for patients who have existing liver disease; are underweight with 'failure to thrive', whatever the cause; anorexia nervosa; cystic fibrosis; HIV positive; and those taking enzyme-inducing drugs (e.g. barbiturates, phenytoin, carbamazepine, rifampicin, St John's Wort) or who chronically abuse alcohol; they are at higher risk of hepatic necrosis
- if above, on, or even slightly below the 'treatment line', give IV acetylcysteine in 5% glucose
- Time interval is critical in assessing need for treatment. Detailed questioning is essential

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

- If for any reason glucose 5% is unsuitable, sodium chloride 0.9% can be substituted

Prepare and check infusion bags carefully. Administration errors are common

PARACETAMOL POISONING • 2/5

Patients who present within 8 hr of ingestion

Gastric lavage/lemlesis is not indicated

- If patient thought to have taken > 12 g or 150 mg/kg (75 mg/kg in children at higher risk) and presents **within 1 hr** of dosing, give activated charcoal 1 g/kg (maximum 50 g) orally or via nasogastric tube
- If plasma paracetamol concentration below relevant line on treatment graph **and** history consistent with < 150 mg/kg paracetamol being ingested, child requires no treatment
- If there is **absolute certainty** that a single dose of paracetamol of < 150 mg/kg (or < 75 mg/kg in high risk children) has been ingested, plasma paracetamol need not be measured and child requires no treatment
- If paracetamol overdose deliberate, even if no treatment required, admit patient for interview with Psychiatric Priority Referral Team

Patients who present 8–15 hr after ingestion

- If > 12 g or 150 mg/kg has been ingested and the paracetamol concentration is not yet known, give acetylcysteine **at once** while awaiting laboratory result
- discontinue the acetylcysteine only if the plasma paracetamol concentration is below relevant treatment line, there is no abnormality of the INR, plasma creatinine or alanine aminotransferase (ALT), and patient is asymptomatic. Do not

discontinue the infusion if there is any doubt about the timing of the overdose

- Start acetylcysteine if the plasma paracetamol concentration is above relevant line on the graph or if INR, plasma creatinine or ALT is abnormal

Patients who present 15–24 hr after ingestion

- If patient presents 15-24 hr after a potentially dangerous dose (> 12 g or 150 mg/kg), give acetylcysteine according to the regimen above **at once**. Treatment can be stopped 24 hr after ingestion if:
 - patient asymptomatic
 - plasma paracetamol < 10 mg/L
 - INR normal
- Prognostic accuracy of the treatment line on graph after 15 hr is uncertain and clinical judgement becomes more important in management
- plasma paracetamol concentration above relevant line should be regarded as carrying serious risk of severe liver damage
- Patients presenting 15 hr or longer after an overdose tend to be more severely poisoned and at greater risk of developing serious liver damage

Patients who present > 24 hr after ingestion

- If patient presents who has taken a potentially dangerous dose (> 12 g or 150 mg/kg), or is symptomatic, or has abnormal laboratory results, give acetylcysteine (standard regimen)

PARACETAMOL POISONING • 3/5

- repeat investigations at end of standard regimen and continue with doses of 50 mg/kg in 500 mL over 8 hr if patient has, or is at risk of developing, fulminant hepatic failure
- insert urinary catheter to monitor urine flow and rehydrate to maintain urine output > 1 mL/kg/hr
- 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

Staggered overdose

- If several overdoses of paracetamol have been taken over a short period of time the plasma paracetamol concentration will be meaningless in relation to treatment graph
- consider patient at serious risk and start acetylcysteine

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 50 mg/kg over 4 hr

MONITORING TREATMENT

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

Patients who present within 8 hr of overdose

- INR, AST/ALT and plasma creatinine 24 hr after overdose or when antidote treatment complete

Patients who present within 8-15 hr after overdose

- INR, AST/ALT, plasma creatinine and phosphate when antidote treatment complete. If abnormal or patient symptomatic, continue monitoring and seek advice from National Poisons Information Service (0870 600 6266)

Patients who present 15-24 hr after overdose

- INR, AST/ALT, plasma creatinine and phosphate when antidote treatment complete. If abnormal or patient symptomatic, continue monitoring and seek advice from National Poisons Information Service (0870 600 6266)
- Urine output
- Blood glucose – finger prick (4 hrly)
- Blood gases and acid-base daily
- Observe for signs of encephalopathy (mental confusion, drowsiness, spatial disorientation, asterixis)

PARACETAMOL POISONING • 4/5

Life-threatening features

- A poor prognosis is 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
- Patients with incipient or established hepatic failure may be candidates for liver transplantation
- Treat haemorrhage with fresh frozen plasma
- Hypophosphataemia usually occurs after paracetamol poisoning and correlates well with the degree of hepatic damage

Psychiatric review

- All patients admitted after acute self-poisoning or deliberate drug overdose should be offered an interview with a member of the Psychiatric Priority Referral Team within 24 hr of admission or regaining consciousness

DISCHARGE POLICY

- See **Acute poisoning/Drug overdose**
- Advise patients to return to hospital if vomiting or abdominal pain develop or recur

Patients who present within 8 hr of overdose

- Discharge if INR, AST/ALT and plasma creatinine normal at 24 hr after overdose, or after antidote treatment complete

Patients who present > 8 hr after overdose

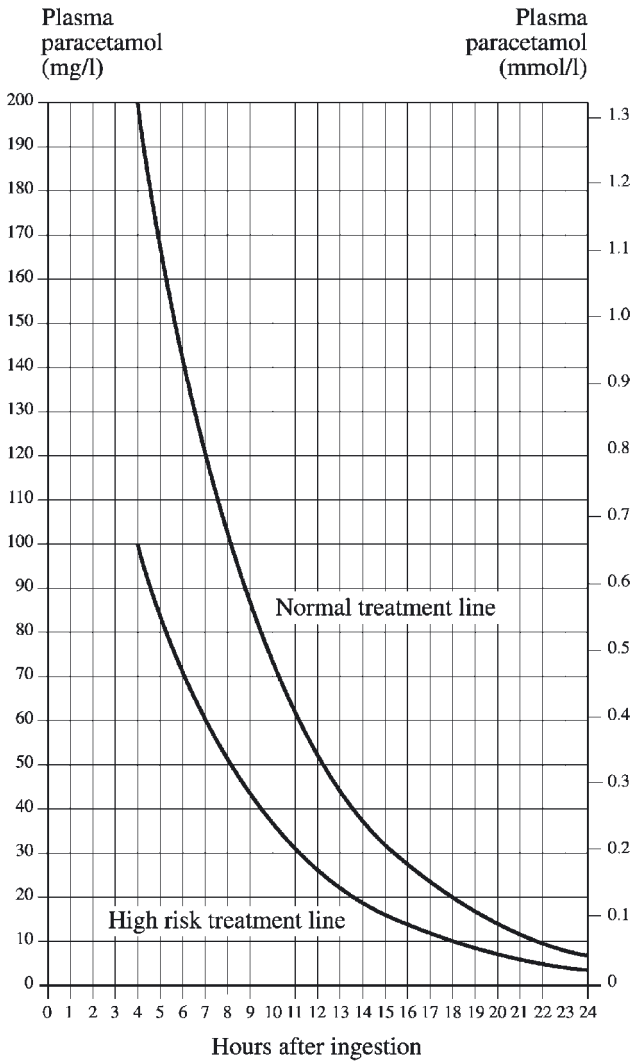
- If INR, AST/ALT and plasma creatinine normal after antidote treatment complete, asymptomatic patients may be discharged

Staggered overdose

- Discharge after acetylcysteine treatment or 24 hr after last paracetamol dose if asymptomatic and INR, plasma creatinine and ALT are normal

PARACETAMOL POISONING • 5/5

Figure 1: Treatment graph for paracetamol overdose



PHENOTHIAZINE POISONING/SIDE EFFECTS • 1/1

In poisoning contact National Poisons Information Service (0870 600 6266) for advice

RECOGNITION AND ASSESSMENT

Symptoms and signs

- Drowsiness
- Confusion

Common preparations

- Chlorpromazine
- Perphenazine
- Prochlorperazine
- Promazine
- Trifluoperazine
- Metoclopramide

Extrapyramidal side effects

- **Not** dose-related
- Dystonia (e.g. oculogyric crises, spasmodic torticollis)
- Dyskinesia
- Appear after only a few doses

Complications

- Convulsions
- Hypothermia
- Hypotension
- Arrhythmias (e.g. sinus tachycardia, QT and QRS prolongation, VT/VF, bundle branch/atrio-ventricular block)
- Respiratory depression
- Rhabdomyolysis
- Renal failure

IMMEDIATE TREATMENT

- If patient presents within 1 hr of ingesting a potentially toxic dose, give activated charcoal 1 g/kg (max 50 g)
- Maintain clear airway and adequate ventilation
- Correct hypotension (see **Acute poisoning/Drug overdose**)
- Correct hypothermia using conventional means (e.g. Bair Hugger, blankets)
- Correct acid-base and metabolic disturbance
- Control convulsions with IV lorazepam

Treatment of extrapyramidal side effects

- Procyclidine orally
- in severe reactions give IV or IM
- subsequent oral doses may be needed for two to three days
- if procyclidine not available, benzotropine or diazepam can be used

MONITORING TREATMENT/SUBSEQUENT MANAGEMENT

- See **Acute poisoning/Drug overdose**

SALICYLATE POISONING • 1/3

Salicylate poisoning can be fatal, contact National Poisons Information Service (0870 600 6266) for advice on management of serious cases

RECOGNITION AND ASSESSMENT

Symptoms and signs

- Common features
 - vomiting
 - dehydration
 - tinnitus
 - vertigo
 - deafness
 - sweating
 - warm extremities with bounding pulse
 - increased respiratory rate
 - hyperventilation
 - acid-base disturbance:
 - > 4-yrs-old usually mixed respiratory alkalosis and metabolic acidosis with normal or high arterial pH
 - < 4-yrs-old usually a dominant metabolic acidosis with low arterial pH
- Uncommon features
 - haematemesis
 - hyperpyrexia
 - hypoglycaemia
 - hypokalaemia
 - thrombocytopenia
 - increased INR/PTR
 - intravascular coagulation
 - renal failure
 - non-cardiac pulmonary oedema

- confusion
- disorientation
- coma
- convulsions

Preparations

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

Investigations

- U&E, creatinine
- INR
- Arterial blood gases
- Blood glucose (capillary)
 - in asymptomatic patients with a reliable history of ingestion of < 120 mg/kg of aspirin, plasma salicylate not required
 - In those who have ingested > 120 mg/kg, measure plasma salicylate at least 2 hr (if symptomatic) or 4 hr (if asymptomatic) after ingestion
- If coincident paracetamol overdose requiring infusion of antidote, sample before administration of N-acetylcysteine
- Urine pH

SALICYLATE POISONING • 2/3

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
 - < 10-yrs-old
 - CNS features
 - acidosis
 - hyperpyrexia
 - late presentation
 - pulmonary oedema
 - salicylate concentration > 5.1 mmol/L

IMMEDIATE TREATMENT

- If ingested > 250 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)

Interpretation of plasma salicylate concentrations

- Clinical presentation is the most important factor
- Late presenting patient may have a sub-toxic salicylate concentration, but serious acid-base or CNS disturbances

- Plasma salicylate < 2.5 mmol/L and mild clinical effects:
 - continue maintenance management
- Plasma salicylate 2.5–5.1 mmol/L and moderate clinical effects:
 - continue with maintenance management and start **alkaline diuresis** in children < 5-yrs-old
 - in older children start alkaline diuresis if plasma salicylate > 3.6 mmol/L
- Plasma salicylate > 5.1 mmol/L and severe clinical effects
 - use **haemodialysis**

Children < 10-yrs-old have an increased risk of salicylate toxicity and may require haemodialysis at an earlier stage

Alkaline diuresis

- If serum potassium low, this must be corrected first, either enterally if tolerated or IV (maximum rate 40 mmol/L)
- If serum potassium within normal range, alkalinise urine to enhance salicylate excretion (optimum urine pH 7.5–8.5)
 - give 1 mL/kg (1 mmol/kg) sodium bicarbonate 8.4% in 500 mL sodium chloride 0.9% or glucose 5% at 2–3 mL/kg per hr, and repeat if necessary to maintain urine pH 7.5–8.5
 - do not use volumes of IV fluids above maintenance requirements (forced diuresis) - it does not increase salicylate elimination and can cause pulmonary oedema

SALICYLATE POISONING • 3/3

Haemodialysis

- Use in patients with severe poisoning
- plasma concentrations > 5.1 mmol/L
- renal failure
- congestive cardiac failure
- non-cardiogenic pulmonary oedema
- convulsions
- CNS effects not resolved by correction of acidosis
- persistently high salicylate concentrations unresponsive to urinary alkalinization
- severe metabolic acidosis
- children < 10-yrs-old who have an increased risk of salicylate toxicity

MONITORING TREATMENT/SUBSEQUENT MANAGEMENT

- See **Acute poisoning/Drug overdose**
- During alkaline diuresis, check U&E, blood glucose, acid-base hrly
- Repeat plasma salicylate 2 hrly until falling
- if plasma salicylate continues to rise, consider a second dose of activated charcoal
- Continue therapy until patient improving and plasma salicylate falling

TRICYCLIC ANTIDEPRESSANT POISONING • 1/2

For advice contact National Poisons Information Service (0870 600 6266)

RECOGNITION AND ASSESSMENT

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

Preparations

- Amitriptyline
- Amoxapine
- Clomipramine
- Dosulepin
- Doxepin
- Imipramine
- Lofepramine
- Nortriptyline
- Trimipramine

Investigations

- U&E
- Arterial blood gas
- 12-lead ECG – large doses cause prolongation of PR and QRS intervals

IMMEDIATE TREATMENT

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

- Correct any hypoxia
 - if $\text{PaCO}_2 > 6 \text{ kPa}$, arrange assisted ventilation
- If dose $> 4 \text{ mg/kg}$ within previous hour, give activated charcoal, 25-50 g in children 2 to 12-yrs-old, 50 g > 12 -yrs-old, either orally (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
 - resist temptation to treat with drugs
 - correct hypoxia and acidosis – inform consultant
 - consult a cardiology registrar at local paediatric cardiac centre

Prolonged resuscitation may be successful after cardiac arrest

TRICYCLIC ANTIDEPRESSANT POISONING • 2/2

MONITORING TREATMENT

- See **Acute poisoning/drug overdose**
- Cardiac monitor for at least 6 hr
- asymptomatic patients with normal ECG after 6 hr are unlikely to develop late complications

SUBSEQUENT MANAGEMENT

- See **Acute poisoning/drug overdose**
- Consider second dose of charcoal after 2 hr if:
 - sustained-release formulation taken
 - CNS/respiratory depression
- In severe cases, correct hypotension by raising foot of bed or, if necessary, expanding the intravascular volume
- Control convulsions with IV lorazepam
- 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

DIABETES AND FASTING • 1/5

Management of children with diabetes undergoing surgery and other procedures that require fasting

PRINCIPLES

Reasons to control diabetes well in the peri-operative period

- To prevent hyperglycaemia and keto-acidosis, resulting from:
 - omission of insulin
 - stress hormone response to surgery
 - catabolic state
- To minimize risk of infection, enhanced by hyperglycaemia
- To prevent hypoglycaemia, resulting from:
 - starvation pre- and postoperatively
 - anorexia postoperatively

Careful regular monitoring of blood glucose is required throughout the peri-operative period

- Diabetic patients should preferably be first on morning list
- Give usual insulin on the evening before the procedure
- Recommend normal age-dependent fasting - see **Pre-operative fasting**

If any concerns, contact diabetic team

MINOR SURGERY (able to eat within 4 hours of procedure)

Pre-operative care

First on the morning list:

- Advise usual doses of insulin on night before procedure
- On the day of the procedure omit insulin and breakfast
- Allow clear fluids, including sweet drinks, up to 06.00
- Measure and record capillary blood glucose pre-operatively and half hrly during the operation

First on the afternoon list:

- Advise usual doses of insulin on night before procedure
- Advise child to have normal breakfast no later than 07.30
- Breakfast insulin dose
 - if using Multiple Daily Injection (MDI) regimen, give usual breakfast insulin
 - if using twice daily insulin regimen give 1/2 of rapid-acting component of morning dose as rapid-acting insulin
 - see Table 1 for insulin dosage calculation
- Allow clear fluids until 3 hr prior to the operation
- Measure and record capillary blood glucose on arrival in theatre
- Measure and record capillary blood glucose hrly once nil by mouth and half hrly during the operation

DIABETES AND FASTING • 2/5

Table 1: **How to calculate of $\frac{1}{2}$ rapid-acting component of twice daily insulin dose (pre-op)**

Example: Usual morning insulin is 20 units of Mixtard 30

● 30% (0.3) of Mixtard 30 is short acting
● If usual dose is 20 units Mixtard 30 in the morning, the short acting component is 6 units (0.3 x 20)
● The child should have $\frac{1}{2}$ of this (i.e. 3 units) as a short acting insulin SC before breakfast on day of surgery

- If any concerns (e.g. vomiting, prolonged operation), start IV fluids and insulin as for **Major surgery**
 - lunch on the same day of the procedure, give $\frac{2}{3}$ of rapid-acting component of usual morning dose as rapid-acting insulin with meal (see Table 2)
 - teatime on the same day of the procedure, it may be appropriate to give the child's usual insulin dose or a reduced dose - contact the diabetes team for advice
- Postoperative care**
- Monitor capillary blood glucose in recovery and then hrly for 4 hr
 - If well on return to ward and using Multiple Daily Injection (MDI) regimen
 - give dose of rapid-acting insulin appropriate for carbohydrate content of next meal (if advice needed, contact diabetes team) and
 - give next dose of long-acting insulin at the usual time
 - If using twice daily premixed insulin regimen and able to eat by:
 - If any concerns (e.g. vomiting or prolonged operation), start IV fluids and insulin as for **Major surgery**
 - when the child is ready to eat, see **Major and emergency surgery - postoperative care**

Table 2: **How to calculate $\frac{2}{3}$ of rapid-acting component of twice daily insulin dose (post-op)**

Example: Usual morning insulin is 20 units of Mixtard 30

● 30% (0.3) of Mixtard 30 is short acting
● If usual dose is 20 units Mixtard 30 in the morning, the short acting component is 6 units (0.3 x 20)
● The child should have $\frac{2}{3}$ of this (i.e. 4 units) as a short acting insulin SC before their meal

DIABETES AND FASTING • 3/5

MAJOR AND EMERGENCY SURGERY

MAJOR SURGERY (unable to eat within 4 hr of start of procedure)

Pre-operative care

- Admit on day before surgery
- Check pre-meal and bedtime capillary blood glucose measurements on ward

First on morning list:

- If using multiple daily injections (MDI), give usual mealtime short-acting insulin **but half the usual dose of long-acting insulin on night before procedure**
- If using twice-daily insulin regimen, give usual doses of insulin with meal on night before procedure
- On day of procedure, omit insulin and breakfast
- Allow clear fluids, including sweet drinks, up to 06.00
- Insert 2 IV cannulae if possible. These can be inserted in theatre, if necessary
- Start a glucose and sliding scale insulin infusion in theatre - see **below**
- Measure and record capillary blood glucose pre-operatively and half hrly during operation

First on afternoon list:

- Advise usual doses of insulin on night before procedure
- Advise child to have a normal breakfast no later than 07.30
- Breakfast insulin dose:
 - if using Multiple Daily injection (MDI) regimen, give usual breakfast insulin

- if using twice daily insulin regimen give $\frac{1}{2}$ of rapid-acting component as rapid-acting insulin
- see **Table 1** for insulin dose calculation
- Allow clear fluids until 3 hr before operation
- Measure and record capillary blood glucose on arrival in theatre
- Insert 2 IV cannulae if possible. These can be inserted in theatre, if necessary
- Start a glucose and sliding scale insulin infusion in theatre - see **below**
- Measure and record capillary blood glucose hrly once nil-by-mouth and half hrly during the operation

EMERGENCY SURGERY

Emergency procedures differ from elective ones as children run the risk of developing ketoacidosis if they are ill. The prolonged starvation associated with delayed surgery poses additional complications

Pre-operative care

- **Inform Diabetes Team immediately**
- Do not give any SC insulin while child is starved
- Check venous U&E, glucose, blood gas when child is cannulated
- Commence a glucose and sliding scale insulin infusion - see **below**
- Measure and record capillary blood glucose hrly once nil-by-mouth and half hrly during operation

DIABETES AND FASTING • 4/5

If patient ill or diabetes not well controlled, follow guideline for Diabetic ketoacidosis and postpone operation until patient stabilised

Operate once patient rehydrated, with stable blood pressure, serum sodium and potassium within normal range and blood glucose < 17 mmol/L

INTRAVENOUS INSULIN AND FLUIDS

Maintenance fluid infusion

- Use premixed 500 mL bags of sodium chloride 0.45% and glucose 5% with 10 mmol/L of potassium chloride
- Fluid requirements:
 - ≤ 2 yr 80 mL/kg/24 hr
(discuss with Diabetes Medical Team)

- 3-5 yr 70 mL/kg/24 hr
- 6-9 yr 60 mL/kg/24 hr
- ≥ 10 yr 30 mL/kg/24 hr

Insulin infusion

- Add 50 units of Actrapid insulin to 50 mL of sodium chloride 0.9% to make a 1 unit/mL solution
- Administer this via syringe pump - do not add directly to fluid bag
- If possible, insert 2 cannulae, so that insulin infusion is given by a dedicated vein rather than via a 3-way connection - if this is not possible, use Y connector with one-way valve
- Determine infusion rate from hrly capillary blood glucose results, according to sliding scale - see Table 3
- Insulin sliding scale should always be given in conjunction with a glucose infusion

Table 3:

Capillary blood glucose (mmol/L)	Insulin infusion rate (mL/kg/hr)
≥ 28.1	Call Doctor
18.1-28	0.1
12.1-18	0.075
8.1-12	0.05
4.1-8	0.03
≤ 4	Stop insulin, treat hypo. Recheck blood glucose after 30 min and follow sliding scale

- If blood glucose > 15 mmol/L, check for ketones – if positive, contact doctor

Do not switch off insulin and/or maintenance fluids in transit to and from theatre

Do not give ANY SC insulin until child is ready to come off the sliding scale

DIABETES AND FASTING • 5/5

MONITORING

- Adjust glucose infusion rate according to blood glucose - see Table 3. Aim to keep blood glucose between 4 and 12 mmol/L
- Check capillary blood glucose half hrly during surgery and adjust insulin infusion according to Table 3
- If using twice daily premixed insulin regimen and taking adequate oral fluids and snacks by:
 - lunch on the same day of the procedure, give $\frac{2}{3}$ of rapid-acting component of usual morning dose as rapid-acting insulin with meal (see Table 2)
 - teatime on the same day of the procedure or breakfast on next day, it may be appropriate to give child's usual insulin dose or a reduced dose - contact diabetes team for advice

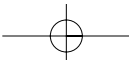
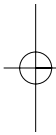
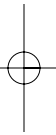
POST-OPERATIVE CARE

- Check capillary blood glucose half hrly for the first two hr and then hrly
- Continue glucose and sliding scale insulin infusion until taking adequate oral fluids and snacks. While on insulin sliding scale, child may safely eat and drink
- If taking adequate oral fluids and snacks and using Multiple Daily injection (MDI) regimen:
 - give dose of rapid-acting insulin appropriate for carbohydrate content of next meal (if advice needed, contact diabetes team) and
 - give next long-acting insulin dose at the usual time. If the child was treated using a sliding scale overnight, and usual dose of long-acting insulin was omitted the previous night, give $\frac{1}{2}$ usual dose of long-acting insulin with breakfast if ready to eat

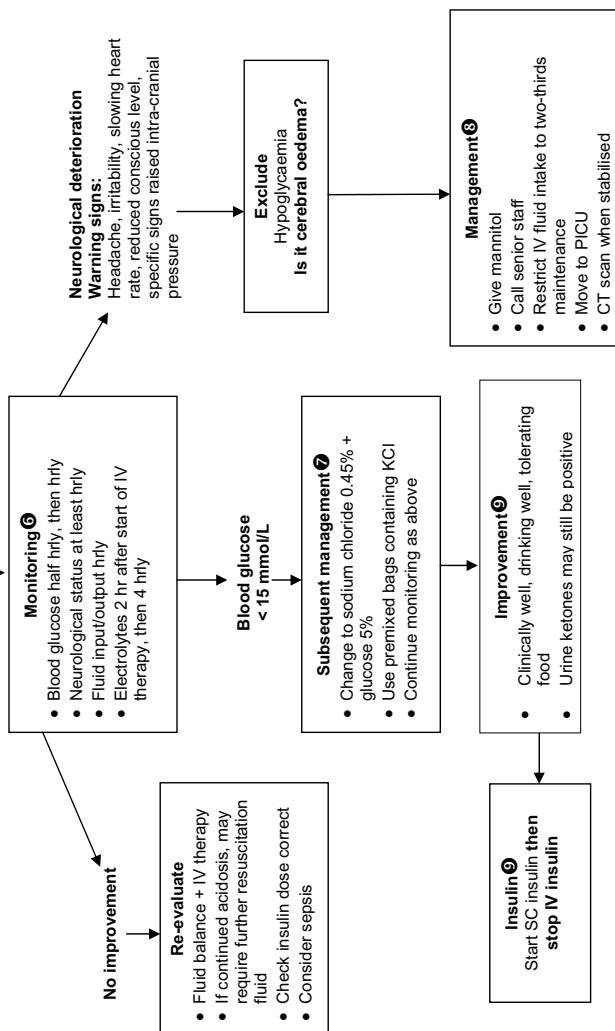
***Give SC insulin dose, after
30 min give meal, after
further 30 min stop infusion***

Patients unlikely to resume eating and drinking

- If after 48 hr patient still unable to eat or drink enough post-operatively:
 - assess for enteral or parenteral feeding - contact Nutrition Support Team
 - contact diabetic specialist nurses for advice on prescribing regular SC insulin



DIABETIC KETOACIDOSIS • 2/8



DIABETIC KETOACIDOSIS • 3/8

RECOGNITION AND ASSESSMENT ①

Symptoms and signs ①

- Thirst
- Weight loss
- Polyuria
- Flushed appearance
- Sighing respiration (Kussmaul breathing)
- Odour of ketones
- Dehydration
- Drowsiness
- Coma

Assessment ①

- Airway, breathing, circulation
- Conscious level-look for signs of cerebral oedema (see **Glasgow Coma Score**)
- Headache, confusion, irritability, abnormal movements, slow pulse, high BP, papilloedema, small and irregular pupils
- Presence of infection
- Height, weight

Degree of dehydration

See Table: Assessment of degree of dehydration in **Diarrhoea and Vomiting** guideline

Investigations ①

- Insert large IV cannula

All cases

- Capillary blood glucose

- FBC
- Blood glucose
- Blood gas
- **Haemoglobin A1c**
- Blood osmolality, sodium, potassium, urea, bicarbonate, creatinine, pH
- Urine ketones on urinalysis
- Blood ketones
- Infection screen: blood and urine culture; if meningism, lumbar puncture

Moderate and severe cases

- Liver function tests and amylase
- Group and save

Newly diagnosed cases

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

DIABETIC KETOACIDOSIS • 4/8

IMMEDIATE TREATMENT ②

Inform senior staff

Admission

- If alert and <10% dehydrated, admit to ward
- If shock or GCS < 8, admit to PICU
- otherwise admit to HDU

General

- Nil by mouth for first 8-12 hr
- if vomiting, complaining of abdominal pain or has silent abdomen, insert nasogastric tube
- Place on weigh-bed (if available)
- Strict fluid balance - catheterize 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 ③

- Patient is shocked (very rare in DKA):
 - tachycardia
 - reduced peripheral pulse volume
 - mottled cool peripheries

- prolonged capillary refill time (poor sign)
- altered state of consciousness
- AND acidosis
- with or without hypotension
- Give sodium chloride 0.9% 10 mL/kg rapidly and reassess

If still shocked despite giving sodium chloride 0.9% 30 mL/kg, discuss with consultant

- When no longer shocked and circulated blood volume has been restored, calculate volume of fluid required (see below)

INTRAVENOUS FLUIDS ④

Volume of fluid

- Total fluid requirement is the addition of four categories:
 - fluid to re-expand circulating volume if shocked
 - maintenance fluids
 - deficit
 - continuing losses

Maintenance fluids

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

Age (yr)	Rate (mL/kg/24 hr)	Rate (mL/kg/48hr)
0-2	80	160
3-5	70	140
6-9	60	120
10-14	50	100
> 15	30	60

DIABETIC KETOACIDOSIS • 5/8

Fluid deficit

- This is the estimated amount of fluid the patient has lost, (i.e. how dehydrated)
- Calculate from weight loss
- Most accurate method
- weigh child and compare with recent weight
- gives good estimate of fluid loss (1 kg weight loss = 1 L fluid deficit)
- Clinical assessment
- deficit in mL = % dehydration x body weight (kg) x 10
- e.g. for a 10 kg child with 5% dehydration, the deficit is 5 x 10 x 10 = 500 mL
- Most cases of DKA will be 10% dehydrated

Total Amount

- Hourly rate of fluid replacement = (48 hr maintenance requirements + deficit - resuscitation fluid already given)/48
- Also replace continuing losses = output (vomitus, urine [> 2 mL/kg/hr], nasogastric fluid loss) - input Do not include normal urine output < 2 mL/kg/hr
- add amount of fluid lost over last 4hr to fluids to be given over next 4 hr. Recalculate every 4hr
- If losses excessive and child's weight not rising or clinical state not improving, calculate losses and replace over 1-2 hr
- Weight should rise gradually with rehydration
- Record weight hrly using the weigh-bed to obtain accurate assessment

Type of fluid

Table 1

Time (hr)	K ⁺ < 3.5	K ⁺ 3.5-5.5	K ⁺ > 5.5
Use hourly rate including continuing losses. Recalculate at least every 4 hrs	500 mL sodium chloride 0.9% with potassium chloride 40 mmol (commercially premixed bag)	1 L sodium chloride 0.9% with potassium chloride 40 mmol (commercially premixed bag)	1 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 to approximate calculated strength of potassium chloride.

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)

DIABETIC KETOACIDOSIS • 6/8

- Further fluid and K⁺ as dictated by the patient's condition and serum K⁺ (Table 1), repeated until glucose fallen to 15 mmol/L, then move to **Subsequent Management**

YOU MUST obtain consultant authorization before using bicarbonate infusion (not recommended)

Insulin infusion ⑤

- Soluble insulin (e.g. Actrapid) infusion 1 unit/mL in sodium chloride 0.9% via IV syringe pump at 0.05 units/kg/hr (or 0.1 units/kg/hr if 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, consult senior medical staff and re-evaluate (e.g. sepsis, insulin errors)
- If blood glucose fall exceeds 5 mmol/L per hr, reduce insulin infusion rate by 20%. Do **not** stop insulin infusion. Check capillary glucose in 1 hr

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

MONITORING TREATMENT ⑥

- Hrly capillary blood glucose
- Check U&E, glucose, osmolality and pH 2 hrly until improving, then 4 hrly
- Neurological status hrly
- Complete DKA summary sheets

SUBSEQUENT MANAGEMENT ⑦

If blood glucose has fallen below 15 mmol/L and Na⁺ still < 130 or Na⁺ > 150, contact consultant to discuss fluid management

- Once blood glucose has fallen below 15 mmol/L, use fluid regimen in Table 2

Table 2

Time (hr)	K ⁺ ≤ 5.5	K ⁺ > 5.5
Use hourly rate including continuing losses. Recalculate at least every 4 hrs	500 mL glucose 5% with sodium chloride 0.45% and potassium chloride 20 mmol (commercially premixed bag)	1 L glucose 5% with sodium chloride 0.45%

DIABETIC KETOACIDOSIS • 7/8

If serum potassium is < 2.5 mmol/L, discuss with consultant. Follow instructions under Table 1

- Keep insulin infusion rate at or reduce to 0.05 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 6 mmol/L, reduce insulin infusion rate by 20%. Check capillary glucose in 1 hr. If glucose continues to fall, change fluid regimen to glucose 10% (Table 3)

Table 3

Time (hr)	K ⁺ < 3.5	K ⁺ 3.5-5.5	K ⁺ > 5.5
Use hourly rate including continuing losses. Recalculate at least every 4 hrs	If serum potassium is < 3.5 mmol/L, discuss fluid management with consultant	500 mL glucose 10% with sodium chloride 0.45% and potassium chloride 10 mmol, (remove 50 mL from 500 mL bag of glucose 5%, sodium chloride 0.45% and potassium chloride 10 mmol and add 50mL of glucose 50%)	1 L glucose 10% with sodium chloride 0.45%

- Continue with IV fluids and insulin infusion until urine is negative for ketones and child is tolerating oral fluids and food
- Continue IV insulin pump after first SC dose of insulin for 1 hr if SC dose was soluble (e.g. Humulin S) or 10 min if SC dose of insulin was aspart or lispro (e.g. Novarapid)
- Exclude hypoglycaemia
- If cerebral oedema suspected, inform consultant immediately
- give mannitol 0.5 g/kg (2.5 mL/kg of 20%) over 30 min, repeat once or twice after 4-8 hr if required
- restrict IV fluid intake to two-thirds maintenance
- continue to replace losses
- if patient unconscious, insert urethral catheter
- admit to PICU
- consider CT scan/MR scan

Cerebral oedema ⓘ

- Observe for headache, any change in symptoms, pH < 7.2, or persistently low serum sodium as glucose corrects

DIABETIC KETOACIDOSIS • 8/8

Converting to SC insulin ⑨

- Inform Diabetic Team (consultant, diabetic nurse and dietician)
- Children usually require insulin 0.25-1.0 units/kg per day
 - if child has been given IV insulin, the amount given over the previous 24 hr gives an approximate value of requirement as long as they have been eating reasonably well
- Divide total daily dose as follows:
 - two-thirds dose 20 min before breakfast (give insulin analogues 5 min before meal)
 - one-third dose 20 min before evening meal (give insulin analogues 5 min before meal)
- adjust ratio if necessary, depending on the child's eating patterns
- Choose insulin preparation most suitable for the child: discuss with Diabetes Team
- Continue IV insulin pump after first SC dose of insulin for 1 hr if SC dose was soluble (e.g. Humulin S) or 10 min if SC dose of insulin was aspart or lispro (e.g. Novarapid)
- brand of soluble insulin - specify if pre-filled pen or cartridges
- needles 6 mm or 8 mm (5 mm only at the discretion of consultant or nurse specialist)
- one pack Hypostop triple pack
- one packet Glucose tablets
- one box lancets (e.g. Microfine plus)
- one kit GlucaGen HypoKit (glucagon 1 mg ;0.5 mg < 25kg, 1 mg > 25kg)
- one box blood glucose strips (e.g. MediSense Optium Plus strips), appropriate to glucose monitor
- one box Ketostix (for urine ketones)
- one box blood ketone strips if appropriate
- Diabetic Team will organize out-patient follow-up

DISCHARGE POLICY

- Prescribe the following as TTO for all new patients:
 - brand and strength of regular insulin - specify if pre-filled pen or cartridges

DIABETES NEW (NON-KETOTIC) • 1/2

Any child or young person presenting to the GP or A&E with symptoms suggestive of diabetes should be referred (by phone) immediately to the Paediatric Diabetes Team

RECOGNITION AND ASSESSMENT

Definition

Elevated blood glucose with no ketonuria/blood ketones

Symptoms and signs

- Change in school performance, etc
- Thirst
- Weight loss
- Polyuria
- Nocturia
- May be absent

Investigations

- Height and weight
- Blood:
 - glucose
 - electrolytes
 - pH
 - ketones
 - haemoglobin A_{1c}
 - FBC
 - cholesterol and triglycerides
 - TSH and FT4
 - autoantibody screen for endomysial, thyroid and islet cell antibodies

- Do not arrange a fasting blood glucose or glucose tolerance test
- Urine
- Ketones
- Glucose

IMMEDIATE TREATMENT

- Inform Diabetes Team – consultant or diabetes nurse specialist
- Start on SC insulin – total daily dose of 0.5 units/kg
 - two-thirds of total dose 10-20 min before breakfast (give insulin analogues 5 min before meal)
 - one-third of total dose 10-20 min before evening meal (give insulin analogues 5 min before meal)
- For advice on which insulin to use, discuss with consultant with special interest in diabetes

SUSEQUENT 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 dieticians

MONITORING TREATMENT

- Glucose stix monitoring pre-meals and at 00.00 and 04.00 hr

DIABETES NEW (NON-KETOTIC) • 2/2

DISCHARGE POLICY

- Out-patient appointment to see consultant one to two weeks after discharge
- Prescribe as TTO:
 - brand and strength of regular insulin – specify if pre-filled pen or cartridges
 - brand of soluble insulin – specify if pre-filled pen or cartridges
 - needles 6 mm or 8 mm (5 mm only at discretion of consultant or nurse specialist)
 - one pack Hypostop triple pack
 - one packet glucose tablets
 - one box lancets (e.g. Microfine plus)
 - GlucaGen HypoKit (glucagon)
1 mg - one kit (0.5 mg < 25 kg,
1 mg > 25 kg)
 - one box blood glucose strips – appropriate to blood glucose monitor (e.g. MediSense optium strips)
 - one box Ketostix (ketones in urine)
 - if appropriate, one box blood ketone sticks

HYPOGLYCAEMIA - UNEXPLAINED AND PROLONGED • 1/6

RECOGNITION AND ASSESSMENT

Definition

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

Symptoms and signs

- Neuroglycopenia:
 - lethargy
 - lassitude
 - tremulousness
 - loss of consciousness
 - seizure
- Autonomic effects:
 - sweating
 - shaking
 - trembling
 - tachycardia
 - anxiety
 - hunger

Previous history

- Ask about:
 - antenatal history – ‘small-for-dates’
 - prematurity
 - history of hypoglycaemia on the neonatal unit
 - early or prolonged jaundice
 - family history of sudden death (MCAD LCAD)
 - history of neuroglycopenia/autonomic symptoms when glucose intake decreased, e.g. during minor illnesses

- development especially developmental regression
- medication
- access to glycomenic agents (e.g. metformin)
- oral hypoglycaemics
- nutritional intake

Investigations

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)

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

- Before treating hypoglycaemia take venous blood for assay using the correct blood bottles (Table 1)
- once samples have been obtained, correct hypoglycaemia (see **Immediate treatment**)
- inform laboratory immediately so that samples arrive as quickly as possible (within 20 min)

HYPOGLYCAEMIA - UNEXPLAINED AND PROLONGED • 2/6

- Ensure that the first voided urine specimen after the hypoglycaemia episode is obtained to test for ketone bodies, organic/amino acid metabolites and reducing substances. Check with laboratory

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

Total blood requirement (6.5 mL minimum)

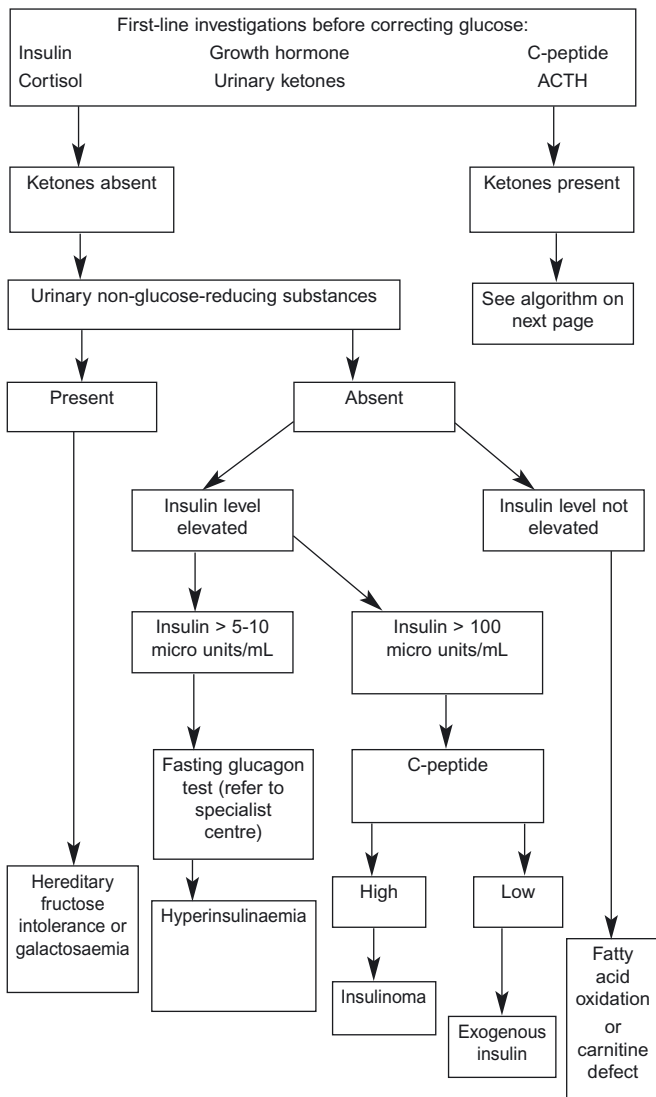
- EDTA 0.5 mL
- Fluoride 2 mL
- Lithium heparin 2 mL
- Clotted 2 mL

Investigations

- In all prolonged unexplained hypoglycaemia:
 - glucose stix
 - capillary blood gas
 - true glucose
 - lactate
 - ACTH
 - growth hormone
 - insulin
 - C-peptide
 - cortisol
 - urea and electrolytes
 - urinary ketones

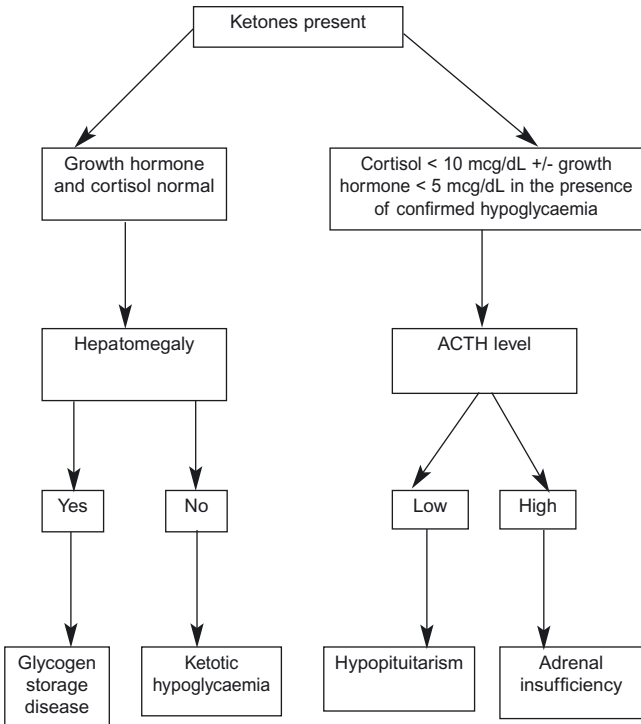
HYPOGLYCAEMIA - UNEXPLAINED AND PROLONGED • 3/6

Differential diagnosis



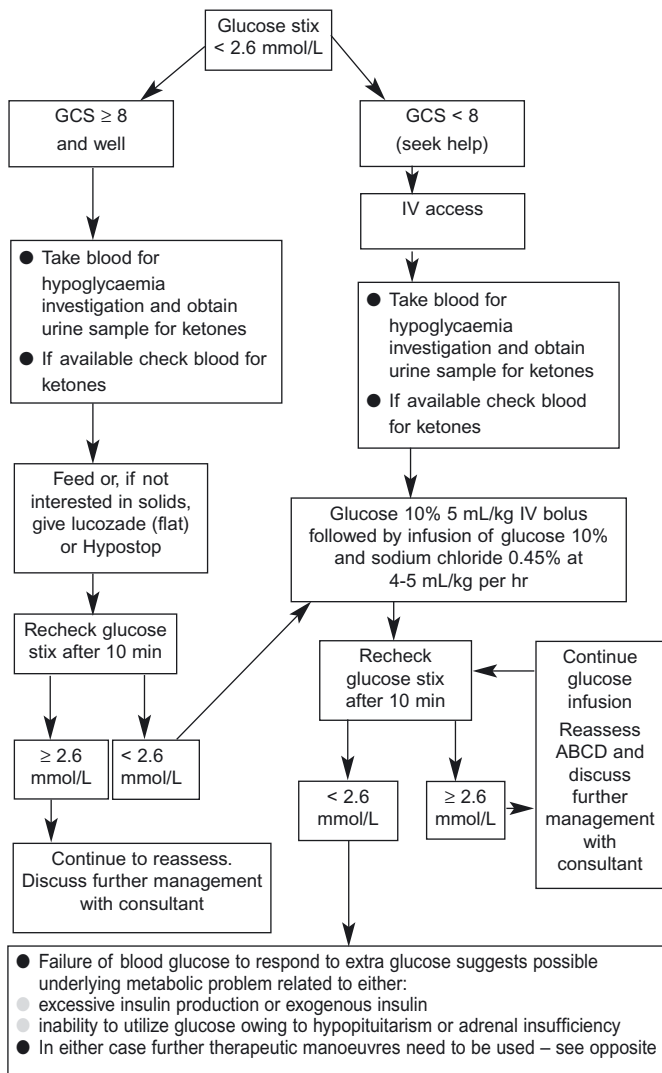
HYPOGLYCAEMIA - UNEXPLAINED AND PROLONGED • 4/6

Differential diagnosis

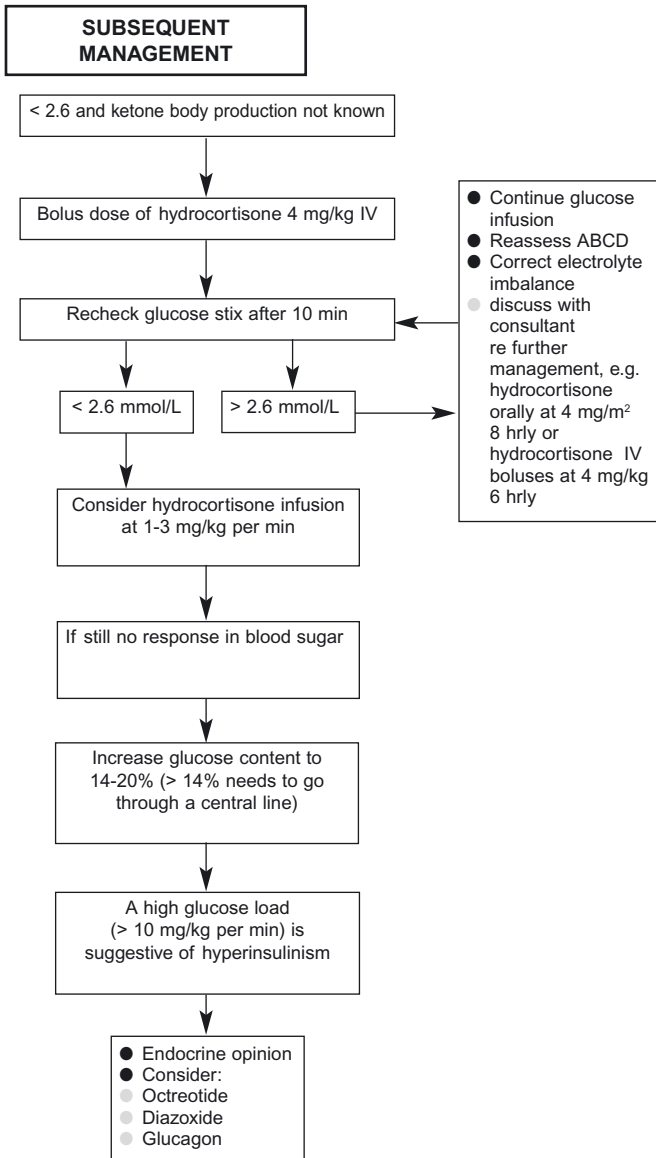


HYPOGLYCAEMIA - UNEXPLAINED AND PROLONGED • 5/6

IMMEDIATE TREATMENT



HYPOGLYCAEMIA - UNEXPLAINED AND PROLONGED • 6/6



STEROID-DEPENDENCE (PITUITARY-ADRENAL AXIS IMPAIRMENT) • 1/2

RECOGNITION AND ASSESSMENT

Definition

- Children with the following conditions are steroid-dependent with a depressed or absent pituitary-adrenal axis:
 - hypopituitarism
 - adrenal insufficiency
 - congenital adrenal hyperplasia
 - growth hormone deficiency
 - prolonged corticosteroid use for immunosuppression
 - severe asthma requiring oral corticosteroids or high-dose inhaled corticosteroids

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

- Steroid-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

MANAGEMENT

Elective surgical and investigative procedures

- Check whether pre-operative discussion of endocrine management has taken place

- If no plan for corticosteroid manipulation, prescribe either:
 - if surgery expected to last > 2 hr, hydrocortisone 2 mg/kg per hr via IV infusion throughout the operation and until child can take oral medication

OR

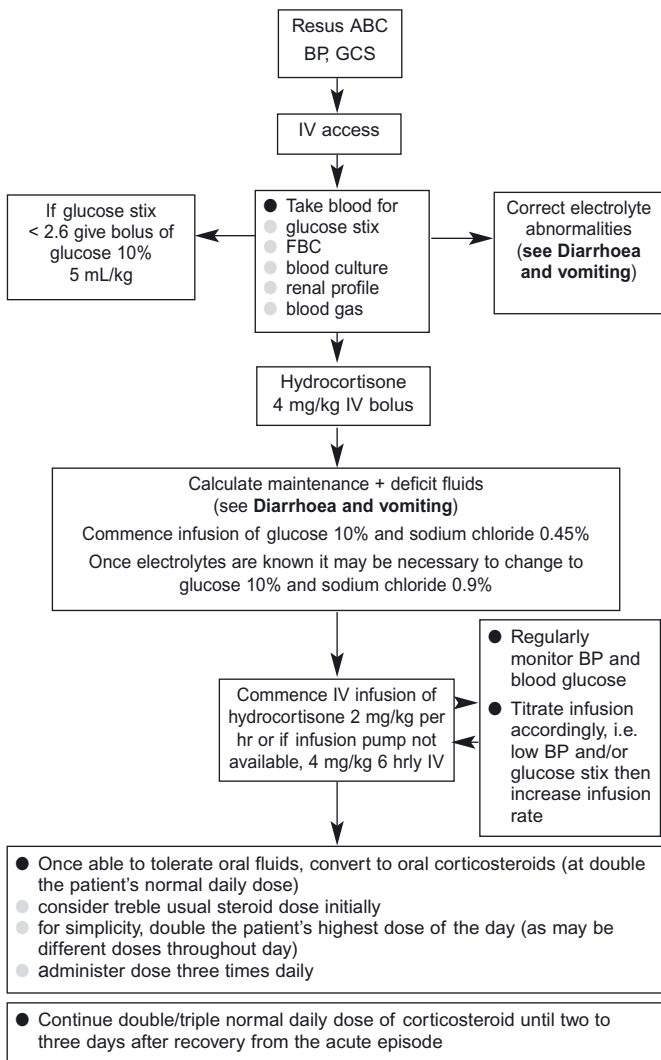
- if surgery expected to last < 2 hr, hydrocortisone 2 mg/kg IV at induction
- When child capable of taking oral medication, give double usual daily maintenance dosage of hydrocortisone for the subsequent 48 hr
- Continue usual medication with:
 - fludrocortisone
 - growth hormone
 - thyroxine
 - DDAVP (may require adjustment)

Acute illness

- During illness steroid-dependent children can usually be managed at home
- Recommend that corticosteroid dosage be doubled up to a maximum of 60 mg/m² at the start of the episode until 48 hr after recovery (see BNFC for surface area)
 - If unable to take oral corticosteroids (e.g. vomiting or acute collapse) parents to administer IM hydrocortisone 2 mg/kg
- If IM hydrocortisone required, hospital assessment necessary with training of parents to administer IM
- Continue usual dose of other medication
 - failure to do so may lead to hypoglycaemia

STEROID-DEPENDENCE (PITUITARY-ADRENAL AXIS IMPAIRMENT) • 2/2

Algorithm for the management of unwell steroid-dependent children



ACUTE ABDOMINAL PAIN • 1/2

RECOGNITION AND ASSESSMENT

Symptoms and signs

- Pain may be localized to one part of the abdomen or generalized
- If child < 5-yrs-old, pain is likely to be generalized with severity difficult to assess
- 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:
 - localised tenderness, though can be more diffuse
 - guarding and rebound tenderness
 - young children may not have typical features

Intussusception

- History of intermittent colicky abdominal pain
- Vomiting and passage of blood and/or mucus per rectum following respiratory or diarrhoeal illness
- On examination:
 - in about two-thirds of cases, a palpable sausage-shaped mass

crossing the midline in the epigastrium or behind the umbilicus

- associated with Henoch-Schönlein purpura

Mid-gut volvulus

- History of:
 - bowel obstruction
 - abdominal pain
 - distension
 - vomiting (usually bile-stained)

Pneumonia

- History of fever and cough
- On examination:
 - tachypnoea
 - recession +/- focal signs at one base

Differential diagnosis

Surgical problems

- Acute appendicitis
- Intussusception
- Intestinal obstruction
- Torsion of ovary or testis
- Hydronephrosis
- Renal calculus

Medical problems – relatively common

- Mesenteric adenitis
- Constipation
- Gastroenteritis
- Lower lobe pneumonia
- Acute pyelonephritis
- Henoch-Schönlein purpura
- Hepatitis

ACUTE ABDOMINAL PAIN • 2/2

Medical problems – rare but important

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

Investigations

- Urine testing and analysis
- Haemoglobin, white cell count and differential
- Blood culture
- CRP, ESR
- U&E
- Amylase
- Glucose
- LFT
- Imaging:
 - only if bowel obstruction or perforation suspected, abdominal X-ray
 - if child stable, ultrasound scan of abdomen
 - chest X-ray

TREATMENT

- If present, treat hypotension and shock
- Indications for surgical review:
 - localised right iliac fossa pain
 - rebound tenderness/pain on percussion
 - migration of pain

- redcurrant jelly stools
- bile-stained vomiting
- abdominal distension
- inguino-scrotal pain or swelling
- If stable, period of observation may be useful to make diagnosis
- Do not withhold analgesia pending surgical review: opioids may be necessary (see **Analgesia guideline**)

DISCHARGE POLICY

- Discharge usually within 24 hr of symptoms settling, e.g. fever, abdominal pain
- Follow-up usually appropriate in Primary Care/GP

CONSTIPATION • 1/5

RECOGNITION AND ASSESSMENT

Definition

- **Constipation** implies infrequent bowel evacuation, hard, small faeces, or difficult or painful defecation
- **Faecal soiling** (also called overflow as a result of faecal impaction) is the passage of liquid or formed stools in the child's underwear over which the child has no control
- **Encopresis** (also called functional non retentive soiling) is the inappropriate passage of normal stools in inappropriate places. Often associated with behavioural problems
- **Faecal incontinence** is faecal soiling in the presence of an anatomical or organic lesion

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

- 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
 - 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
- abdominal distension
- tight empty rectum in presence of palpable faecal mass
- gush of liquid stool and air from rectum on withdrawal of finger
- Anteriorly displaced anus
- Anal stenosis:
 - tightness or stricture felt when per rectum digital examination is done using lubricated fifth finger newborn and infants up to 6 months

Differential diagnosis

- Idiopathic constipation (90-95%)
- Constipation secondary to anal lesions
- Neurogenic constipation
- Constipation secondary to endocrine (hypothyroidism) and metabolic disorders
- Constipation induced by drugs (opioids)
- Coeliac disease

Investigations

- Most children with chronic constipation require minimal investigation:
 - a careful history and physical examination will help determine appropriate investigation
- Radiological studies:
 - not indicated in uncomplicated cases

CONSTIPATION • 2/5

- plain abdominal film can be useful in assessing:
 - presence or absence of retained stool
 - lower spine in an encopretic child with no faecal masses on abdominal and rectal examination
 - child who refuses rectal examination

MANAGEMENT

- Also see **Constipation management flowchart**

Principles of treatment

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

Education

- Give parents clear explanation of pathophysiology of constipation and soiling to maintain motivation and compliance with therapy

Diet

- Encourage high fibre diet and good fluid intake
- Carbohydrates, especially sorbitol found in prune, pear and apple juices, can cause an increased frequency and water content of stools

Behavioural management

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

Medication

Mild to moderate constipation (no soiling or features of megarectum)

- Try a stool softening or osmotic laxative such as lactulose first
- If not improved within a month, follow with a stimulant laxative such as senna, bisacodyl or sodium picosulphate syrup
- Maintain for at least one month after regular bowel actions have been achieved

CONSTIPATION • 3/5

Chronic severe constipation with or without soiling

First, evacuate retained faeces, using one of the following evacuation methods (choice depends on age and sensitivity of child), using as few steps as possible

Oral disimpaction

1. Polyethylene glycol (Movicol paediatrics plain); faecal impaction dose, see overleaf
2. Sodium picosulphate (Picolax sachets) – single dose, repeated if no stool passed within 8 hr, see **Bowel cleansing solutions in BNFC**. You may need to soften stools first using docusate sodium or polyethylene glycol (Movicol) for 5-7 days (see table below)

Omit step 3 in children < 20 kg

3. Polyethylene glycol (Klean-Prep) – large volume, may have to be given via nasogastric tube, see **Bowel cleansing solutions in BNFC**. Administer in hospital

Rectal disimpaction

4. Suppository/enema – avoid if possible
 - glycerine suppositories in babies < 1-yr-old
 - enemas may require sedation – small volume sodium citrate enemas (micro enema) preferable to large volume phosphate enemas

Manual evacuation

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

Movicol paediatric disimpaction dosage (number of sachets daily)

AGE	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
2-4 yrs	2	4	4	6	6	8	8
5-11 yrs	4	6	8	10	12	12	12

CONSTIPATION • 4/5

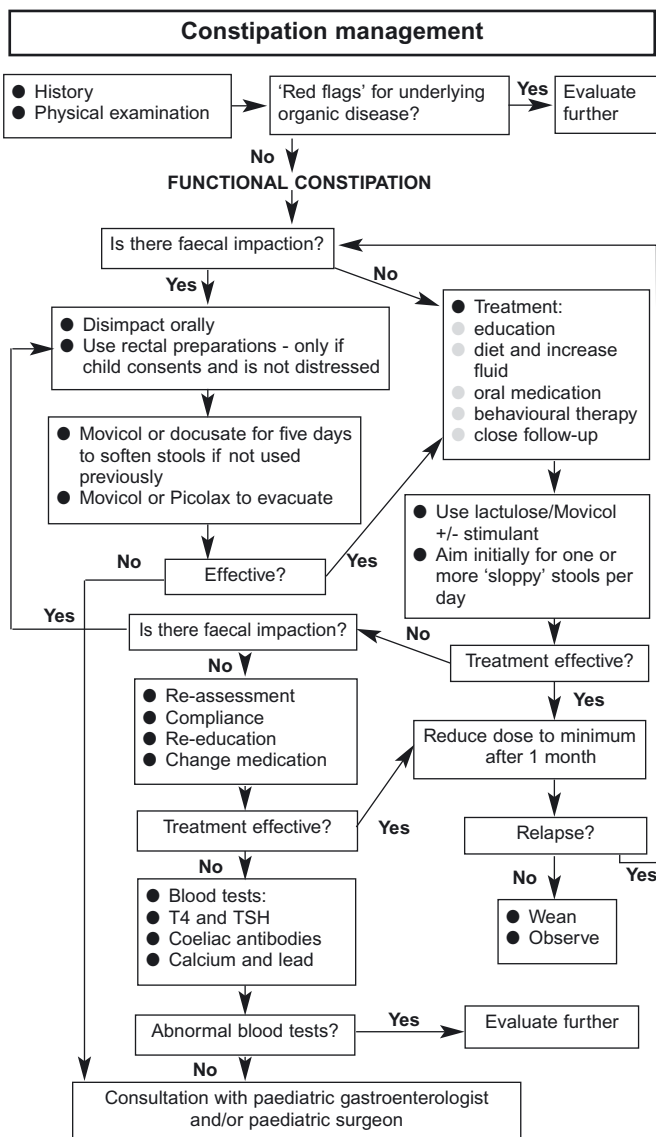
- After disimpaction, focus treatment on the prevention of recurrence and the establishment of a regular bowel habit to allow the bowel to regain normal tone and sensation
- this can take months and relapses are not uncommon
- treatment involves long-term laxative treatment, usually with an osmotic laxative (e.g. Movicol) and a stimulant (e.g. senna, bisacodyl or sodium picosulphate)
- aim for soft/loose stools initially daily
- high doses may be required and doses may need frequent adjustment by child and parent to maintain a regular bowel action – parents should be advised to reduce doses gradually and to increase again if no bowel action in three days
- timing of doses for convenience with bowel action
- child and family will need frequent review and support initially either in clinic or by telephone
- emphasize the need for good compliance
- Once regular bowel habit has been established for a few months, and child has good sensation to pass stools, gradually withdraw laxative

Supporting child and family

- Keep regular and frequent outpatient contact
- Use outreach nursing support
- Child psychology support when available is invaluable

Indications for seeking advice of paediatric gastroenterologist

- Organic cause of constipation suspected
- 'Disimpaction' orally/rectally unsuccessful or required more than three times
- Soiling/abdominal pain continues despite treatment
- Regular enemas required

CONSTIPATION • 5/5

DIARRHOEA AND VOMITING • 1/6

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
 - 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 antibiotic use
 - symptoms of other causes of D & V (e.g. pyrexia)

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

Table 1: Assessment of degree of dehydration

General condition	Eyes	Tears	Mouth and tongue	Thirst	Skin	Body weight loss (%)	Estimated fluid deficit	Degree of dehydration
Well, alert, restless	Normal	Present	Moist	Drinks normally, not thirsty	Pinch retracts immediately	< 5%	< 50 mL/kg	No dehydration
Restless, irritable	Sunken	Absent	Dry	Thirsty, drinks eagerly	Pinch retracts slowly	6-10%	50-100 mL/kg	Dehydration
Lethargic, floppy, unconscious	Very sunken and dry	Absent	Very dry	Drinks poorly/ unable to drink	Pinch retracts very slowly	> 10%	> 100 mL/kg	Severe dehydration

DIARRHOEA AND VOMITING • 2/6

Calculating fluid deficit

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

Calculating maintenance fluids

- 100 mL/kg per day for first 10 kg
- 50 mL/kg per day for second 10 kg
- 20 mL/kg per day for each subsequent kg

Investigations

- Urine for MC&S
- If bloody/chronic diarrhoea present send stools for MC&S
- If moderate – severe dehydration present or diagnosis in doubt
- FBC, U&E, glucose, blood and urine cultures
- if decreased level of consciousness LP

IMMEDIATE TREATMENT

See **flowchart - Management of acute gastroenteritis in young children**

General advice to parents

- Adequate hydration important
- '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 refeeding with resumption of normal diet (without restriction of lactose intake) after 4 hr rehydration
- Do not use antidiarrhoeal agents

Continue breastfeeding throughout the episode of illness

Treatment of dehydration

- Treatment of choice is oral rehydration solution (ORS; e.g. Dioralyte) orally/via nasogastric (NG) tube over 3-4 hr
- IV fluids only if not taking orally and intolerant of NG tube
- as a bolus for shock – sodium chloride 0.9% (20 mL/kg)
- for maintenance use – sodium chloride 0.45% and glucose 5%
- Admit if:
 - patient ≥ 10% dehydrated
 - patient 6-10% dehydrated and not improving after 4 hours observation on ward
 - parents unable to manage oral rehydration at home
 - patient not tolerating oral rehydration (refusing, vomiting, insufficient intake)
 - failure of treatment (e.g. worsening diarrhoea and/or dehydration)
 - other concerns (e.g. diagnosis uncertain, child < 2-months-old, irritable, drowsy, potential for surgery)

DIARRHOEA AND VOMITING • 3/6

Step 1: Mild dehydration ($< 5\%$)

- Can be managed at home
- Emphasize to parents the importance of adequate hydration
- Rehydrate orally using ORS (prescribe sachets and give clear instructions: if not tolerated, parents may substitute other fluids the child likes)
 - 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 is well tolerated with no adverse effects

Step 2: Moderate dehydration (6-10%)

- If improving after 4 hours observation can be managed at home provided social circumstances are appropriate/parents are happy. Otherwise, admit
- Calculate deficit and replace with ORS orally over 4 hr
- Give small frequent feeds (5 mL every 1-2 min)
- If not tolerating oral rehydration (refuses, vomits, takes insufficient volume), use NG tube

- Review after 4 hr
 - if 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, consider IV rehydration
- If improving move to *Step 1*

Step 3: Severe dehydration ($> 10\%$) - see flowchart

- 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 is drowsy
- Calculate deficit using uncorrected weight
- 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 sodium chloride 0.45% and glucose 5% over 24 hr
 - give maintenance as sodium chloride 0.45% and glucose 5% (with 10 mmol potassium chloride/500 mL of IV fluid)
 - start normal diet as soon as tolerated

DIARRHOEA AND VOMITING • 4/6

- continue to replace ongoing losses with ORS for each watery stool or vomit (10 mL/kg per watery stool)
- when improves move to *Step 2*

Beware hypernatraemic dehydration

Hypernatraemic dehydration

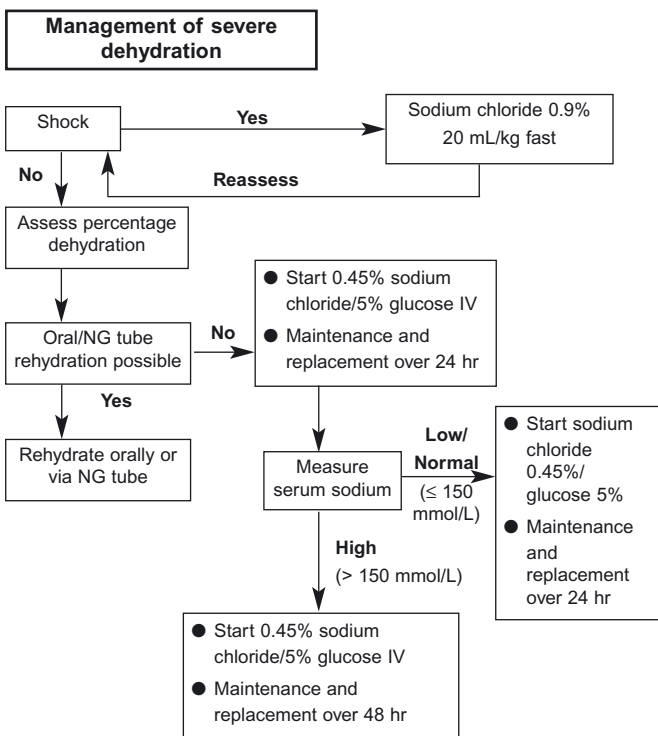
- In hypernatraemic dehydration there are fewer signs of dehydration
- skin feels warm and doughy, child is lethargic and irritable with hypertonia and hyperreflexic
- If in shock, resuscitate with sodium chloride 0.9% 20 mL/kg bolus
- If Na > 170 mmol/L, contact PICU

In hypernatraemic dehydration, the aim is to reduce the sodium by no more than 10 mmol in 24 hrs

- After initial resuscitation, give ORS: replace deficit (+ maintenance) over 48 hr – via NG if necessary

- Check U&E after 1 hr
- If ORS not tolerated or sodium drops > 0.5 mmol/L/hr, start IV rehydration with sodium chloride 0.45% and glucose 5%, replacing deficit (+ daily maintenance) over 48 hr
- Recheck U&E after 1 hr
- If sodium dropping by > 0.5 mmol/L/hr, change to sodium chloride 0.9% + glucose 5% and reduce rate by 20%
- Once rehydrated, start a normal diet including maintenance fluids orally

DIARRHOEA AND VOMITING • 5/6

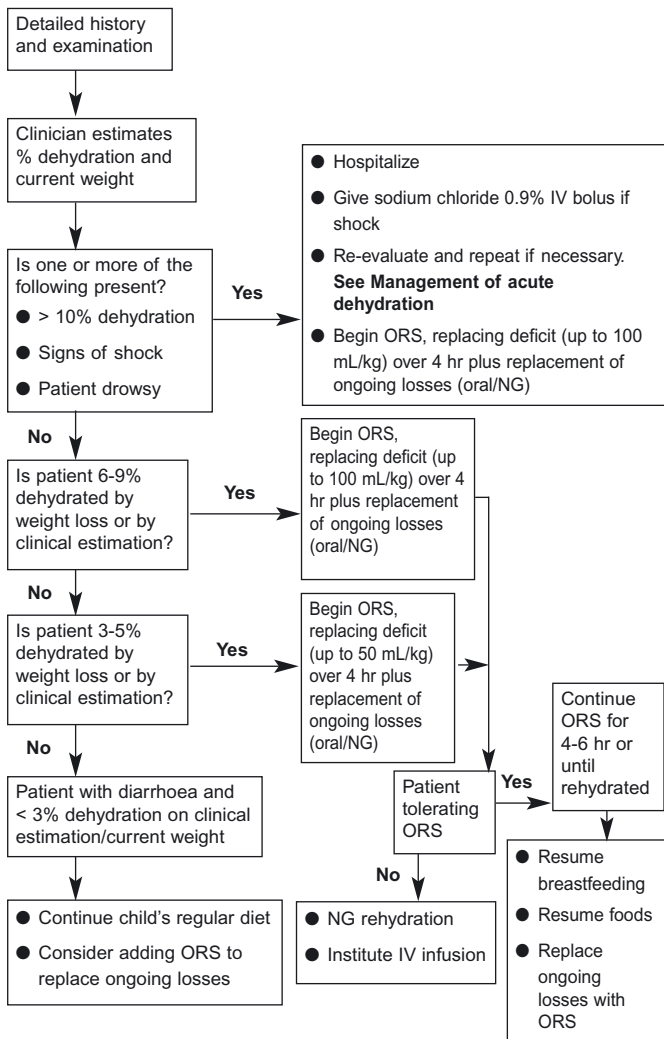


DISCHARGE POLICY

- If dehydration was > 5%, ensure child has taken and tolerated two breast or bottle feeds, or at least one beaker of fluid
- Check child has passed urine
- Tell parents the diagnosis and advise on management and diet
- Explain nature of the illness, signs of dehydration, how to assess and deal with continuing D & V
- Emphasize importance of adequate hydration
- Continue to supplement with ORS at 10 mL/kg per watery stool or vomit
- Do not withhold food
- full feeding appropriate for age is well tolerated
- Advise parents on how to prevent transmission to other family members and contacts
- Exclude from school/nursery until free of D & V
- Give open access if appropriate
- If diarrhoea persists for > 10 days, advise to return for medical reassessment

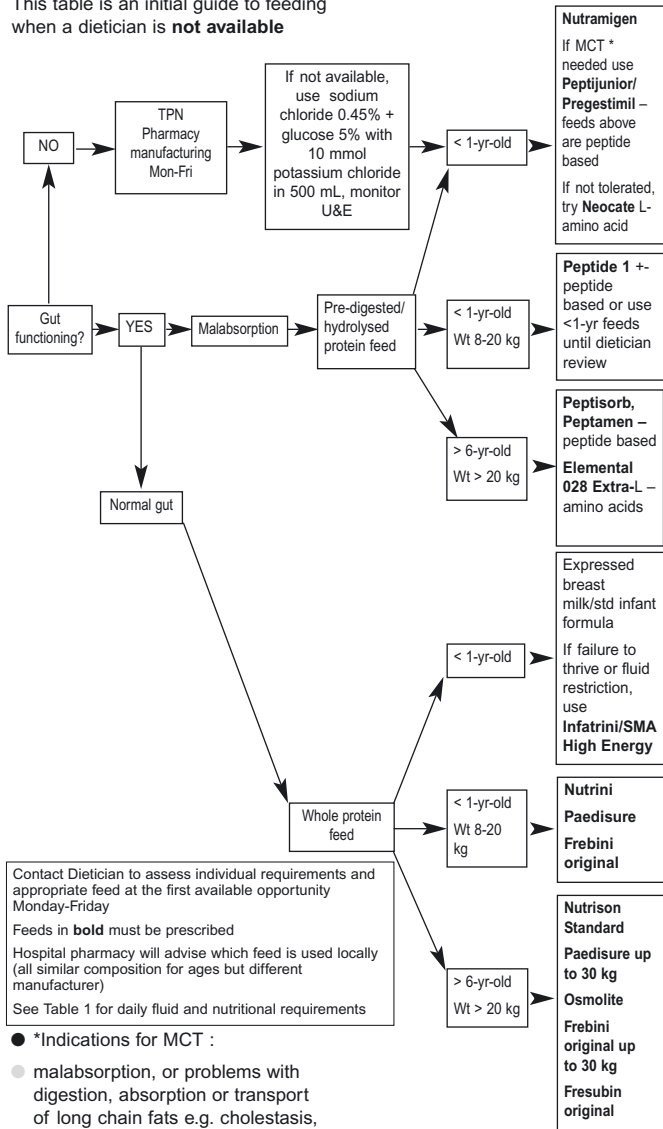
DIARRHOEA AND VOMITING • 6/6

MANAGEMENT OF ACUTE GASTROENTERITIS IN YOUNG CHILDREN



NUTRITIONAL FIRST LINE ADVICE • 1/3

This table is an initial guide to feeding when a dietician is **not available**



NUTRITIONAL FIRST LINE ADVICE • 2/3

Table 1: Nutritional and fluid requirements

Age	Average weight (kg)	Fluid mL/kg per day	Energy *EAR/ day	Energy kcal/kg per day	Protein g/kg per day	Sodium mmol/kg per day	Potassium mmol/kg per day
0 to 3-months-old	6	150	530	100–115	2.1	1.5	3.4
4 to 6-months-old	7.5	130	670	95	1.6	1.6	2.8
7 to 9-months-old	9	120	845	95	1.5	1.6	2.0
10 to 12-months-old	10	110	890	95	1.5	1.5	1.8
1 to 3-yr-old female		95			1.1	1.7	1.6
male	12 12.5		1165 1230	95 95			
4-yr-old female		95			1.1	1.9	1.6
male	16 16.5		1460 1520	87 94			
5-yr-old female		95			1.1	1.9	1.6
male	18 18.5		1550 1720	82 88			
6-yr-old female		85			1.1	1.9	1.6
male	20.5 21		1620 1810	76 84			
7 to 10-yr-old female		75			1.0	1.8	1.8
male	27 27		1740 1970	70 70			
11 to 14-yr-old female		55			1.0	1.6	1.8
male	43 40		1845 2220	47 55			
15 to 18-yr-old female		50			1.0		
male	56 62.5		2110 2755	40 45		1.3 1.0	1.6 1.4

*EAR - estimated average requirements = BMR (basal metabolic rate) x 1.4–1.5

NUTRITIONAL FIRST LINE ADVICE • 3/3

Nutritional Composition of milks - for further information use BNFc

per 100 mL	Kcal	Protein g	Fat g	CHO g	Na mmol	K mmol	Osmolality
Breast milk (mature)	70	1.3	4.2	7.2	0.6	1.5	276
Cow & Gate Premium	67	1.4	3.5	7.5	0.8	1.7	330
Infatrini	100	2.6	5.4	10.4	1.0	2.6	310
SMA High Energy	91	2.0	4.9	9.8	1.0	2.3	415
Nutramigen	68	1.9	3.4	7.4	1.4	1.9	290
Peptijunior	67	1.8	3.6/50% MCT	6.9	1.4	1.9	190
Neocate	71	2.0	3.5	6.6	0.9	1.6	360
Nutrini	100	2.8	4.5	12.2	2.3	2.6	250
Paedisure	100	2.8	5.0	11.2	2.6	2.8	320
Nutrison Standard	100	4.0	3.9	12.3	3.5	3.5	310
Osmolite	100	4.0	3.4	13.6	3.83	3.8	288
Pepdite 1+	100	3.1	3.9/35% MCT	13.0	2.1	3.0	465
Peptisorb	100	4.0	1.7/47% MCT	17.6	4.3	3.8	520
Peptamen	100	4.0	3.7/70% MCT	12.7	2.6	2.8	240
Over 6 yrs Elemental Extra 028	85	2.5	3.5/35% MCT	11	2.7	2.4	700

FAILURE TO THRIVE • 1/3

RECOGNITION AND ASSESSMENT

Definition

- An infant or older child who fails to gain weight as expected. Majority are pre-school age children but can apply to older children
- Growth below the third percentile or a change in growth that has crossed downwards two major growth percentiles in a short time (approximately four months, or longer period in older child)
- Associated features include:
 - developmental delay
 - apathy
 - misery

Symptoms and signs

- Gastrointestinal problems
 - vomiting
 - voracious appetite
 - anorexia
 - diarrhoea
- Physical examination
 - dysmorphic features
 - heart murmurs
 - abdominal distension
 - wasting

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 third percentile
- Measure and plot
 - weight (unclotted) – check for bruising
 - head circumference
 - length or height
 - calculate and plot BMI
- Infant may be a small, normal child growing below but parallel to the third percentile
- parents are often also small
- useful to record height of parents and grandparents

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

Patient and family history

- Take a full feeding history
 - type of milk given (breast milk, baby milk, cow's milk)
 - volume given at each feed
 - frequency of feeding
 - method of making up the feeds (correct strength)
 - introduction of solids – age and type of solid
 - any difficulty with feeding process (e.g. breathless, uncomfortable)
- Ask about social factors
 - were either of the parents in care during childhood or had learning disability?

FAILURE TO THRIVE • 2/3

- is there a lack of money in the home or other stress?
- do parents have a history of psychiatric illness or depression (including post-natal depression)?
- ask parental ages, health, siblings ages/health
- did siblings experience FTT?
- Further gastrointestinal investigation or management of CF/malabsorption disorders should be undertaken by referral to the specialist Gastroenterology Team who will undertake as appropriate:
- endoscopy
- jejunal biopsy
- gastrointestinal imaging

Investigations

- Initiate when social factors excluded as the most likely cause

Routine tests

- Faeces: culture and sensitivity, microscopy for ova and cysts and parasites
- Urine: microscopy, culture and sensitivity
- Haemoglobin, blood film (for signs of iron deficiency), WBC and ESR
- Biochemical profile including creatinine, bicarbonate, calcium and albumin
- Anti-gliadin antibodies (anti-tissue transglutaminase)

Further tests

- Chest X-ray
- Bone age
- If underlying pathology indicated by history or clinical examination or results of routine investigations, request further tests, such as:
 - sweat test/cystic fibrosis (CF) gene

Differential diagnosis

- Low genetic growth potential:
 - familial
 - 'light-for-dates' baby
 - genetic syndrome
- Social factors:
 - maternal depression
 - poor parenting skills
 - abuse
- Malabsorption:
 - CF
 - coeliac disease
 - other protein intolerance
 - lactose intolerance
 - infestation
- Vomiting/severe regurgitation
- Chronic underlying disorder:
 - renal failure
 - congenital heart disease
 - severe asthma
 - immune deficiency
 - other rare conditions e.g. chromosomes or metabolic tests if dysmorphic features present

FAILURE TO THRIVE • 3/3

MANAGEMENT

- Most patients can be managed as outpatients
- record height and weight at each visit
- seek dietician opinion
- significant weight gain after admission (> 180 g/week in infant) supports parenting issues as cause
- if treatable cause identified, treat appropriately
- If social problems responsible, consider:
 - health visitor support
 - social work support
 - day care and nursery provision
 - case conference
 - care proceedings

JAUNDICE IN NEONATES • 1/4

RECOGNITION AND ASSESSMENT

Definition

- Prolonged neonatal jaundice
- visible jaundice beyond 2 weeks old. Affects 2.4-15% of newborns. Bilirubin fractionation is the most important test in any infant who remains jaundiced for more than 2 weeks

Aetiology

Unconjugated jaundice

- Common causes:
 - breast milk jaundice (one-third of breastfed babies remain jaundiced beyond 2-weeks-old)
 - prolonged 'physiological jaundice'
 - haemolytic processes (Rh/ABO/minor incompatibility)
- Uncommon causes
 - hypothyroidism
 - urinary tract infection/sepsis
 - gastrointestinal stasis
- Increased bilirubin production:
 - membrane defects (spherocytosis, elliptocytosis)
 - enzyme defects (G6-PD, pyruvate kinase)
- Increased bilirubin breakdown
 - infection (UTI)
- Decreased bilirubin metabolism
- Reduced uptake
 - portacaval shunt, hypoxia, sepsis, congenital heart disease

- Decreased conjugation
 - Crigler-Najjar types I, II
 - Gilbert's syndrome
 - Lucey-Driscoll syndrome
 - hypothyroidism
 - panhypopituitarism

Conjugated jaundice

- All causes uncommon
- Obstructive:
 - biliary atresia
 - choledochal cyst
 - gallstones/biliary sludge
 - Alagille's syndrome
 - inspissated bile
 - cystic fibrosis
 - neonatal sclerosing cholangitis
 - Caroli's disease (congenital hepatic fibrosis)

Hepatocellular

- Idiopathic
- Viral:
 - CMV/HIV
- Bacterial:
 - urinary tract infection/sepsis
- Genetic/metabolic:
 - alpha-1-anti-trypsin deficiency
 - tyrosinaemia
 - galactosemia
 - progressive familial intrahepatic cholestasis (PFIC)
 - cystic fibrosis
 - panhypopituitarism

JAUNDICE IN NEONATES • 2/4

Toxic/secondary

- Parenteral nutrition

Previous history

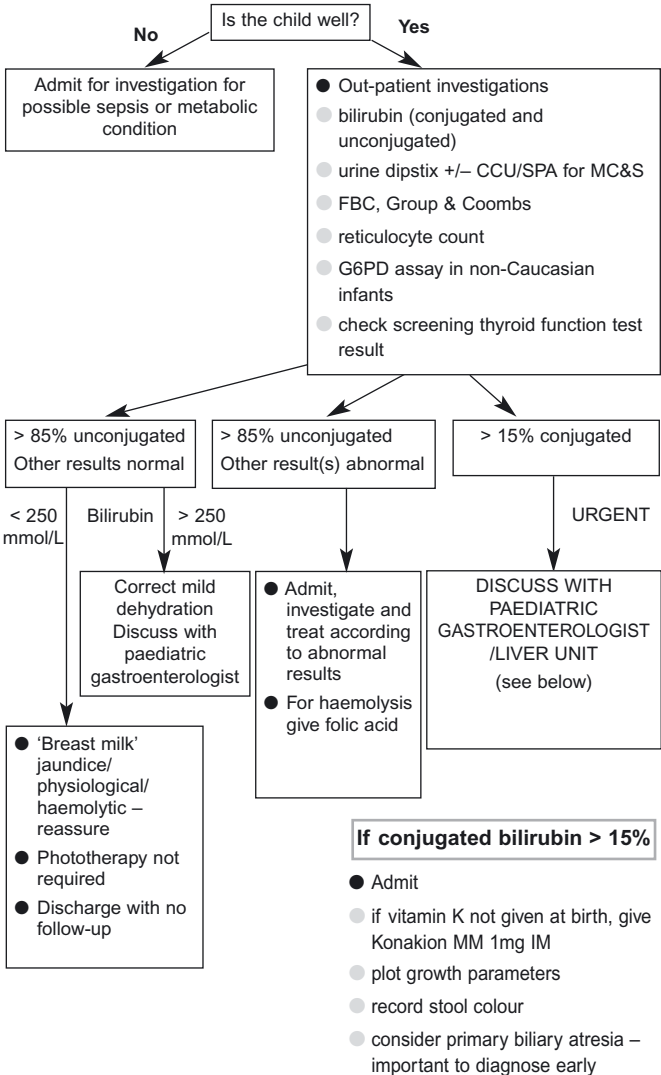
- Obtain full history with emphasis on:
 - obstetric details and birth (e.g. maternal infection/cholestasis of pregnancy)
 - consanguinity of parents
 - similar problems with parents or among siblings
 - feeding – history of weight gain/vomiting
 - past ABO or rhesus disease/Rh negative
 - stool and urine colour
 - temperament ('good baby' – hypothyroidism/panhypopituitarism)
 - excessive bleeding (vitamin K deficiency)

Examination

- Examination with emphasis on:
 - signs of sepsis
 - examining for red reflex (cataracts in galactosaemia)
 - maculopapular/petechial rash in congenital infections
 - hepatosplenomegaly
 - nappy check – pale stools +/- dark urine indicate cholestasis
 - dysmorphic findings (Alagille's)

JAUNDICE IN NEONATES • 3/4

MANAGEMENT



JAUNDICE IN NEONATES • 4/4

Investigations

- Blood tests all patients:
- EDTA:
 - blood group
 - direct Coombs
 - FBC
 - retics
- Coagulation
- INR
- Li Hep:
 - renal/liver/bone
 - split bilirubin
 - thyroid function tests
- Fluoride:
 - glucose
- Consider (after discussion with gastroenterologist):
- Clotted:
 - cholesterol/TG
 - ferritin
 - AFP
 - toxoplasma serology
 - hepatitis A/B/C
 - HIV
 - immunoglobulins
 - autoantibodies
- Li Hep:
 - cortisol
 - lactate
 - gal-1-PUT
 - amino acids
 - acylcarnitine
 - ammonia (on ice)
 - alpha 1 antitrypsin
 - VLCFA

- Urine:
 - organic acids
 - succinylacetone
 - bile acids
 - CMV
- Ultrasound scan of liver
- liver biopsy
- ophthalmology review
- X-ray wrist and spine
- DISIDA scan

If conjugated bilirubin > 15%

- Ursodeoxycholic acid 10-15 mg/kg orally daily
- Vitamin A 5000 units orally daily
- Alfacalcidol 20 nanograms/kg orally daily
- Vitamin E 10 mg/kg orally daily
- Vitamin K (phytomenadione) 1 mg IM daily
- Change feed to pregestemil

BLOOD AND PLATELET TRANSFUSIONS

• 1/1

Always check front sheet in patient notes before prescribing any blood product

BLOOD TRANSFUSION

- Transfuse if haemoglobin ≤ 8 g/dL or symptomatic
- if having radiotherapy, transfuse if Hb < 10 g/dL
- If previous reactions to blood products have occurred, pre-medicate with oral or IV chlorphenamine and hydrocortisone
- Explain indications for blood products to parents
- document indications and consent

Irradiated blood

- Use irradiated blood if:
 - allogenic bone marrow transplant (BMT) from start of conditioning regime
 - allogenic BMT donors
 - if $<$ seven days pre-harvest for autologous BMT and stem cell transplant patients, e.g. stage IV neuroblastoma, Hodgkin's disease, serious immunodeficiencies, if patient has received fludarabine

Leucodepleted blood

- All packed cells are leucodepleted and therefore CMV negative

Volume to be transfused

- Calculate volume to be given as $\{12 - \text{Hb (g/dL)}\} \times \text{weight} \times 4 \text{ mL}$ – round off to nearest unit unless under 10 kg. 1 adult unit - 280 mL; Paediatric unit - 50 mL. Give **total** over 3-6 hr
- If Hb < 6 g/dL, give blood over 8 hr and give furosemide orally if tolerated or IV
- In newly diagnosed patients with leukaemia and profound anaemia, aim for Hb 8-9 g/dL

PLATELET TRANSFUSION

- Transfuse platelets if platelet level:
 - $< 10 \times 10^9/\text{L}$
 - $< 20 \times 10^9/\text{L}$ and febrile
 - $< 50 \times 10^9/\text{L}$ and bleeding or brain tumour
- Dosage:
 - < 10 kg – one-quarter of a pack
 - > 10 kg – one pack

Idiopathic Thrombocytopenic Purpura (ITP) – transfuse platelets only if bleeding

FEBRILE NEUTROPENIA • 1/3

Regular clinical assessment of patients is a vital part of effective management of febrile neutropenia in children

RECOGNITION AND ASSESSMENT

Definition

- Temperature
 - $\geq 38^{\circ}\text{C}$ on two separate occasions separated by > 1 hr
 - OR
 - $\geq 38.5^{\circ}\text{C}$ at any time
- Neutrophils $< 1 \times 10^9/\text{L}$

IMMEDIATE TREATMENT

See **Table 1 and Figure 1**

Antibiotic choice depends on whether there is a suspicion of an infection of the central venous line (CVL) e.g. Hickman line

No obvious line infection

- Start tazocin and gentamicin (unless penicillin allergy, then use ceftazidime and gentamicin: if doubt whether truly allergic, discuss with consultant)
 - gentamicin dose is based on Ideal Body Weight (IBW) in obese children
- If clinically well and afebrile, and no growth in blood cultures after 48 hr
 - stop antibiotics
- If during the first 48 hr, child remains febrile or is clinically unstable, or fever settles and then recurs after 48 hr:
 - change antibiotics to meropenem and vancomycin

- If febrile after 96 hr or signs of severe sepsis (see **Sepsis guideline**) occur between 48 and 96 hr
 - add liposomal amphotericin (AmBisome)
- Discharge once afebrile for continuous 24 hr in otherwise well child

Suspected line infection

- Erythema at exit site/tracking along line or flushing-associated rigors
- If patient unwell (e.g. with signs of septic shock):
 - treat with tazocin and gentamicin as above, and teicoplanin
- If patient well, start tazocin and teicoplanin
- Discuss with Oncology Team consultant
- If clinically stable and afebrile after 48 hr
 - continue first-line antibiotics (tazocin and teicoplanin)
 - if during the first 48 hr, child remains febrile or shows signs of severe sepsis, or fever settles and then recurs after 48 hr:
 - change antibiotics to meropenem and vancomycin
- If febrile after 96 hr or clinically unwell between 48 and 96 hr
 - add liposomal amphotericin (AmBisome)
 - if blood cultures positive and patient remains febrile despite adequate antibiotics, repeat blood culture and/or consider removal of suspected line
- Discharge once afebrile for continuous 24 hr in otherwise well child

FEBRILE NEUTROPENIA • 2/3

Antibiotics (IV)

Table 1:

Antibiotics (IV)	
Tazocin (piperacillin with tazobactam)	<ul style="list-style-type: none"> ● 90 mg/kg 6 hrly ● If creatinine clearance 20-40 mL/min, give 8 hrly; if < 20 mL/min, give 12 hrly ● Maximum single dose 4.5 g ● Avoid if true penicillin allergy (if unsure, discuss with consultant)
Gentamicin	<ul style="list-style-type: none"> ● 7 mg/kg once daily – based on IBW (round dose +/-10% to vial size) ● Pre-dose level prior to third dose or, if creatinine clearance < 70 mL/min, before second dose ● No post-dose level is required ● Target pre-dose level < 1 mg/L
Teicoplanin	<ul style="list-style-type: none"> ● Staphylococcal CVL infections well enough to be treated as an out-patient ● 10 mg/kg (max 400 mg/dose) 12 hrly for three doses followed by 10 mg/kg per day (max dose 400 mg/day)
Ceftazidime	<ul style="list-style-type: none"> ● As first line instead of tazocin if penicillin allergic. If history of anaphylaxis with penicillin, start on second line with meropenem and vancomycin
Meropenem	<ul style="list-style-type: none"> ● 20 mg/kg 8 hrly ● Round up dose to nearest 50 mg ● Maximum of 1 g per dose
Vancomycin	<ul style="list-style-type: none"> ● Vancomycin may be used to treat staphylococci with a high (≥ 8.0 mg/L) minimum inhibitory concentration (MIC) for teicoplanin ● 15 mg/kg 8 hrly ● Dose should be given over at least 60 min at a maximum rate of 10 mg/min ● Maximum of 2.1 g per day until levels are known ● Pre-dose level prior to third dose ● No post-dose level required ● Adjust dose as follows: <ul style="list-style-type: none"> ● pre-dose level (mg/L) ● < 5 – give 6 hrly and recheck level in 24-48 hr ● 5-10 – continue current dose and recheck level in 3-5 days ● 10-14 – reduce frequency of dosing. Recheck level in 24-48 hr ● > 14 – stop vancomycin. Recheck level next day to see if therapy can be restarted
Antifungal therapy	
Liposomal amphotericin (AmBisome)	<ul style="list-style-type: none"> ● 1 mg/kg per day ● If strong clinical/microbiological evidence of fungal infection, increase to 3 mg/kg per day

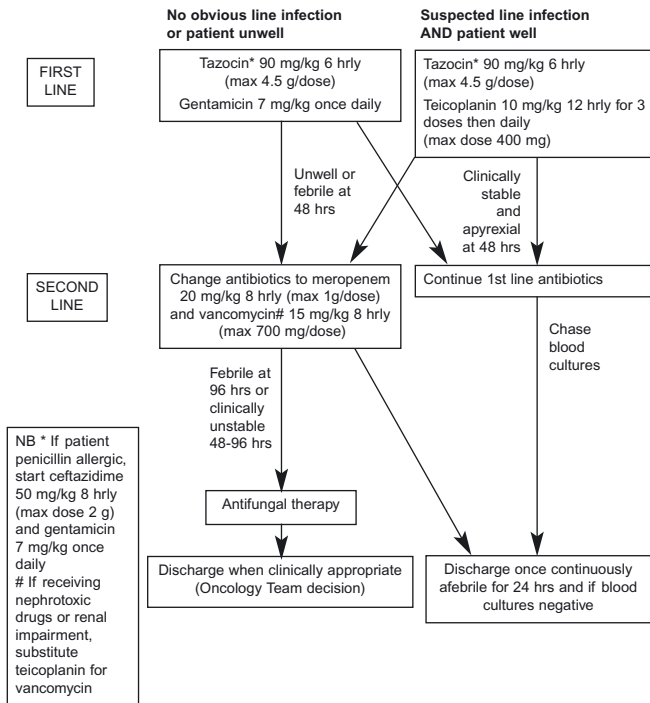
There is no role for empirical use of metronidazole in febrile neutropenic patients with diarrhoea

FEBRILE NEUTROPENIA • 3/3

SUBSEQUENT MANAGEMENT

- Change antibiotics according to results of culture and sensitivity reports
- Discuss culture-positive patients with microbiologist or infectious diseases consultant for advice on appropriate treatment. Where blood cultures positive for yeast in the presence of suspected line infection, remove suspected lines promptly
- Give culture-positive patients at least seven days treatment
- Patients who are afebrile for a continuous period of 24 hr and are otherwise clinically stable can be discharged – there is no requirement for a particular neutrophil concentration
- No need for routine in-patient observation after stopping antibiotics

Figure 1: Management of febrile neutropenic patients. If renal impairment, see text for adjusted doses



HENOCH-SCHÖNLEIN PURPURA • 1/2

RECOGNITION AND ASSESSMENT

Definition

- Vasculitic condition of unknown aetiology
- Often develops after an upper respiratory tract infection
- Affects skin, gastrointestinal tract, joints and renal tract

Symptoms and signs

Rash

- Purpuric with surrounding erythema and raised on extensor surfaces of legs, and buttocks

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
- Oedema of hands, feet, sacrum and scrotum

Renal

- Microscopic haematuria – common
- Proteinuria can present 4-6 weeks after initial presentation
- Hypertension

- Nephrotic syndrome – proteinuria +/- oedema and hypoalbuminaemia
- Nephritic syndrome – haematuria with at least one of the following:
 - raised urea and creatinine
 - hypertension
 - oliguria

Neurological

- Headache – common
- Rarely – seizures, paresis, coma

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 > three days

Investigations

All patients

- BP
- Urine dipstick
- if proteinuria – send urine for early morning protein:creatinine ratio
- if haematuria – send urine for microscopy

HENOCH-SCHÖNLEIN PURPURA • 2/2

Additional investigations

Blood tests – if urinalysis is abnormal or there is clinical uncertainty of the diagnosis

- FBC
- U&E
- Albumin
- If fever, blood culture
- Coagulation

IMMEDIATE TREATMENT/ SUBSEQUENT MANAGEMENT

- Condition is self-limiting - symptomatic relief only

Joint pain

- NSAIDs (ibuprofen first-line, indometacin second-line)

Abdominal pain

- Give prednisolone as for nephrotic syndrome. Renal involvement is 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 follow up required

HSP with haematuria or proteinuria $>$ 1+

- GP to check urinalysis at 6 weeks
- If blood or protein $>$ 1+, routine follow up in outpatients

Refer to nephrologist if:

- Urinalysis blood or protein $>$ 1+ after 6 months
- Macroscopic haematuria or heavy proteinuria at presentation

- Hypertension (see **Hypertension**)
- Significant proteinuria (early morning urine protein creatinine ratio $>$ 100 g/mol or 3+ proteinuria for three days)

- Impaired renal function

Refer to nephrologist if:

- Atypical or rapidly resolving rash

FOLLOW-UP

Uncomplicated HSP

- GP follow up in 1-2 weeks. Monthly BP for 6 months and weekly urine dipsticks until urine clear

HSP with complications/ abnormal urine analysis

- GP follow up as for uncomplicated HSP and follow up in general paediatric outpatients in 6-8 weeks
- If persistent proteinuria/haematuria or abnormal renal function, refer to nephrologist

DISCHARGE ADVICE

- 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

IDIOPATHIC THROMBOCYTOPENIC PURPURA (ITP) • 1/2

RECOGNITION AND ASSESSMENT

Definition

- Platelets < 100 x 10⁹/L, usually < 20 x 10⁹/L
- Self-limiting disease with shortened platelet survival and increased megakaryocytes
- Good prognosis
- Chronic (> 6 months)

Symptoms and signs

- Acute onset bruising, purpura and petechiae
- serious mucosal bleeding unusual – look for other causes
- Preceding infection – 80%
- Absence of:
 - hepatosplenomegaly
 - lymphadenopathy
 - evidence of serious cause/chronic underlying illness

Investigations

- FBC and film
- CMV and EBV IgM
- Consider HIV, Hepatitis B and C if risk factors
- If ITP, headache and neurological signs, urgent brain CT scan
- Bone marrow aspiration unnecessary unless:
 - neutropenia or severe anaemia
 - hepatosplenomegaly
 - lymphadenopathy

- pallor and lassitude
- pain – limb/abdomen
- limp

Bone marrow mandatory before steroid administration

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 – if ≥ 10 kg, 1 unit; if < 10 kg 10 mL/kg
 - immunoglobulin 1g/kg
- Avoid aspirin
- Reassure parents
- Discuss treatment with platelets with haematologist in event of:
 - essential operations
 - emergency dental extractions

SUBSEQUENT MANAGEMENT

- 75–80% resolve in six months
- favourable outcome irrespective of treatment
- Avoid contact sports
- impossible to prevent fighting/rigorous knockabout games at home

IDIOPATHIC THROMBOCYTOPENIC PURPURA (ITP) • 2/2

MONITORING TREATMENT

- Weekly FBC until platelet count increased

DISCHARGE POLICY

- Discharge when platelets > 100 x 10⁹/L and asymptomatic
- Advise of risk of relapse (20%)
- Note that mothers with a history of ITP (even if they have normal platelet counts) can give birth to thrombocytopenic babies

CHRONIC IDIOPATHIC THROMBOCYTOPENIC PURPURA

- Avoid NSAIDs
- Avoid contact sports
- Investigate for autoimmune disease and immune deficiency
- Treat only:
 - profound thrombocytopenia (< 10 x 10⁹/L) with repeated mucosal bleeding
 - older girls with menorrhagia
 - trauma
 - acute neurological signs
- If treatment indicated, give prednisolone 1-2 mg/kg/day until count responds
- must have bone marrow aspirate before treatment

HAEMOPHILIA • 1/4

INTRODUCTION

- Haemophilia is a serious disease. Each child with haemophilia must:
 - have open access
 - be treated without delay
 - be registered with the designated tertiary haemophilia unit
 - be registered locally (if shared care is appropriate) – for local registration, there will be two copies of the treatment sheet, one copy at the front of patient notes and a second copy on the ward

INDICATIONS FOR ADMISSION

- Bleeding in mouth, neck, respiratory passages or gastrointestinal tract
- Suspected internal bleeding (intracranial, intra-thoracic or intra-abdominal)
- Haemorrhage endangering a nerve (e.g. carpal tunnel – median nerve, ileo-psoas – 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 hly replacement therapy

MANAGEMENT OF ACUTE BLEEDING

Patients familiar with their condition often present for treatment before any physical signs are present, particularly during a haemarthrosis, which will later become very painful

- give replacement therapy **immediately** – any delay may increase severity of bleed and risk of joint damage
- if any doubt about whether to give treatment, contact local on-call haematologist or designated tertiary haemophilia unit

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 concentrate)

HAEMOPHILIA • 2/4

Type of lesion	Level of factor desired
<ul style="list-style-type: none"> ● Uncomplicated bleeding into joints and muscles 	<ul style="list-style-type: none"> ● non-weight bearing joint – 30% ● weight bearing joint – 50% (may need twice daily infusion)
<ul style="list-style-type: none"> ● Haematoma in potentially serious situations : <ul style="list-style-type: none"> ● bleeding in mouth ● neck ● respiratory passages ● endangering nerves 	<ul style="list-style-type: none"> ● 30-50%
<ul style="list-style-type: none"> ● Pre-dental extraction 	<ul style="list-style-type: none"> ● 50%
<ul style="list-style-type: none"> ● Major surgery ● Serious accident ● Head injury 	<ul style="list-style-type: none"> ● 80-100%

Calculation of replacement factor

- All boys with haemophilia receive recombinant factor
- Calculate units of factor needed, X, using following formula:
- $X = \frac{\% \text{ rise in factor required} \times \text{wt (kg)}}{K}$

(where K is the recovery constant)

- Recovery constants vary. Common factors used are:
 - haemophilia A – factor VIII concentrates are: Kogenate, ReFacto, Helixate and Recombinate, with recovery constant (K) = 2
 - Haemophilia B – factor IX concentrate is BeneFIX, with recovery constant (K) = 0.8. It often has a short half life in children
 - Factor X deficiency – Beriplex is the blood product used, with recovery constant (K) = 2.2

- Von Willebrand's disease – Haemate P is the blood product used with a recovery constant (K) = 1.5
- For any other factor concentrate, contact either local haematologist on-call or local tertiary haemophilia unit (haematologist on-call) to discuss treatment and ascertain correct recovery constant

Administration of factor concentrate

- Give intravenously over about 3 min
- adverse reactions rare but include anaphylactic shock

Duration of treatment

- Decided by local haematologist on-call or designated tertiary haemophilia unit (haematologist on-call). **If in doubt, ask**

HAEMOPHILIA • 3/4

DDAVP (see below)

VON WILLEBRAND'S DISEASE

- More common than haemophilia
- caused by a 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 DDAVP or Haemate P

MANAGEMENT OF ACUTE BLEEDING

Tranexamic acid

- Anti-fibrinolytic agent
- Contraindicated in the presence of haematuria
- For minimal mucosal bleeding, a tranexamic acid mouth wash may be sufficient to stop initial bleeding

- Oral tranexamic acid alone can be used to treat minor problems such as recurrent epistaxis, but main use is in combination with DDAVP, if appropriate
- oral dose – 25 mg/kg tds (maximum dose 1.5 grams)

DDAVP (see below)

- Treatment of choice in responsive patients for spontaneous bleeding, trauma and minor surgery

Haemate P

- Avoid if at all possible
- Use in patients not responsive to DDAVP or unsuitable for DDAVP (e.g. < 2 yrs old)
- See above for administration of replacement factor. The recovery constant for haemate P is 1.5

DDAVP IN MILD HAEMOPHILIA A AND VON WILLEBRAND'S DISEASE

- Intranasally or IV
- may be used to raise Factor VIII levels
- response usually a fourfold rise (IV) or two-fold rise (intranasal) in Factor VIII and Von Willebrand's antigen levels

Patient selection

In haemophilia:

- Consider **only** in mild (**NOT** severe) haemophilia A
- **Not** appropriate in Factor IX deficiency (haemophilia B)
- Do **not** use in child < 1 yr-old
- caution in children < 2 yrs-old
- Check notes for outcome of previous DDAVP challenge

HAEMOPHILIA • 4/4

In Von Willebrand's disease

VWD Type	Advice
Type 1	● Most patients responsive
Type 2A	● Some patients responsive ● ask about previous challenge
Type 2B	● DO NOT GIVE DDAVP ● it causes platelet agglutination and thrombocytopenia
Type 3	● Not all responsive and some can be severe ● ask about previous challenge

Administration

- Intravenously: 0.3 mcg/kg IV in sodium chloride 0.9% 50 mL over 20 min. May be repeated after 12 hr*
- Intranasally: 4 mcg/kg IV once
- **Side effects** include hypertension
- measure pulse and blood pressure every 5 min during infusion. If either rises unacceptably, reduce rate of infusion
- Ensure blood samples taken before and after infusion to measure Factor VIII level and ensure therapeutic level reached

*tachyphylaxis can occur with the depletion of stored factor VII with consecutive days. After 3 days there may be an inadequate rise of Factor VIII

HEPATITIS • 1/1

Follow-up for children diagnosed with Hepatitis B or C

HEPATITIS B

Diagnostic tests

- HBsAg (Hepatitis B surface antigen)
- HBsAb (antibody) – indicates previous immunisation or infection
- If HBsAg positive, refer to Regional Liver Unit and request following investigations:

Yearly follow up

- Clinical assessment
- Serology (clotted specimen)
 - HBsAg
 - HBeAg – (if previously HBeAg positive)
 - HBeAb
- Hepatitis B DNA PCR (EDTA)
- LFT (bilirubin, ALT, AST, GGT, albumin)
- FBC

If LFT abnormal, inform Regional Liver Unit

HEPATITIS C

Diagnostic tests

(For neonates see **Neonatal Guidelines**)

- Hepatitis C Virus (HCV) antibody (ab)
- HCV PCR
- if HCV ab negative and HCV PCR negative, not infected, discharge

- if HCV ab positive and HCV PCR negative, in two samples taken at least one week apart, not infected: discharge
- if HCV PCR positive, refer to Regional Liver Unit

Yearly follow up

- Clinical assessment
- HCV PCR
- LFT
- FBC

HIV AND HEPATITIS B POST-EXPOSURE PROPHYLAXIS (PEP) • 1/4

BACKGROUND

- Blood-borne viruses (BBV) can be transmitted by:
 - accidental needlestick injury
 - mucocutaneous exposure to infected fluids
 - sexual abuse
 - biting, or being bitten by, another child
 - playground or sports field injuries
- Blood borne viruses include:
 - human immunodeficiency virus (HIV) – least likely
 - hepatitis B virus (HBV) – most likely
 - hepatitis C virus (HCV)
- Body substances presenting a risk of infection include:
 - blood
 - breast milk
 - amniotic fluid
 - semen
 - any body fluid if visibly bloodstained
- Urine, faeces, vomit and saliva are not sources of HIV unless bloody
- HIV cannot penetrate intact skin

Risk factors for HIV

- Source:
 - men who have sex with men
 - immigrant from sub-Saharan Africa or any other area with high HIV prevalence
 - intravenous drug user, particularly from London or outside UK
- Child:
 - mucosal breach: ulcer, trauma
 - sexually transmitted disease

Risks of HIV transmission from different exposures (known HIV +ve source except community needlestick)

Exposure	Risk
Community needlestick (source unknown)	< 1 per 100,000
Occupational needlestick injury	3.2 per 1000
Single vaginal intercourse	1-2 per 1000
Single anal intercourse	1-30 per 1000
Mucocutaneous/ocular exposure to blood	1 per 1000

HIV AND HEPATITIS B POST-EXPOSURE PROPHYLAXIS (PEP) • 2/4

RISK ASSESSMENT

- Careful history and examination to assess the risk of presence of HIV, HBV and HCV

Negligible or no risk

- Intact skin visibly contaminated with blood or body fluids
- Kissing
- Casual touching
- reassure parents and child
- no follow up

Low risk

- Mucous membrane or conjunctival contact with blood or body fluids
- Superficial (intra-dermal) injury associated with needle or instrument contaminated by blood or body fluid
- counsel family about risks of HIV, HBV and HCV transmission
- discuss risks of HIV PEP – risks outweigh potential benefits, not recommended
- recommend HBV immunisation or booster if already immunised

Moderate risk

- Skin-penetrating needle contaminated with blood or body fluid
- Wound causing bleeding and produced by sharp instrument visibly contaminated with blood
- Vaginal intercourse with assailant of unknown HIV status
- counsel family about risks of HIV, HBV and HCV transmission
- discuss risks of PEP outweigh the benefit
- accelerated HBV immunisation or booster if already immunised

High risk

- Significant exposure to blood or body fluids from source known to be HIV, HCV or HBV infected
- Anal intercourse
- Vaginal intercourse with other risk factor as above with source of unknown status
- counsel family about risk of HIV, HBV and HCV transmission
- recommend HIV PEP
- accelerated HBV immunisation or booster if already immunised
- HBV immunoglobulin if source is HBsAg +ve and child has had ≤ 1 dose Hepatitis B vaccine before

SAMPLES

Source

- Discarded needle and syringe are not useful
- Known source: consent for testing for HIV, HBV and HCV. Contact microbiologist if urgent test result required because of risk factors present in source
- if source already known to be HIV positive, obtain details of present and past antiretroviral medications and resistance test results

Child

- High risk only:
- offer to take blood for baseline HCV, HBV and HIV serology
- specimen will be stored and tested if later sample positive
- If antiretroviral therapy is to be started, request FBC, U&E and LFT

HIV AND HEPATITIS B POST-EXPOSURE PROPHYLAXIS (PEP) • 3/4

HIV PEP

Counselling and support

- Discuss with on-call service for infectious diseases, microbiology or genito-urinary medicine, paediatric ID consultant locally or if not available from St Mary's (0207 886 6666) or St George's (0208 672 1255)
- HIV PEP is most effective if started within 1 hr of exposure, but may be beneficial up to 72 hr after exposure
- Child's family should agree to give drugs for a total of 28 days
- they should be counselled about likely side-effects (see Table overleaf) and given contact phone numbers in case of concerns during or after treatment period
- Make an appointment to see a paediatric consultant within 72 hr of starting HIV PEP

Regimens

Use accurate weight and height measurements to calculate doses

- **Low and moderate risk:** not recommended – give only if family insist
- **High risk:** PEP definitely indicated – give at least 3 drugs:
 - zidovudine AND
 - lamivudine (child)
 - for children over 40 kg use Combivir instead of separate zidovudine and lamivudine AND
 - Kaletra
 - if Kaletra not available, use nelfinavir instead
- If index case has drug-resistant virus, seek expert help

HIV AND HEPATITIS B POST-EXPOSURE PROPHYLAXIS (PEP) • 4/4

HIV PEP Drugs

Drug	Dose	Formulation	Side effects	Intake recommendation
zidovudine (ZDV or AZT)	180 mg/m ² /dose 12-hrly	Tab. 300 mg Caps. 100/250 mg Susp. 10 mg/mL	Neutropenia +/- anaemia, nausea, headache, hepatitis myopathy, nail pigmentation	Can be given with food; capsules can be opened and dissolved in water
lamivudine (3TC)	4 mg/kg/dose 12-hrly; max dose 150 mg 12-hrly	Tab. 100/150 mg; Susp. 10 mg/mL (room temp)	Pancreatitis, peripheral neuropathy, nausea, diarrhoea, cough, headache, rash, insomnia, alopecia, muscle disorders	Can be given with food
Combivir (AZT & 3TC)	1 tab 12-hrly	Tab. 300 mg AZT 150 mg 3TC	As above	As above
nelfinavir	infant 75 mg/kg 12-hrly, child 55 mg/kg 12-hrly, max dose 1250 mg 12-hrly	Tab. 250 mg; or 625 mg	Diarrhoea, nausea, rash, exacerbation of chronic liver disease	Best given with food (light meal or snack). Can be crushed and administered as powder, or dissolved in water
Kaletra (lopinivir (LPV)/ ritonavir (RTV))	300 mg LPV/m ² + 75mg RTV/m ² 12-hrly Max dose 5 mL, 2 tab or 3 caps 12-hrly	Caps 133.3 mg LPV/ 33.3 mg RTV Tab 200 mg LPV/ 20 mg RTV Liq 5 mL = 400 mg LPV/100 mg RTV	Diarrhoea, headache, nausea, vomiting. Caution in liver disease.	Give with or after food

HEPATITIS PEP

HBV

- Hepatitis B vaccine accelerated course (0, 1 and 2 months)
- Hepatitis B immunoglobulin only if source known to be HBsAg +ve infected

HCV

- There is no recognised PEP for HCV
- Families may be counselled that, in the event of HCV seroconversion, therapy is increasingly successful and it is worth testing for this virus

FOLLOW-UP

- Before discharge, provide families embarking on HIV PEP with:
 - an outpatient appointment,

preferably within succeeding 72 hr, to see a paediatrician or member of ID/GUM team with experience in antiretroviral drugs

- contact telephone number in case of concerns about any aspect of HIV PEP
- enough antiretroviral medication to last until clinic appointment
- letter for GP
- Arrange HBV, HCV and HIV antibody test at 3 months after exposure
- If source is HCV RNA PCR positive, arrange the following enhanced HCV follow-up:
 - at 6 weeks: 8 mL EDTA blood for HCV PCR
 - at 12 weeks: 8 mL EDTA blood for HCV PCR and 4 mL clotted blood for anti-HCV antibodies
 - at 24 weeks: 4 mL clotted blood for anti-HCV antibodies

IMMUNODEFICIENCY • 1/4

RECOGNITION AND ASSESSMENT

- Primary immunodeficiency disease is rare; prevalence is between 1 in 10,000 and 1 in 100,000
- Major manifestation is increased susceptibility to infection

Symptoms and signs

- Warning signs of primary immunodeficiency:
 - eight or more new ear infections within one year
 - two or more serious sinus infections within one year
 - two or more months on antibiotics without resolution of symptoms
 - two or more episodes of pneumonia within one year
 - severe failure of an infant to gain weight or grow normally
 - recurrent, deep skin or organ abscess
 - persistent thrush in mouth or on skin after 1-yr-old
 - failure of IV antibiotics to clear infections
 - two or more infections such as meningitis, osteomyelitis, cellulitis or sepsis
 - family history of primary immunodeficiency

Previous history

- Ask about:
 - birth weight and length – failure to thrive
 - delayed umbilical cord separation of more than three

weeks (leucocyte adhesion defect)

- severe adverse reaction to immunization e.g. BCGitis
- an unusually severe course of measles or chickenpox (common in cellular immune deficiency)
- significant adverse reactions to blood, plasma or gamma globulin injections
- 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 antenatal HIV testing (a negative antenatal HIV test does not exclude HIV in the child)

Physical examination

- Look for:
 - congenital abnormalities: dysmorphic features, congenital heart disease, situs inversus, white forelock
 - children who appear chronically ill, underweight or short in stature
 - scarring or perforation of tympanic membranes from frequent infection
 - oral candidiasis or periodontitis (particularly common in T-cell deficiency and granulocyte defects, respectively)
 - enlargement of liver and spleen – found in X-linked hyper-IgM syndrome
 - hypoplastic tonsils and small lymph nodes, suggesting B-cell defect

IMMUNODEFICIENCY • 2/4

- lymphadenopathy and splenomegaly, suggesting common variable immunodeficiency, chronic granulomatous disease, or lymphoproliferative disorders
- characteristic clinical patterns of some primary immunodeficiencies if present (e.g. telangiectasia, severe eczema)

Investigations

- FBC
- WBC, differential count, platelets, ESR
- Quantitative immunoglobulins
- IgG, IgM, and IgA
- Antibody responses to previous vaccines
- tetanus, diphtheria, *Haemophilus influenzae*, pneumococcus titres
- Infection evaluation – inform parents first and obtain verbal consent
- HIV, appropriate cultures, appropriate X-rays
- Discuss test abnormalities with:
 - paediatric infectious diseases clinician and/or laboratory immunologist

Investigations for individual immune system components

- Refer to specialist

Humoral (B-cell system)

- Selective clinical features:
 - recurrent sinopulmonary infections; chronic diarrhoea, malabsorption; enteroviral infections

- Initial tests:
 - quantitative immunoglobulins (IgG, IgM, IgA); isoohaemagglutinins (anti-A, anti-B); antibody titres to previous vaccines (tetanus, diphtheria, pneumococcus)
- Advanced tests:
 - IgE levels; B-cell enumeration; specific antibody response to pneumococcal vaccine (in children > 2-yrs-old); lymphocyte proliferations
 - IgG subclasses are not useful

Cellular (T-cell system)

- Selective clinical features:
 - recurrent thrush, failure to thrive, intractable diarrhoea; infections caused by fungi, protozoa, mycobacteria, or viruses
- Initial tests:
 - absolute lymphocyte count
- Advanced tests:
 - T-cell subset enumeration; lymphocyte proliferation; enzyme assays (ADA, PNP)

Phagocytic

- Selective clinical features:
 - history of delayed umbilical cord separation; recurrent skin abscesses; infection by low virulence organisms (fungi, opportunistic gram-negative organisms)
- Initial tests:
 - FBC (white blood cell number and morphology), IgE
- Advanced Tests:
 - chemiluminescence; adhesion molecule assays

IMMUNODEFICIENCY • 3/4

Complement

- Selective clinical features:
 - recurrent Neisserial or pneumococcal infections
- Initial tests:
 - CH50; C3, C4
- Advanced tests:
 - complement component assays; APH50 assays (regional immunology laboratory)

Table 1: Investigations

Investigations	Sample	Volume	
		Minimum	Ideal
Initial tests			
FBC and ESR	EDTA	1.3 mL	4 mL
IgG, IgM, IgA	Clotted	0.5 mL	4 mL
IgG function (antibody response to vaccines)	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	Clotted	0.5 mL	4 mL
Second-line tests			
IgE levels	Clotted	0.5 mL	4 mL
Anti-A and anti-B titres	Clotted	0.5 mL	4 mL
B-cell and T-cell subset enumeration	EDTA	1 mL	4 mL
		Requires arrival same day at local immunology centre: discuss before sending	
Lymphocyte proliferation	Lithium heparin	Discuss with local immunology centre	
Enzyme assay (ADA, PNP)	EDTA	3.5 mL	1 mL
		Discuss with Guy's Hospital	
Chemiluminescence	EDTA	0.25 mL	4 mL
		Discuss with local immunology centre	
Adhesion molecule assay	EDTA	0.25 mL	4 mL
		Discuss with local immunology centre	
APH50	Clotted	0.5 mL	4 mL
Complement components	Clotted	2 mL	4 mL

IMMUNODEFICIENCY • 4/4

SUBSEQUENT MANAGEMENT

- Many immunodeficient patients have a normal life span on immunoglobulin or other therapy
- Provide a well-rounded, nutritious diet – no special dietary limitations are necessary
- Protect from unnecessary exposure to infections
- Avoid live vaccines (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. $CD4 < 15\%$ or $< 200 \text{ cells/mm}^3$, give *Pneumocystis jiroveci* (PCP) prophylaxis with cotrimoxazole

KAWASAKI DISEASE • 1/3

MUCO-CUTANEOUS LYMPH NODE SYNDROME

*Early treatment reduces
mortality from coronary
artery aneurysms*

RECOGNITION AND ASSESSMENT

Symptoms and signs

- Fever for at least five days and four of the following:
 - bilateral non-exudative conjunctival infection
 - oral changes (red lips/pharynx/tongue)
 - extremity changes (peripheral oedema followed by desquamation 10-15 days after onset of fever)
 - polymorphous rash
 - acute cervical lymphadenopathy with individual node(s) > 1.5 cm diameter
 - absence of another diagnosis (e.g. group A streptococcal infection [GAS], measles)
- The presence of a coronary artery aneurysm with any one of the above features is diagnostic

Other features

- Most common in children < 5-yrs-old
- Atypical cases may not fulfil all

the above criteria

- Fever usually precedes the other signs and is characteristically unresponsive to antipyretics
- Other symptoms include irritability, aseptic meningitis, uveitis, cough, vomiting, diarrhoea, abdominal pain, urethritis, arthralgia and arthritis

Investigations

- None is diagnostic
- Throat swab for GAS
- Anti-streptolysin O titre (ASOT) or anti-DNase B for evidence of streptococcal infection
- Measles IgM antibody test if rash present
- FBC – platelets often high for 10-15 days after onset of fever
- ESR
- CRP
- ECG
- If full diagnostic criteria found, echocardiogram **not** required until six weeks from onset of signs and symptoms
- If criteria incomplete or presentation atypical, aneurysms on echo are diagnostic: discuss with a cardiologist.

KAWASAKI DISEASE • 2/3

IMMEDIATE TREATMENT

- Aspirin 25 mg/kg orally 6 hrly
- Intravenous immunoglobulin (IVIG) 2 g/kg over 10-12 hr (start slowly and follow manufacturer's instructions on package insert)

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 hr
- Anticipate anaphylaxis, flushing, fever, headache, shivering
- If tolerated, increase infusion rate to give total dose over remaining 10 hr and monitor hrly
- If mild reaction, stop infusion for 15 min then restart at slower rate

SUBSEQUENT MANAGEMENT

- After 2 weeks, reduce dose of aspirin to 5 mg/kg orally as single daily dose for six weeks (until result of echocardiogram known)
- If fever persists, consider a single repeat dose of IVIG

DISCHARGE POLICY

- Discharge when fever settles
- Echocardiogram at six weeks from onset of signs and symptoms
- Out-patient 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 three months following IVIG therapy

KAWASAKI DISEASE • 3/3

OUT-PATIENT MANAGEMENT

- No aneurysms at six weeks echocardiogram
- stop aspirin
- no restriction on activity
- Single aneurysm < 7 mm diameter
- aspirin 3-5 mg/kg once daily until aneurysm disappears
- cardiologist will advise on limitation of activity
- annual echocardiogram
- Multiple or giant aneurysm
- avoid strenuous activity
- discuss need for anticoagulation, stress test and repeat echocardiogram with cardiologist

MENINGITIS • 1/5

RECOGNITION AND ASSESSMENT

If < 28-days-old see **Neonatal meningitis in Neonatal Guidelines**

Symptoms, especially in infants, are often vague and non-specific. Be alert

Symptoms and signs

- Infants:
 - poor feeding
 - vomiting
 - irritability
 - fever
 - fits
 - altered level of consciousness
- Older child may also have:
 - severe headache
 - photophobia
 - confusion
- Pyrexia
- Petechial rash
- A full fontanelle in the younger child (unless dehydrated)
- Evidence of raised intracranial pressure in the older child:
 - disc oedema, any localizing neurological features, reduced conscious level
- Neck stiffness
- Kernig's sign positive
- Irritability
- Focal neurological signs including squints
- Altered level of consciousness

Differential diagnosis

It is difficult to differentiate viral from bacterial meningitis clinically

- If rash or severely ill, consider **Meningococcal septicaemia**
- In viral meningitis, child is not usually severely ill
 - look for obvious clues such as resolving mumps
- Subarachnoid haemorrhage
- Other intracranial sepsis
- Systemic sepsis
- Encephalitis
- Malaria in travellers
- Other causes of confusion or raised intracranial pressure

INVESTIGATIONS

Lumbar puncture

If any doubt about need for lumbar puncture (LP) or there are signs of severely raised intracranial pressure (i.e. disc oedema) any localizing neurological features (markedly reduced conscious level), discuss with a consultant

- Perform LP to:
 - exclude meningitis (if clear)
 - obtain specimens for bacteriological tests to determine duration of appropriate antibiotics
 - complete screening for pyrexia of unknown origin

MENINGITIS • 2/5

- Perform LP before giving antibiotics if child is stable and this will not delay antibiotics by more than an hour
- Delay LP if:
 - GCS < 8 (LP contraindicated)
 - GCS 8-12 (discuss with consultant)
 - deteriorating GCS
 - focal neurological signs
 - coagulopathy or thrombocytopenia suspected (e.g. purpuric rash)
 - local infection over lumbar spine
- If there is no clinical response after 48 hr of therapy, consider repeat LP

After a febrile convulsion in a child > 18 months, there is no need for an LP unless there are signs of meningitis

Specimens

- Consider which specimens to collect - see below. Add up the number of drops you need to collect before starting the LP. Six drops = approx 0.2 mL
- Have bottles ready: at least one fluoride tube (usually grey top) for glucose and four glass bottles
- If tap traumatic, discard first blood-stained specimen

Table 1: Collection of specimens (stated volumes represent minimum required)

Department	Specimens
Always send to Biochemistry	<ul style="list-style-type: none"> ● 0.2 mL in a fluoride tube (grey top) for glucose ● 0.2 mL in a glass bottle for protein, plus 0.2 mL for lactate if metabolic disorder suspected ● Simultaneous blood glucose in a fluoride tube
Always send to Microbiology	<ul style="list-style-type: none"> ● 0.2 mL in a glass bottle for MC & S, plus 0.5 mL (0.2 mL minimum) for meningococcal and pneumococcal PCR, and/or ● If high clinical suspicion of TB meningitis, 0.2 mL for TB culture and PCR
Virology	<ul style="list-style-type: none"> ● If possible viral meningitis or encephalitis (fever and fluctuating level of consciousness), 0.2 mL in a glass bottle for viral culture, and ● 0.2 mL for PCR for herpes simplex virus and ● 0.2 mL for enterovirus PCR, and ● If history of contact with case of chickenpox or rash, 0.2 mL for VZV and/or ● If rash, high temperature or rapid recovery, 0.3 mL for Human Herpes Virus 6

MENINGITIS • 3/5

Interpretation of cerebrospinal fluid results

- Gram stain and culture will usually identify bacteria responsible unless child has already been given antibiotics
- White cell count showing polymorphonuclear leucocytosis is usually indicative of bacterial meningitis. Lymphocytosis can occur in partially-treated pyogenic meningitis, TB meningitis and viral meningitis
- White cell count < 200 cells/mm³ suggests viral meningitis with lymphocytes usually predominating, although polymorphs occasionally seen in early stages. A similar cellular picture may be seen in partially treated bacterial meningitis
- Protein is usually markedly elevated (> 400 mg/L) in bacterial meningitis (upper limit of normal is 20 mg/L in infants and children, and up to 60 mg/L in neonates)
- very high levels of CSF protein are sometimes seen in TB meningitis
- CSF glucose is normally about 1 mmol/L below the serum level
- CSF glucose is likely to be depressed in bacterial meningitis
- low CSF glucose level in the presence of lymphocytosis raises the possibility of TB meningitis or herpes or mumps encephalitis
- CSF glucose is usually not depressed in viral meningitis

CT scan

- Not performed routinely, does not exclude raised intracranial pressure
- indicated in presence of focal neurological signs suggestive of space occupying lesion (e.g. cerebral abscess) – in this case request CT with contrast

Other

- FBC and differential WBC
- Blood cultures prior to start of antibiotics
- U&E, glucose
- If meningococcal disease suspected, refer to **Meningococcal septicaemia**; send EDTA blood for meningococcal DNA PCR
- Urine bacterial culture
- Throat/nose swab for bacterial culture
- Viral titres plus mycoplasma IgM
- Stool sample for viral culture, if viral meningitis suspected

IMMEDIATE TREATMENT

Steroids

- Give in any case of suspected meningitis without a purpuric rash
- Dexamethasone 150 mcg/kg IV 6 hrly for four days
 - give first dose 15-20 min before antibiotics or as soon as possible afterwards

MENINGITIS • 4/5

Antibiotics

Start immediately without waiting for identification of organisms or sensitivities

- Give cefotaxime or ceftriaxone until certain it is **not bacterial** meningitis
- in infants < 3–months-old, add amoxicillin to cover listeriosis until results of culture and sensitivities known
- If suggestive of herpes encephalitis (period of decreased level of consciousness with fever) add aciclovir
- If suggestive of TB (contact with TB, other features of TB, long history), discuss with Infectious Diseases Team about treatment
- If unusual cause suspected, contact microbiologist

Anticonvulsants

- Use if child is very irritable or has fits
- Drugs of choice:
 - phenytoin
 - lorazepam for acute control

Other supportive measures

- If child shocked, give human albumin 4.5%:
 - initial dose 20 mL/kg and reassess

Do not give excessive fluid boluses

Intensive care

- Inform PICU if:
 - depressed conscious level
 - shock does not respond to initial resuscitation

MONITORING TREATMENT

- In a semi-conscious patient, monitor the following hrly until improvement evident:
 - neuro-observations
 - pulse
 - BP
- Examine child daily for complications of meningitis
 - in young infants, measure head circumference daily
- For Group B streptococcal meningitis:
 - if recovery slow, CT scan at 10 days for microabscess or hypodensity
 - if persistent pyrexia, LP at one to two weeks to check if CSF clear
 - if fever persists, look for other foci e.g. bone scan/skeletal survey or other organism such as coagulase negative staphylococcus from line

MENINGITIS • 5/5

SUBSEQUENT MANAGEMENT

- Duration of therapy required depends on the organism identified:
 - meningococcus – seven days
 - pneumococcus or *Haemophilus influenzae* – 10 days
 - grp B Streptococcus - 14 days
 - Gram-negatives or listeria - 21 days
 - other – discuss with microbiologist
 - if all cultures taken before antibiotics negative, stop antibiotics after 48 hr

Eradication treatment to clear naso-pharynx

- Start when tolerating feeds
- Meningococcal meningitis
 - if ceftriaxone given as treatment, eradication treatment not required
 - give rifampicin orally (12 hrly for 2 days)
- *Haemophilus influenzae*
 - if children < 4 yrs old in the family, give rifampicin orally daily for 4 days

Fluid restriction

- In severe cases, restrict fluid intake to 80% maintenance to reduce risk of hyponatraemia secondary to increased anti-diuretic hormone secretion
- Measure urine and plasma osmolalities daily

Public health

- Inform Public Health consultant of a case of suspected meningitis
- Public Health Department will arrange prophylaxis for close contacts

DISCHARGE POLICY

- Organize formal hearing test 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 six weeks after day of admission

NOTIFIABLE DISEASES AND FOOD POISONING • 1/2

The doctor admitting is required to notify the following to the Health Protection Unit:

- Acute encephalitis
- Acute poliomyelitis
- Anthrax
- Cholera
- Diphtheria
- Dysentery (amoebic and bacillary)
- Food poisoning (or suspected food poisoning: inform public health if acquired abroad or if family member food handler or health care worker)
- Leprosy
- Leptospirosis
- Malaria
- Measles
 - fever, maculopapular rash for ≥ 3 days and ≥ 1 of: Koplik's spots, coryza, conjunctivitis, raised measles IgM, measles encephalitis or pneumonitis. Inform public health of MMR or measles vaccination history
- Meningitis (viral, bacterial or fungal)
- Meningococcal septicaemia (without meningitis)
- Mumps
- Ophthalmia neonatorum
- Paratyphoid fever
- Plague
- Rabies
- Relapsing fever
- 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
 - Smallpox
 - Tetanus
 - Tuberculosis
 - TB diagnosed on X-ray, microscopy or culture from any source (i.e. not just sputum). Atypical mycobacterial infection is not notifiable, nor patients given chemoprophylaxis but not thought to have TB
 - Typhoid fever
 - Typhus
 - Viral haemorrhagic fever
 - Viral hepatitis
 - either diagnosed clinically or by positive serology. Inform public health if acquired abroad or in UK, risk factors and immunization against Hepatitis A and B
 - 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 immunization history
 - Yellow fever

NOTIFIABLE DISEASES AND FOOD POISONING • 2/2

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
- Listerioses
- Psittacosis
- Cryptosporidiosis
- Giardiasis
- Creutzfeldt Jacob Disease and other prion diseases
- SARS

Contact details for your nearest HPU can be found on the Health Protection Agency website under Local and Regional Services (http://www.hpa.org.uk/lars_hpus.htm)

- Urgent out of hours notifications (to be followed by normal paper notification later):
 - meningitis (meningococcal /Hib) and meningococcal septicaemia
 - cluster or outbreak suspected (two or more cases epidemiologically linked)
 - any other case where the potential for transmission is significant, and/or where the contacts are particularly susceptible - and where public health action is known to be effective

West Midlands

Birmingham and Solihull HPU	0121 224 4670 / 4685
Black Country HPU	01384 454300
Coventry and Warwickshire HPU	01926 493491 ext 234
Herefordshire and Worcestershire HPU	01905 760024
Shropshire and Staffordshire HPU	01785 221120 / 01785 221126

SEPTICAEMIA (INCLUDING MENINGOCOCCAL) • 1/4

Meningococcal septicaemia: be alert for septicaemia in any child presenting with a purpuric rash (see Petechial rash guideline).

In the early stages of meningococcal septicaemia, a macular rash that DOES blanch on pressure is sometimes present. When in doubt, seek an experienced opinion urgently. Treat IMMEDIATELY as delay can be fatal

RECOGNITION AND ASSESSMENT

- Assess Airway, Breathing, Circulation and resuscitate as required

Definition: features of sepsis

- Temperature > 38.5° or < 36°C
- Tachycardia or bradycardia
- Tachypnoea
- White cell count above or below normal range or left shift

Severe Sepsis

- Cardiovascular dysfunction despite ≥ 40 mL/kg resuscitation fluids in 1 hr
- hypotension
- inotrope requirement
- base excess < -5
- lactate > 3.5 mmol/L

- urine output < 0.5 mL/kg/hr
- capillary refill > 5s
- core to peripheral temperature gap > 3°C
- Respiratory
 - FiO_2 > 50% to maintain SpO_2 > 92%
 - PaCO_2 > 6 kPa
- Neurological
 - GCS < 12
- Haematology
 - platelets < $80 \times 10^9/\text{L}$
 - INR > 2
- Renal
 - creatinine > 60 mmol/L
- Hepatic
 - bilirubin > 60 mmol/L
 - ALT > 70 mmol/L

If neutropenic, see **Febrile neutropenia guideline**

MENINGOCOCCAL SEPTICAEMIA

- Assess severity of disease on the Glasgow Meningococcal Septicaemia Prognostic Score
- assess on admission and regularly for the first 12-24 hr as this is when deterioration is most likely to occur
- a score > 8 indicates high risk of mortality: refer to PICU

SEPTICAEMIA (INCLUDING MENINGOCOCCAL) • 2/4

Glasgow Meningococcal Septicaemia Prognostic Score (GMSPS)

Criteria	Score
Systolic BP (cuff width > 2/3 upper arm length) If < 75 mmHg in child < 4-yrs-old Or < 85 mmHg in child > 4-yrs-old	3
Skin/rectal temperature difference (measure for 2 min) If axilla/rectal temperature difference > 3°C, score	3
Modified coma scale (see Glasgow Coma Scale guideline) If initial score < 8 Or deterioration of ≥ 3 points at any time	3
Deterioration in last hour (subjective) Ask parents or nurse; if yes, score	2
Neck stiffness if no neck stiffness, score	2
Extent of purpura Widespread ecchymoses or extending lesions on review, score	1
Base deficit If deficit > 8 mmol/L, score	1
Maximum score	15

Investigations

- FBC and differential
- Blood culture (it is important to put in maximum amount of blood the bottle is designed to take)
- Blood gas and lactate
- Blood glucose
- Meningococcal PCR
- Group and save
- Clotting profile
- U&E, LFT, Ca⁺⁺, Mg⁺⁺, PO₄⁻, CRP
- Throat swab
- Save for serum cortisol

If no rash

- Chest X-ray
- Urine culture (in severe sepsis, catheterise)
- Lumbar puncture if not contraindicated and where cardiovascularly and haematologically stable

Differential diagnosis

- Toxic shock syndrome
- Malaria

SEPTICAEMIA (INCLUDING MENINGOCOCCAL) • 3/4

IMMEDIATE TREATMENT

- Ensure patent airway and adequate breathing
- Administer 100% O₂ through a reservoir mask
- if airway and breathing remain compromised despite simple airway manoeuvres and 100% O₂, contact consultant on call and anaesthetist on call
- Assess circulation - if severe sepsis or extensive rash, insert 2 large IV cannulae or establish intraosseous access and give human albumin 4.5% 20 mL/kg
- Meningococcal septicaemia (purpuric rash) or < 18 months-old, give cefotaxime 50 mg/kg IV
- If no rash and no evidence of meningitis > 18 months old, give cefuroxime
- if pseudomonas or multiple-resistant organisms, or severe sepsis suspected, add aminoglycoside.
- if MRSA suspected, add vancomycin
- if anaerobic infection suspected, add metronidazole
- If hypotension continues, peripheries remain cool, rash continues to evolve, and capillary refill > 2 sec, give further human albumin 4.5% 20 mL/kg
- start dopamine infusion at 5 mcg/kg/min (15 mg/kg in 50 mL of sodium chloride 0.9% at 1 mL/hr)
- increase in 5 mcg/kg/min increments every 5 min up to 15 mcg/kg/min
- if still hypotensive, start adrenaline 0.1 mcg/kg/min (0.3 mL/kg of 1:1000 in 50 mL sodium chloride 0.9% at 1 mL/hr)
- Reassess ABC
- If still unstable, arrange immediate intubation with senior anaesthetist
- prepare atropine 20 mcg/kg
- if no neck stiffness, ketamine 1 mg/kg; if neck stiffness, thiopentone 3 mg/kg
- suxamethonium 2 mg/kg
- then morphine 20 mcg/kg/hr (1 mg/kg in 50 mL saline 0.9% at 1 mL/hr)
- and midazolam 2 mcg/kg/min (6 mg/kg in 50 mL saline 0.9% at 1 mL/hr)
- and vecuronium 1 mcg/kg/min (1.5 mg/kg in 25 mL saline 0.9% at 1 mL/hr)
- Site nasogastric tube and urinary catheter
- Prepare for central venous line with portable ultrasound if available
- Monitor blood glucose hrly for first 6 hr: give glucose 10% 5 mL/kg bolus and start maintenance fluids

SUBSEQUENT MANAGEMENT

- If circulation still compromised:
 - contact consultant on call and inform PICU
 - Give IV fluids (sodium chloride 0.45% and glucose 5%) at 100% maintenance requirement
 - If passing urine, give IV fluids with potassium 10 mmol/L if hypokalaemic, give 0.2 mmol/kg over 1 hour

SEPTICAEMIA (INCLUDING MENINGOCOCCAL) • 4/4

- If hypocalcaemic, give calcium chloride 10% (0.7 mmol/mL) 0.1 mL/kg (max 10 mL) IV over 30 min or calcium gluconate 10% (0.22 mmol/mL) 0.5 mL/kg (max 20 mL) IV over 30 min
- If $Mg^{++} < 0.75$ mmol/L, give magnesium sulphate 50% 0.1 mL/kg (max 10 mL) IV over 30 min
- If INR > 2, give fresh frozen plasma (FFP) 10 mL/kg
- after 60 mL/kg, give packed cells 20 mL/kg
- If patient stabilizes after resuscitation:
 - inform consultant paediatrician on call
 - admit to general paediatric ward for monitoring and continue treatment
 - administer O₂ via facemask or nasal cannula to maintain continuous O₂ saturation > 95%
 - treat poor perfusion and hypotension with 20 mL/kg aliquots of human albumin 4.5% solution

MONITORING

- Monitor the following every 30 min for first 2 hr, hrly for next 2 hr, then 4 hrly:
 - conscious level
 - temperature
 - respiratory rate
 - heart rate
 - BP
 - capillary refill time
- Monitor urine output hrly
- Monitor blood glucose and electrolytes 6 hrly until stable. Treat hypoglycaemia with bolus IV glucose

- Monitor clotting screen 12 hrly. Treat deranged clotting with FFP 10 mL/kg IV

SUBSEQUENT MANAGEMENT

- Adjust antibiotic treatment once culture results available
- otherwise continue cefotaxime 50 mg/kg 6 hrly IV, or ceftriaxone 80 mg/kg IV daily, for seven days
- Give antibiotics to treat carrier states in meningococcal and haemophilus sepsis (see **Meningitis**)
- If meningitis excluded, antibiotic can be changed to cefuroxime
- Avoid enteral feeds until acute shock has resolved
- Do not hesitate to contact the paediatric consultant on call for advice

Public health

- Meningococcal: inform Public Health consultant available 24 hr/day
- Public Health Department will arrange prophylaxis for close contacts

DISCHARGE POLICY

- Organize formal hearing test after discharge from hospital
- Arrange appointment in follow-up clinic in 8-12 weeks

OSTEOMYELITIS AND SEPTIC ARTHRITIS • 1/4

RECOGNITION AND ASSESSMENT

Symptoms and signs

- Fever
- Loss of function
- Pain in bone or joint
- 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

Urgent Investigations

- FBC
- ESR
- CRP
- Blood culture (**before antibiotics**)
- If cause of fever uncertain, collect other specimens for culture before antibiotics e.g. urine
- clean catch urine preferably; if suspicion of possible UTI do not delay antibiotics if not passing urine, use portable ultrasound: if

urine in bladder, perform in-out catheter urine or suprapubic aspirate

Osteomyelitis

- Plain X-ray AP and lateral of the affected part
- Tissue or pus for gram stain and culture if surgically explored or drained

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 localized and urgent MR is available:
 - consultant paediatrician or orthopaedic surgeon to authorize urgent MR of bone
 - if deep sedation or general anaesthetic required, contact paediatric anaesthetist on call
- If plain X-ray normal, and infection clinically localized and MRI not available, request ultrasound scan of bone
- If localizing signs poor or possible multifocal infection, request bone scan
- If cardiac murmur or multifocal *Staph. aureus*, request echo

OSTEOMYELITIS AND SEPTIC ARTHRITIS • 2/4

IMMEDIATE TREATMENT

- Admit
- Nil by mouth and maintenance fluids IV
- Bed rest
- Refer immediately to orthopaedic and paediatric registrar on call
- confirm they will assess the child within 4 hr of admission
- Early on-call consultant orthopaedic surgeon involvement

Antibiotics

- 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 gentamicin 7 mg/kg once daily and flucloxacillin 50 mg/kg 6 hrly (high dose) IV (max 2 g/dose)
- No organ dysfunction:
 - start flucloxacillin 50 mg/kg IV (max 2 g/dose) as soon as possible (must be within 4 hr)
 - if a neonate or yet to complete three Hib immunizations, add IV gentamicin
- Targeted antibiotic therapy
- If organism identified, use narrowest spectrum possible with good bone/joint penetration
- *Staph. aureus* sensitive to flucloxacillin: flucloxacillin 50 mg/kg 6 hrly IV (high dose, max 2 g/dose)

- Penicillin allergy, instead of flucloxacillin:
 - history of rash: cefuroxime 60 mg/kg 6 hrly (high dose, max 1.5 g/dose)
 - history of anaphylaxis: clindamycin 7 mg/kg 8 hrly (max 1.2 g/dose)

Analgesia

- If necessary initially, to allow splintage use morphine IV (see **Analgesia**)
- Elevate and splint the 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 severe sepsis and transfer to hospital with a PICU for post-operative care
- 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)

OSTEOMYELITIS AND SEPTIC ARTHRITIS • 3/4

SUBSEQUENT MANAGEMENT

Inform paediatric orthopaedic surgeon and paediatrician

Uncomplicated septic arthritis (not complicated by associated osteomyelitis)

- Aspirate or drain joint in theatre
- If treatment started within **24 hr** of first symptoms and clinically improving:
 - recovery of joint movement
 - absence of pyrexia after 4 hrly monitoring for 48 hr
 - WCC < 11, CRP and ESR falling on two successive specimens \geq 24 hr apart
- Discuss with consultant about changing IV to oral antibiotics
- give oral antibiotic to complete six weeks treatment
 - no organism identified – Augmentin Duo (high dose)
 - organism identified – narrowest spectrum with good bone penetration
 - *Staph. aureus* sensitive to flucloxacillin: oral flucloxacillin (high dose)

Early-presenting osteomyelitis

- If IV antibiotics started within 24 hr of onset of symptoms
- If abscess drained and full debridement achieved 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
- Antibiotics IV as above and add:
 - rifampicin 5-10 mg/kg once daily orally if tolerated or sodium fusidate 7 mg/kg (max 500 mg) 8 hrly IV then orally (standard dose) as soon as tolerated (oral 100% bioavailability) if organism cultured is sensitive
- Continue IV antibiotics for six weeks or until ESR < 20
- Continue oral antibiotics until all inflammatory markers are normal and clear evidence of healing established on radiographs

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

OSTEOMYELITIS AND SEPTIC ARTHRITIS • 4/4

- 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
- Continuing problems with local sepsis:
 - return to theatre for further debridement and insertion of Hickman line

MONITORING TREATMENT

- Peripheral colour, warmth, movement of the affected limb – hrly for first 4 hr then 4 hrly for 24 hr
- Respiratory rate, pulse, temperature – 4 hrly

PERI-ORBITAL CELLULITIS (preseptal and orbital) • 1/1

RECOGNITION AND ASSESSMENT

Definition

- Infection of the soft tissues surrounding the eye

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
	Chemosis
	Ophthalmoplegia
	Preceding sinusitis

Complications

- Intracranial abscess
- Meningitis
- Cavernous sinus thrombosis
- Periorbital abscess

MANAGEMENT

Preseptal peri-orbital cellulitis

- Ophthalmology review
- Review eye movements and red-green colour vision twice daily
- IV antibiotics for 48 hr:
 - cefuroxime if ≤ 4 yrs
 - benzylpenicillin and flucloxacillin if > 4 yrs and has received Hib vaccination
 - if improving, convert to oral high dose co-amoxiclav
 - Total duration of treatment (including IV) 14 days

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 child's eyelid cannot be opened
 - bilateral oedema
 - deterioration despite treatment

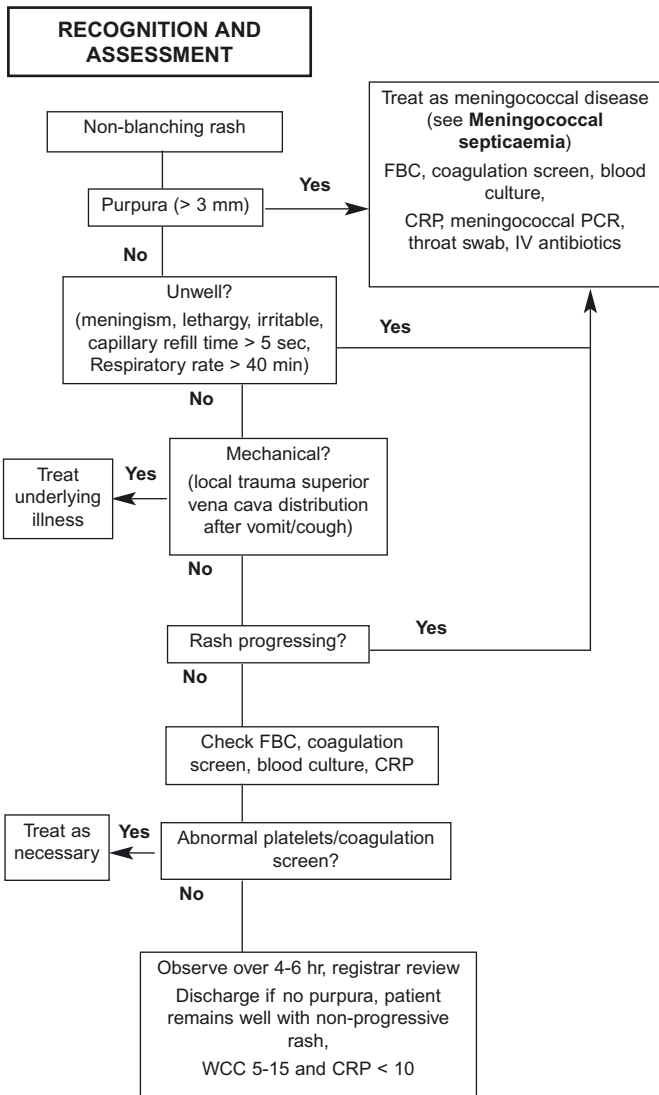
Orbital cellulitis

- Ophthalmology review
- ENT review
- IV cefotaxime or ceftriaxone
- Consider surgical drainage
 - if improving, convert to oral high dose co-amoxiclav
- Total duration of treatment (including IV) 21 days

Intracerebral complications

- Neurosurgical review

PETECHIAL/PURPURIC RASHES • 1/1



TUBERCULOSIS • 1/3

RECOGNITION AND ASSESSMENT

History is most important factor in diagnosing tuberculosis

Definition

- Infection with *Mycobacterium tuberculosis* is a multi-system disorder and can affect:
 - lungs
 - lymph nodes
 - meninges
 - bones and joints
 - abdomen
- Latent TB is infection with TB without clinical symptoms (suspect if in contact with TB)

Symptoms

Suspect TB when following symptoms persist for weeks:

- Weight loss +/- cough
- Persistent, non-remitting cough for 2-4 weeks
- Failure to thrive
- Lack of energy
- Fever and sweats
- Painless lymph nodes, especially if matted
- Headache or irritability for > one week
- Limp, stiff back, swelling of joint
- Swollen abdomen

Signs

- Delayed growth – plot weight and height on growth chart and compare with earlier records
- Swollen joint
- Fever

- Wasting
- Lymphadenopathy
- Chest signs
- Cardiac tamponade
- Ascites
- Meningism
- Conjunctivitis
- Limited flexion of spine
- Kyphosis

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
 - recently died

Investigations

- Tuberculin skin test:
 - Mantoux tests – use tuberculin PPD 2 units (0.1 mL of 2 units/0.1 mL), or 1 unit (0.05 mL of 2 units/0.1 mL) for < 1 yr-old, intradermally
 - can be negative in miliary TB, immunocompromised
- Chest X-ray – look for hilar lymphadenopathy, apical consolidation, pleural effusion, miliary nodules
- If large matted nodes present, arrange ultrasound scan, then biopsy
- Urinalysis: if blood and leucocytes present, send for smear and culture
 - non-tuberculous acid-fast bacteria common in urine

TUBERCULOSIS • 2/3

Latent TB

- Mantoux: if positive or unreliable (e.g. immune deficiency), perform interferon-gamma immunological testing

Children with cough

- Sputum: (for AFB and TB culture) in co-operative child – expectoration may require physio +/- nebulized sodium chloride 0.9% as necessary
- If unable to cough, send gastric aspirate (for TB culture only as microscopy is unreliable) – early morning before feed, daily for three days
 - if no aspirate, rinse with small volumes of sodium chloride 0.9% (5 mL aliquots maximum 20 mL)
 - do not send saliva
- Consider broncho-alveolar lavage (for AFB and TB culture) via bronchoscopy

Children with pleural effusion

- Pleural tap +/- biopsy for histology and microbiology (AFB and TB culture)

Children with lymphadenopathy

- Lymph node aspirate: Fine Needle Aspiration Biopsy (23 G needle)
 - low risk, high yield with sedation and local anaesthetic
- If atypical mycobacterial infection suspected, prefer complete excision biopsy, if possible, to aspiration biopsy
- Send in two separate bottles:
 - one to microbiology for TB culture with no preservative
 - one to histology in 10% formalin

Children with meningism

- CSF – request staining for acid-fast bacilli (AFB) **AND** culture and sensitivity for TB (Note: TB meningitis extremely rare in the UK)
- PCR - expensive: consider for CSF if highly suspicious of TB meningitis, poor sensitivity
- ELISA - poor sensitivity and specificity, do not use

IMMEDIATE MANAGEMENT

- Admission not mandatory but useful to ensure compliance with treatment. If supervision can be guaranteed, allow treatment at home
- Pre-pubertal children are not an infection risk but their families may be
 - notify case to Public Health and Infection Control
- Inform TB clinic, who will organize chest X-ray and Mantoux for all close and visiting contacts
- Advise anyone with cough to avoid visiting ward

Discuss treatment with specialist in respiratory or infectious diseases

- Check U&E and LFT before treatment
- Unless sensitivities known from source case, start treatment with:
 - isoniazid
 - rifampicin
 - pyrazinamide
 - ethambutol
- In malnourished or breastfed infants, add pyridoxine to prevent isoniazid neuropathy

TUBERCULOSIS • 3/3

SUBSEQUENT MANAGEMENT

- Consider HIV test if mother not known to be HIV-negative at antenatal screening
- Other drugs may be necessary once sensitivities available – if resistant, seek specialist advice

MONITORING TREATMENT

- Check LFT only if vomiting, nausea, lethargy, jaundice, etc
- raised transaminases are to be expected: check and stop treatment only if symptomatic
- If unable to report visual problems check visual evoked response

DISCHARGE POLICY

- Discharge if tolerating treatment and compliance guaranteed

OUTPATIENT MANAGEMENT

Active TB

- Review to ensure compliance
- monthly for first two months
- two-monthly until treatment complete
- for three months after end of treatment
- further as clinically indicated

Latent TB (Mantoux +ve and asymptomatic)

- treat with isoniazid for six months, or with rifampicin and isoniazid for 3 months

BELL'S PALSY • 1/1

RECOGNITION AND ASSESSMENT

Definition

- Idiopathic lower motor neurone facial nerve palsy

Symptoms and signs

- Asymmetry of face or smile
- Increased or decreased lacrimation
- Hyperacusis
- Altered taste
- Difficulty in closing eye
- Painless

History

- Abrupt onset with no progression
- No seizure activity
- No head injury

Examination

- Full neurological examination, including other cranial nerves, and fundoscopy
- demonstrable weakness in lower motor neurone distribution (includes forehead)
- 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

- None needed if all history/examination unremarkable
- Ophthalmology referral if difficulty in closing eye

IMMEDIATE TREATMENT

- If difficulty in closing eye, provide eye patch and hypromellose eye drops
- If no other signs, no other treatment necessary
- If vesicles suggest HSV, prescribe aciclovir, and consider immune deficiency
- Corticosteroids are not useful

Follow up

- Four weekly GP follow-up until symptoms and signs have resolved

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 not happening in one situation only
- Seizure type: (focal or generalised or any other type) based on history and EEG
- Try to categorize into one of epilepsy syndromes

RECOGNITION AND ASSESSMENT

- Detailed and accurate history from an eyewitness (beginning, middle and end of the episode)
- When the history is unclear, recording the episode with a camcorder 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 generalized epilepsies, some symptomatic epilepsies (tuberous sclerosis), autosomal dominant frontal epilepsies
- Genetic conditions, e.g. Angelman's syndrome

- Neurocutaneous syndromes – look for stigmata
- 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
- Myoclonic

Focal

- Without impairment of consciousness (focal motor, sensory or other types)
- With impairment of consciousness (previously known as complex partial)
- Focal with secondary generalisation (clinically look like generalised seizures)- history of aura, Todd's paralysis, focal features on EEG

EPILEPSY SYNDROMES

- 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 option for epilepsy surgery

Identification

Based on:

- Seizure type
- Age of onset

EPILEPSY • 2/6

- Neurodevelopment status
- Appearance of EEG (ictal and interictal)

Childhood absence epilepsy

- Usually presents at 3–8-yrs-old
- More common in girls
- Several (up to 100) brief episodes in a day
- No post-ictal features
- Typical EEG – three per sec spike and wave
- 10–30% of children have generalized seizures at some stage

Juvenile absence epilepsy

- Usually presents after 9–10-yrs-old
- Absence frequency is less than in childhood absence epilepsy
- Cluster after awakening
- 90% of children have generalized seizures at some stage
- EEG – faster spike and wave

Juvenile myoclonic epilepsy (JME)

- Usually presents between 12–18-yrs-old
- Jerks after awakening (myoclonic jerks) – common and often go unrecognized
- 90% of children have generalized 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 and arm with gurgling and salivation
- May become secondary generalized
- Spikes in one or the other centro temporal area
- Awake EEG could be normal and usually asleep EEG would show the spikes

Panayiotopoulos syndrome

- Younger children (peak 5-yrs-old)
- Autonomic seizures and behavioural disturbances usually nocturnal
- Usually starts with vomiting and child initially conscious
- Subsequent deviation of eyes to one side, impaired consciousness or may end in hemiclonic seizure or (rarely) generalised seizure
- Child looks unwell, unresponsive
- 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
- Typical EEG changes are spike in occipital area

EPILEPSY • 3/6

Temporal lobe epilepsy (TLE)

- Focal seizures with impaired consciousness and complex automatism
- 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, disembryonic neuroectodermal tumour

Frontal lobe epilepsy

- Focal motor seizures
- Tonic or clonic seizures – may have speech arrest and head rotation
- Complex partial seizures
- Multiple brief seizures in the night
- Nocturnal seizures are a characteristic feature of frontal lobe epilepsy
- Ictal EEG can be normal
- Can mimic pseudoseizures

Other epilepsy syndromes

- Epileptic encephalopathy in newborns (myoclonic or Ohtohara syndrome)
- West's syndrome (infantile spasms)
- Severe myoclonic epilepsy of infancy (Dravet syndrome)
- Lennox-Gastaut syndrome
- Laundau-Kleffner syndrome
- For other epilepsy syndromes see International League against Epilepsy website (<http://www.ilae-epilepsy.org>)

INVESTIGATIONS

Indications for EEG

- Clinically diagnosed epilepsy
- After an episode of status epilepticus (see 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 generalized tonic-clonic seizures
- To monitor progress in well-controlled epilepsy
- Prior to stopping treatment

EPILEPSY • 4/6

Indications for MRI of brain

- Focal epilepsy (including TLE) except Rolandic seizures
- Epilepsy in children < 2-yrs-old
- 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 is useful to pick up focal epilepsies and sleep-deprived EEG is useful in generalised epilepsies including JME. Sleep EEG should be done with Melatonin)
- Video telemetry useful if diagnostic dilemma, pseudoseizures or prior to surgery
- Drug levels – 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 Syndrome, need a series of investigations (discuss with paediatric neurologist)

TREATMENT

General guidelines

- Discuss treatment with a consultant before starting
- Start antiepileptic only if diagnosis certain (two or more unprovoked seizures)
- Preferably after initial EEG results obtained
- Start with small dose and build up to half maintenance – increase to full maintenance if seizures continue
- Increase dose stepwise every two to three weeks

First line drugs (See table for choice of anti-epileptic drug)

- Carbamazepine – start with 2.5-5 mg/kg per day in two divided doses increasing to 20-30 mg/kg per day
OR
- Valproate – start with 5-10 mg/kg/day in two divided doses increasing to 40 mg/kg per day
- 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
- Sugar-free preparations of liquids should be used
- Potential adverse effects **must** be discussed with parents and documented in the notes

EPILEPSY • 5/6

- If child develops adverse effects, discuss and reduce dose
- Additional advice regarding safety (e.g. supervision when swimming) **must** be discussed and documented
- Discuss and prescribe rescue treatment, especially in generalized epilepsy, with training for the parents
- Provide written information, including information about national or local epilepsy associations
- Access to epilepsy specialist nurse
- Parents and children should be allowed to ask questions, especially about sensitive issues such as sudden death

Table 1: Drugs of first, second and third choice in the treatment of seizure types

Seizure type	First	Second	Third
Generalised epilepsy	sodium valproate or carbamazepine	carbamazepine† or sodium valproate	lamotrigine* levetiracetam topiramate
Childhood absence epilepsy	sodium valproate ethosuximide	lamotrigine*	levetiracetam topiramate
Focal epilepsy including TLE	carbamazepine	sodium valproate lamotrigine topiramate levetiracetam	clobazam phenytoin
Infantile spasms	vigabatrin or ACTH	prednisolone sodium valproate 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 generalised epilepsies

* Lamotrigine can increase myoclonic seizures in some myoclonic epilepsy syndromes

EPILEPSY • 6/6

Epilepsy in adolescence – additional factors to be considered

- Compliance
- Career choices
- Driving
- Contraception and pregnancy, including pre-pregnancy counselling
- Alcohol and drugs

SUSEQUENT MANAGEMENT

- Increase dose of antiepileptic gradually until good control towards full dose or maximum tolerated dose
- If suboptimal control with one drug or unacceptable side effects, start second-line drug

OUT-PATIENT MANAGEMENT

- Initial follow-up at six to eight 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 < 2 yrs-old
 - AED (anti-epileptic drug) do not control seizures within 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
 - Rasmussen's encephalitis
 - Hypothalamic hamartoma

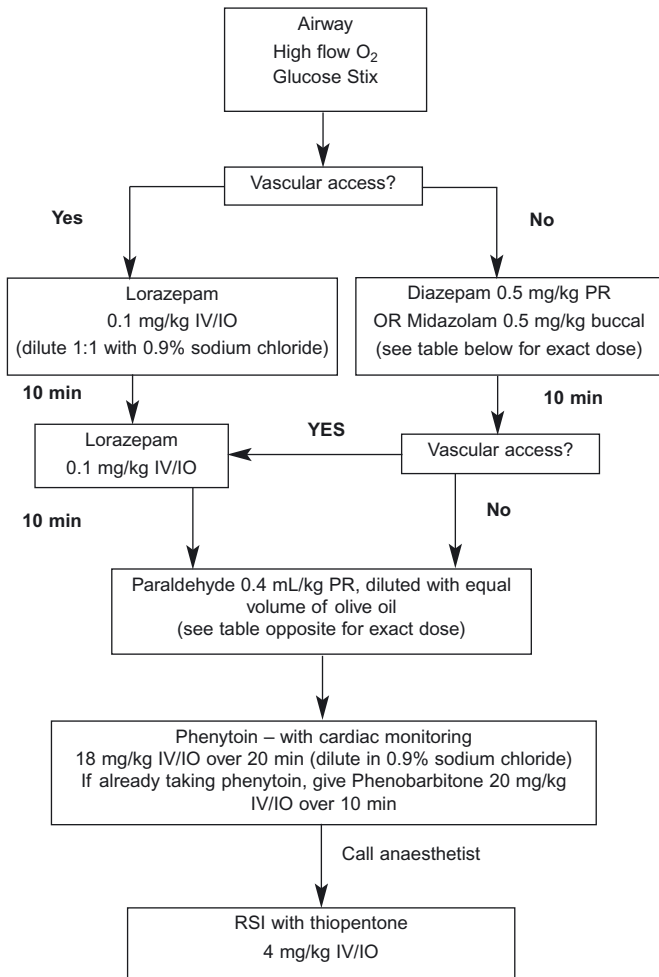
WITHDRAWAL OF ANTIEPILEPTIC DRUGS

- Consider when child has been seizure free for two years
- 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 antiepileptic medication if important events such as GCSEs are looming
- Gradual withdrawal over two to three months is usual
- Some drugs (phenobarbital or benzodiazepines) need very slow withdrawal over 6-12 months

STATUS EPILEPTICUS • 1/2

ACUTE SEIZURE MANAGEMENT

Follow each step until fits resolve, but do not treat post ictal posturing as fitting



STATUS EPILEPTICUS • 2/2

Diazepam (rectal)		Midazolam (buccal)		Paraldehyde (rectal)	
1 month-2-yrs	5 mg	6 months-1-yr	2.5 mg	1-3 months:	0.5 mL
2-12-yrs	5-10 mg	1-4-yrs	5 mg	3-6 months:	1 mL
> 12-yrs	10 mg	5-9-yrs	7.5 mg	6 months-1 yr:	1.5 mL
		> 10-yrs	10 mg	1-2 years:	2 mL
				3-5 years:	3-4 mL
				6-18 years:	5-10 mL

GLASGOW COMA SCORE • 1/1

Response ≥ 4-yrs-old

Eye opening	Score
Spontaneously	4
To speech	3
To pain	2
Never	1

Best motor response	Score
Obeys commands	6
Localizes pain	5
Withdrawal	4
Flexion to pain	3
Extension to pain	2
None	1

Best verbal response	Score
Orientated and converses	5
Disorientated and converses	4
Inappropriate words	3
Incomprehensible sounds	2
None	1

Response < 4-yrs-old

Eye opening	Score
Spontaneously	4
To speech	3
To pain	2
Never	1

Best motor response	Score
Obeys commands (or spontaneous, purposeful < 2-yrs-old)	6
Localizes pain or withdraws to touch	5
Withdrawal	4
Flexion to pain	3
Extension to pain	2
None	1

Best verbal response	Score
Alert and babbles, words to usual ability	5
Less than usual words, spontaneous irritable cry	4
Cries only to pain	3
Moans to pain	2
None	1

CHILD PROTECTION • 1/4

Always follow the Child Protection Policy and Procedures in your Trust

- Four recognized areas of abuse - rarely seen in isolation
- physical abuse - non-accidental injury
- sexual abuse (see **Child sexual abuse**)
- emotional abuse
- neglect

NON-ACCIDENTAL INJURY

Recognition and assessment

Unless there is an appropriate explanation, discuss injuries with a senior doctor

- 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)
- Odd or aggressive parental behaviour
- Any fracture in an infant without a satisfactory explanation
- Any bruise on a child < 6-months-old
- 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 the Child Protection Register held by Social Services)

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 recommended, refer to Social Services, or (if already involved) the police
- if recommended by police, examine child jointly with the Forensic Medical Examiner
- Discuss referrals by GP with consultant before assessment by on-call team
- consultant will decide whether referral should be made to the child investigating agencies first
- Referrals from A&E or surgical wards should be taken by a doctor above SHO grade
- discuss with a consultant first to determine who should carry out initial examination and whether Social Services or police should be present
- Keep any social worker or police officer present informed

Always discuss referrals with the consultant on call for child protection duties

CHILD PROTECTION • 2/4

History

- Record findings accurately during or immediately after the examination, using a dedicated child protection proforma with body charts if possible
 - Complete and sign each page and include:
 - full family history
 - persons present at interview
 - person giving consent
 - Where a referral is made from Social Services and Police Child Protection Teams, the child may have given a full history, often on video recording
 - ask for this information from the social worker or police officer at the beginning of the examination. Do not go over this again with the child
 - If child first presents in a health setting, particularly if the story is unclear, the registrar or consultant should take history and examine child before discussing with Social Services
 - there should be only one examination - repeated examinations are not in the child's interest
 - Keep your immediate senior informed
- Must include:
 - state of child – cleanliness, appropriate clothing, etc
 - complete exposure so that all body areas are seen
 - accurate description of all injuries (size, colour, position and pattern) on body charts
 - the mouth (torn frenulum of lip and tongue especially)
 - the 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, etc
 - a full paediatric systemic examination
 - plotting the height and weight and head circumference on growth charts
 - the child's emotional state, demeanour and degree of co-operation
 - a comment on the developmental state (or school progress)
 - observations on the relationships or behaviour between parents and child

Examination

Carers with parental responsibility and the child (depending on age and understanding) must give their consent (usually written) for the examination to take place. If consent is not forthcoming, Social Services may obtain a legal order giving permission for the child to be examined

CHILD PROTECTION • 3/4

Investigations

- A selection of the following tests will usually be necessary; seek advice from consultant as to which are appropriate:
 - FBC and clotting screen to eliminate blood disorder
 - bone biochemistry if there are unexplained fractures
 - investigations into other suspected abuse (e.g. failure to thrive)
 - skeletal survey in small children with unexplained injuries
 - head CT scan in children aged < 6 months (only on consultant recommendation)
 - photographs (often a police photographer is used)

EMOTIONAL ABUSE

Recognition and assessment

- 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
- Habitual harassment of a child by disparagement, criticism, threat and ridicule
- Should be 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 is complex and requires a multidisciplinary approach
- Social Services take the investigative lead

NEGLECT

- Neglect may not always be intentional (e.g. parental mental health problems)

Recognition and assessment

- Lack of care of physical needs that can result in failure to thrive
 - important to eliminate organic causes
 - neglect of physical care is most likely to come to Child Health attention along with developmental delay
- Child's appearance
 - note condition of clothing, hair, skin
- Growth
 - height, weight, serial measurements to check growth rate
 - head circumference
 - mid-upper arm circumference

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

CHILD PROTECTION • 4/4

SUBSEQUENT MANAGEMENT

- Majority of children seen will be allowed home if it is safe and after discussion with Social Services
- some children who have been abused will be admitted while the problems are investigated
- Always keep parents and children informed of concerns and what next actions will be
- Be open and honest with the parents

Keeping children safe

- If there is clear evidence of child abuse and parents attempt to remove the child there are two courses of action:
 - in an emergency, dial 999, and ask for a police officer to ensure that the child is not removed from hospital (Section 46, Children Act 1989)
 - if there is time, a social worker can obtain an Emergency Protection Order from the Court (Section 44, Children Act 1989)
- Put the child's safety first
- Communicate with other staff involved (e.g. the nursing staff) so that the situation can be supervised
- Consider the safety of siblings
 - usual for siblings to be examined at the same time as the index child

DISCHARGE POLICY

Only a consultant may allow the child to go home

- Consultant should make the decision regarding discharge, usually after discussion with Police and Social Services

Communication is vital

- Send a written report to the GP, without delay with a copy for Social Services and, if involved, the Police
- If a child is referred from A&E, send a copy of the report to them for feedback
- Ensure notes and tape are taken to the child protection secretary marked 'for urgent attention'
- Complete the ward discharge form
- Examining doctor to discuss appropriate follow-up with the consultant on call

Child protection conference

- May be convened following a child protection investigation to consider:
 - child protection issues
 - placing the child's name on the Child Protection Register
 - how to protect the child
- Medical and nursing staff will be invited
 - expected to contribute, usually in person, or via a written report

CHILD SEXUAL ABUSE • 1/4

Always follow the Child Protection Policy and Procedures in your Trust

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 the production of, pornographic material, watching sexual activities, or encouraging them to behave in sexually inappropriate ways

Presentation

- Information given by the 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

IMMEDIATE ACTION

- Referrals usually come from Social Services or the police
- refer to your departmental rotas – there should be clear local arrangements as to whose responsibility it is for handling child protection matters
- Where sexual abuse is suspected, whoever examines the child must have experience in this field
- junior doctors must discuss the situation with the consultant paediatrician on call before proceeding to any examination
- Forensic sampling:
 - depending on local arrangements, the police will determine whether this is performed by a paediatrician trained in forensic sampling or by a Forensic Medical Examiner (FME)
- The FME will have forensic kits to take the necessary specimens for tests on blood, semen, etc
- Examine child in designated child protection assessment area
- Siblings:
 - discuss with the consultant and Social Services/police whether they need to be examined

If a child presents in a medical setting and there are concerns about sexual abuse, call the consultant on call for child protection immediately

CHILD SEXUAL ABUSE • 2/4

- An examination of this nature requires preparation with due regard to the child
- a young child may not comprehend what is happening to him/her and there is a risk that the investigation may be as traumatic as the alleged incident
- make every effort to obtain the child's 'informed' consent to the examination, in accordance with their age and understanding
- co-operation of the child is best achieved by telling them exactly what is happening
- in exceptional cases, particularly where there is acute trauma and bleeding which 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

History

- Record findings during or immediately after the history and examination, using a dedicated child protection form with body charts, if available
- Complete and sign each page, and include details of:
 - the incident or symptoms – where a referral is made from the Social Services or Police Child Protection Teams, the child may have already given a full history, often on video, with appropriate non-leading questions. Discuss this information at the beginning of the history and examination. If further clarification is required, use non-leading questions and record all questions and

- responses verbatim
- general health and emotional well-being, with particular emphasis on genito-urinary or bowel symptoms e.g. constipation and secondary enuresis
- past medical history, including A&E attendances
- developmental history or school progress
- medication and immunization history
- family history - other children will require investigation - may be helpful to complete a family tree social history including members of household

Examination

Carers with parental responsibility and the child (depending on age and understanding) must give their consent (usually written) for the examination to take place. If consent is not forthcoming, Social Services may obtain a legal order giving permission for the child to be examined

- Purpose of medical examination is to:
 - detect traumatic or infective conditions that may require treatment
 - evaluate the nature of any abuse
 - provide forensic evidence
 - reassure the child
 - start the process of recovery

CHILD SEXUAL ABUSE • 3/4

Record

- General health
- Growth: height, weight and sexual maturity, plotted on a centile chart
- Developmental, emotional and behavioural assessment
- Evidence of non-genital trauma (e.g. bruises) or neglect
- Evidence of genital and anal trauma (see below)
- A variety of signs are associated with sexual abuse that will vary with:
 - type of abuse
 - age of child
 - degree of force used
 - use of lubricant
 - presence of infection
 - time since the last assault
- digital examination is not indicated routinely – if this is deemed necessary, it should be undertaken only by a consultant in child protection
- a colposcope can be used to magnify and obtain photo documentation (video or still)
- Examine the anus with the child lying in the left lateral position, flexed with the knees towards the chest
 - if anal dilation is to be assessed, part the buttocks gently and observe for 30 sec – up to 2.5 cm of dilatation has been noted after anal abuse
 - the significance of minor dilation is uncertain; remember that there may be a medical aetiology
 - check for any other signs of injury (e.g. anal fissure)

How to examine the genitalia and anus

- For a genital examination, lie the child in the supine frog-legged position, usually on a bed but, in the case of a small child, on a parent's lap – encourage the parents to flex and abduct the child's hips
 - when the labia are separated the hymen may be clearly visible. If it appears closed the margins can be revealed by applying gentle pressure downwards and laterally, or by lifting the labia and applying gentle downwards pressure for a few seconds
 - the posterior hymen is seen more easily with the child in the knee-chest position, which helps

The implication of any abnormal findings needs to be thought through carefully. The absence of relevant abnormal findings on examination does not rule out abuse

CHILD SEXUAL ABUSE • 4/4

INVESTIGATIONS

Consider:

- Mid-stream urine
- Sexually-transmitted diseases, particularly if penetration and/or passage of bodily fluids are suspected
- examining doctor should contact the genito-urinary medicine department and arrange an appointment. It may be possible to arrange a joint examination
- Pregnancy test and post-coital contraception
- levonorgestrel available from high street pharmacy out-of-hours
- Forensic tests (FME to determine)
- Photos/video recordings obtained with a colposcope, which should be stored in accordance with local arrangements

SUBSEQUENT MANAGEMENT

- Discuss findings with the parent(s) and child (depending on age and understanding)
- Inform Social Services/police of initial findings

DISCHARGE POLICY

- Consultant should make the decision regarding discharge, usually after discussion with police and Social Services

Communication is vital

- Send a written report to the GP without delay with a copy for the Police and Social Services
- If a child is referred from A&E, send a copy of the report to them for feedback
- Ensure notes and tape are taken to the secretary marked 'for urgent attention'
- Complete ward discharge form
- Examining doctor should discuss appropriate follow-up with the consultant on call
- referral to counselling services may be indicated
- older girls will usually receive information from the police regarding witness support, and agencies such as Victim Support

GLOMERULONEPHRITIS • 1/2

RECOGNITION AND ASSESSMENT

Definition

- Acute inflammatory process affecting the kidneys leading to haematuria, proteinuria, oedema, hypertension and renal insufficiency

Symptoms and signs

- Reduced urine output
- Macroscopic haematuria - coca-cola coloured urine
- Oedema - often periorbital
- Headache/breathlessness – indicative of severe disease
- History of sore throat in the preceding two to three weeks
- Oedema variable - periorbital/pedal
 - check weight - trend is useful
 - check jugular venous pressure (JVP) - if raised, indicates volume overload (cardiac failure)
- Oliguria (urine output < 300 mL/m² per day)
- 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 dipstick - large amounts of blood and protein; microscopy - red cell casts

U&E

- sodium - may be low (dilutional effect)
- potassium, urea and creatinine
- bicarbonate - may be low
- phosphate, uric acid
- albumin – usually normal
- FBC – low haemoglobin (dilutional effect)
- Serum complement (C3) - decreased for four to six weeks
- ASO titres and Anti-DNAase B - for evidence of streptococcal infection
- Throat swab for Group A Streptococcus
- Renal ultrasound scan – for evidence of pre-existing disease

Differential diagnosis

- Sequel of other bacterial/viral infections
- Chronic renal failure with acute exacerbation
- Henoch Schönlein purpura
- IgA nephropathy
- Alport's hereditary nephritis

IMMEDIATE TREATMENT

- Admit
- Strict fluid balance monitoring and management
 - See **Acute renal failure**
- Treatment of volume overload/hypertension
 - furosemide
 - see **Hypertension**
 - severe cases of fluid overload will require dialysis

GLOMERULONEPHRITIS • 2/2

- Treatment of abnormal chemistry consequent to renal failure
- See **Acute renal failure**
- Oral antibiotics – phenoxymethylpenicillin or erythromycin (if penicillin allergic) for 5 days
- 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

- Gross haematuria, oliguria and abnormal chemistry - usually resolves by two to three weeks
- BP – usually normal by three to four weeks
- Serum C3 levels - usually normal by four to six weeks
- Proteinuria resolves by six months
- Microscopic haematuria resolves by 12 months

Tertiary referral

Refer to nearest paediatric renal centre if:

- Atypical presentation
- Evidence of serious degree of renal failure requiring dialysis
- Poorly-controlled hypertension/cardiac failure/encephalopathy
- Heavy or persistent proteinuria leading to hypo-albuminaemia
- Normal serum C3 at presentation (i.e. not post-streptococcal)
- Associated vasculitis
- Delay in recovery as indicated by timescales above
- Recurrent episodes

DISCHARGE FROM FOLLOW-UP

- Normal BP (when not receiving anti-hypertensive treatment)
- Normal renal function
- Normal urinalysis

HAEMOLYTIC URAEMIC SYNDROME • 1/2

RECOGNITION AND ASSESSMENT

Definition

- Triad of features
- Haemolytic anaemia
- Thrombocytopenia
- Renal insufficiency

Symptoms and signs

- Diarrhoea (with blood and mucus) ± vomiting
- Abdominal pain
- Pallor, lethargy
- Bleeding tendency
- Reduced urine output/facial puffiness
- Pallor
- Muco-cutaneous bleeding
- Overhydration
- Oedema (periorbital/pedal) variable
- Weight gain – observe trend
- Raised jugular venous pressure (JVP) indicates volume overload (cardiac failure)
- Oliguria (urine output < 300 mL/m² per day)
- Tachypnoea
- Liver enlargement
- Dehydration – if diarrhoea has been severe see **Diarrhoea and vomiting**
 - check BP – hypotension
- Tachycardia
- Reduced consciousness – consider cerebral oedema, intracranial haemorrhage

- Convulsions – consider hyponatraemia, cerebral oedema, intracranial haemorrhage
- Paralysis – consider intracranial haemorrhage

Investigations

- FBC and blood film
- Low Hb and platelets
- Fragmented red cells
- Clotting studies
- U&E
- Bicarbonate
- Phosphate, uric acid
- Glucose
- Liver function tests
- 0157 serology – acute and convalescent (10 days after onset of symptoms)
- Urine – stick test for significant blood and protein (indicating glomerular damage) and leucocytes
- Stool – culture for *E. coli* (and typing for 0157 strain)

IMMEDIATE TREATMENT

- Admit
- Strict fluid balance monitoring and management
- See **Acute renal failure**
- Dehydration
 - if signs of hypovolaemic shock give circulatory support (sodium chloride 0.9% 20 mL/kg IV immediately)
 - correct dehydration (see **Diarrhoea and vomiting**)
- Overhydration

HAEMOLYTIC URAEMIC SYNDROME • 2/2

- if signs of overload/cardiac failure, furosemide IV (2-4 mg/kg, no faster than 4 mg/min), repeated 4 hrly if response obtained
- if furosemide ineffective, consider dialysis
- AVOID antibiotics (worsen prognosis)

DISCHARGE FROM HOSPITAL

- Diarrhoea/abdominal pain resolved
- Hb stable (haemolysis ceased)
- Drinking fluids freely and passing normal amounts of urine
- Urea and electrolytes improving with normal potassium levels

SUBSEQUENT MANAGEMENT

Tertiary referral

- If significant renal impairment [anuria, rising creatinine, dialysis required (see **Acute renal failure**)], refer to nearest paediatric renal centre

Follow-up

- Weekly until renal function stable
- 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 five years
- Advise that women with history of haemolytic uraemic syndrome require close monitoring during pregnancy

DISCHARGE FROM FOLLOW-UP

- Renal function normal
- No proteinuria
- Renal growth and function satisfactory at 5-yearly review for 15 years

HYPERTENSION • 1/4

RECOGNITION AND ASSESSMENT

Diagnosis is difficult because symptoms can be minimal and often go unrecognized.

In severely ill children with loss of consciousness, convulsion and hemiplegia, consider hypertension as the cause

Definition

- Depends on a knowledge of the normal range for the age or the height of the child (Tables 1 and 2)

Symptoms and signs

Severe hypertension

Listed in order of frequency, with common presenting features at the 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
 - epistaxis
 - poor growth, weight loss
 - cardiac murmur
 - abdominal pain
 - enuresis

Hypertensive encephalopathy (accelerated hypertension)

- Any neurological sign associated with grossly elevated blood pressure – most commonly:
 - severe generalized headache
 - visual disturbance (+/- retinal changes)
 - seizure

Do not delay initiation of treatment pending investigations once diagnosis has been made

Investigations

- Check for evidence of renal disease
 - plasma creatinine, urea and electrolytes
 - urinalysis for blood and protein
 - renal ultrasound scan
 - DMSA scan may be required to exclude scarring
- Exclude coarctation of aorta
 - check femoral pulses
 - ECG for left ventricular hypertrophy (LVH)
 - echocardiogram
- Exclude catecholamine excess
 - urine VMAs (contact Biochemistry Department for details of how to perform test)
- Exclude corticosteroid excess
 - 24 hr urinary free cortisol and/or discuss with endocrinologist for further investigations

HYPERTENSION • 2/4

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 is necessary but bring BP under control slowly

- Abrupt BP reduction can result in cerebral ischaemia with the risk of permanent neurological sequelae, owing to the failure of cerebral autoregulation after sustained elevation of BP
- Excess BP = actual BP – acceptable BP (Tables 1 and 2)
- 'acceptable BP' is given by the 90th percentile according to height
- Reduce BP gradually. Aim to reduce 'excess BP' by one-third in first 8 hr, another one-third in the next 12 hr, and the final one-third in the next 48 hr
- Mark target BP ranges on chart so the nurses know when to ask a doctor to review
- Discuss choice of drug treatment with **consultant**
- Options comprise: (Table 2)
 - nifedipine oral
 - quick acting
 - may be used to clip peaks of BP

- dose varies with product: check with your pharmacy
- labetalol infusion
 - do not use in heart failure
 - starting dose 0.5-1 mg/kg per hr
 - increase by 1 mg/kg per hr every 30 min until effective
 - maximum dose 3 mg/kg per 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 monitoring required
 - starting dose 500 nanogram/kg per min
 - increase in increments of 0.2 mcg/kg per min
 - maximum 4 mcg/kg per min
 - only effective whilst infused as short half-life
 - stop infusion slowly over 15-30 min to avoid any rebound effects

SUBSEQUENT MANAGEMENT

Essential hypertension

- Indications for treatment are controversial, particularly in the well child with mild hypertension (> 90th percentile) and no identifiable cause

HYPERTENSION • 3/4

- Treat if child has symptoms and a BP > 90th percentile or if BP is consistently well above the 95th percentile (Tables 1 and 2)
- start with simple measures such as weight loss, limitation of sodium intake, and exercise
- add drug therapy only after discussion with a consultant

Renal hypertension

- In children with impaired renal function, keep their BP within the same normal range as for children with normal renal function

OUT-PATIENT MANAGEMENT

Table 1: BP 90th and 95th percentiles

Boys					Girls				
Height (cm)	90 th centile		95 th centile		Height (cm)	90 th centile		95 th centile	
	Sys	Dias	Sys	Dias		Sys	Dias	Sys	Dias
80	100	54	103	58	80	101	56	104	60
85	102	56	105	60	85	102	58	105	62
90	103	59	107	63	90	102	60	106	64
95	104	61	109	65	95	103	62	107	66
100	106	63	110	67	100	104	64	108	68
105	107	65	111	69	105	106	66	109	70
110	108	67	112	71	110	107	67	110	71
115	110	69	114	73	115	108	69	111	73
120	111	71	115	76	120	109	70	113	74
125	112	73	116	77	125	111	71	115	75
130	113	74	117	78	130	112	73	116	77
135	114	74	118	79	135	114	74	118	77
140	116	75	120	80	140	115	74	119	78
145	118	76	122	80	145	117	75	121	79
150	119	76	123	81	150	119	76	123	80
155	122	77	125	82	155	120	78	124	82
160	124	77	127	83	160	121	78	125	83
165	126	79	130	83	165	122	79	127	83
170	127	79	131	84	170	124	80	130	85
175	130	80	134	85					
180	132	81	137	85					

HYPERTENSION • 4/4

Table 2: Drugs commonly used for the management of hypertension in children

Drug	Mechanism of action	Advice
Atenolol	Beta-adrenoceptor blocker	<ul style="list-style-type: none"> ● Reduces heart contractility. Contraindicated in early stages of hypertensive heart failure ● Avoid in confirmed asthmatics
Labetalol	Non-cardioselective beta-blocker with additional alpha-blocking properties	<ul style="list-style-type: none"> ● Combining alpha and beta blockade reduces tachycardia that can be a problem without beta blockade ● Contraindicated in asthmatics and heart failure
Nifedipine	Calcium channel blocker	<ul style="list-style-type: none"> ● Can be used in heart failure as any negative inotropic effect is offset by a reduction in left ventricular work
Enalapril	Angiotensin-converting enzyme (ACE) inhibitor	<ul style="list-style-type: none"> ● Recommended in children with renal hypertension. The first dose should be given at night to prevent transient hypotension ● In children with impaired renal function, check serum creatinine and potassium two to three days after starting treatment and consider withdrawal if they have risen ● Contraindicated in bilateral renal artery stenosis
Losartan	Angiotensin II receptor blocker	<ul style="list-style-type: none"> ● Second line if enalapril contraindicated or not tolerated ● In children with impaired renal function, check serum creatinine and potassium two to three days after starting treatment and consider withdrawal if they have risen ● Contraindicated in bilateral renal artery stenosis

NEPHROTIC SYNDROME • 1/5

RECOGNITION AND ASSESSMENT

Definition

A triad of features:

- Oedema
- Heavy proteinuria, defined as:
 - dipstick 3+ or more, or
 - urinary protein > 40 mg/m² per hr, or
 - early morning protein/creatinine ratio > 200 mg/mmol
- Hypoalbuminaemia – plasma albumin < 25 g/L

Symptoms and signs

Oedema

- Periorbital, pedal, sacral, scrotal
- Also ascites or pleural effusion

Cardiovascular – 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
 - hypotension – a late sign
 - jugular venous pressure (JVP) low
- Muffled heart sounds – suggests pericardial effusion

Respiratory

- Tachypnoea and recession – suggests pleural effusion

Abdomen

- Swelling and shifting dullness – suggest ascites
- Tenderness with fever, umbilical flare – suggests peritonitis
- Scrotal oedema – stretching can cause ulceration or infection

Investigations

Femoral blood sampling is contraindicated because of risk of thrombosis

- Urinalysis
- Early morning urine protein/creatinine ratio – the first morning after admission
 - normal value < 20 mg/mmol; nephrotic > 200 mg/mmol – and more usually > 600 mg/mmol
- Baseline bloods
 - U&E and creatinine
 - albumin
 - FBC
 - immunoglobulins
 - 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 steroids)
 - anti-streptolysin O titre
 - antinuclear antibodies
 - anti-ds DNA antibodies

NEPHROTIC SYNDROME • 2/5

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 glomerular sclerosis
- Multisystem disorders (e.g. HSP, diabetes mellitus, SLE, and malaria)
- Congenital nephrotic syndrome – very rare

IMMEDIATE TREATMENT

General

- Admit
- Strict fluid balance monitoring
- daily weights – mandatory
- Avoid added salt, but a low salt diet is not indicated
- Manage hypovolaemia – see **Complications**
- seek **senior advice before volume resuscitation**, as there is a risk of volume overload
- Prednisolone 60 mg/m² orally once daily (maximum 80 mg), in the morning (see BNFC for surface area)

- Phenoxyethylpenicillin (Penicillin V) for pneumococcal prophylaxis
- If oedema is upsetting to patient or causing breathlessness, add furosemide 1-2 mg/kg orally or IV
- may intensify hypovolaemia, in which case also use 20% albumin – discuss with a **consultant**
- If disease severe – especially with hypovolaemia – as judged by poor perfusion, high haemoglobin, thrombophilia, or abdominal pain or if relapse for > 2 weeks, start dipyridamole at antiplatelet dosage (prescribe to nearest 25 mg) to reduce risk of thrombotic complications

Fluid restriction

- Restrict to usual maintenance intake (insensible losses plus output)
- If not tolerated, aim for:
 - 600 mL/day in children < 5-yrs-old
 - 800 mL/day in children 5-10-yrs-old
 - 1000 mL/day in children > 10-yrs-old

NEPHROTIC SYNDROME • 3/5

COMPLICATIONS

Acute hypovolaemia

- Abdominal pain, looks unwell, tachycardia, poor perfusion, high Hb
- Seek **senior advice before volume resuscitation**, as there is a risk of volume overload
- give human albumin **4.5%** (if available) 10 mL/kg immediately or sodium chloride 0.9% 10 mL/kg immediately

Do not confuse 4.5% albumin with 20% as the latter is hyperosmolar and can easily cause fluid overload

- Start dipyridamole, to reduce risk of thrombotic complications, at antiplatelet dosage (prescribe to nearest 25 mg)

Chronic hypovolaemia

- More common in steroid-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%** 0.5-1.0 g/kg (2.5-5.0 mL/kg) over 2-4 hr with furosemide 1-2 mg/kg IV midway through infusion
- regular observations for signs of overload

- often required daily or twice daily – liaise with a specialist centre
- Start dipyridamole, to reduce risk of thrombotic complications, at antiplatelet dosage (prescribe to nearest 25 mg)

Peritonitis

- Difficult to recognize
- 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 if possible, then start cefuroxime IV plus metronidazole IV pending culture results

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 FDP 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

NEPHROTIC SYNDROME • 4/5

DISCHARGE POLICY AND SUBSEQUENT MANAGEMENT

- Discharge when in remission
- 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 four weeks

New patients

- Prednisolone 60 mg/m² (maximum 80 mg) once daily for six weeks
- Then 40 mg/m² (maximum 60 mg) alternate days for six weeks
- Then stop
- Response usually apparent in 7-10 days
- No response after four weeks suggests steroid resistance

Relapsing patients

- Relapse
- three consecutive days of 3+ or more early morning proteinuria, having previously been in remission
- Start prednisolone 60 mg/m² (maximum 80 mg) once daily
- continue until nil or trace proteinuria for three days
- then 40 mg/m² (maximum 60 mg) alternate days for a further four weeks

- If relapses frequent despite alternate-day corticosteroids for a month
- try short courses of high dose steroids
- discuss with a **paediatric nephrologist**

Oral prednisolone

- While on prednisolone 60 mg/m² once daily advise to:
 - carry a steroid card
 - seek prompt medical attention for illness – especially zoster contacts

Other management

- Urine testing
 - teach technique and provide appropriate dipsticks
 - test only first daily urine sample
 - keep a proteinuria diary
- Steroid diary with instructions regarding corticosteroid dosage

Infectious precautions

- Avoid live immunizations for 3 months after period of treatment with high-dose corticosteroids (2 mg/kg for a week or 1 mg/kg/day for a month)
- Benefit of inactivated vaccines can be impaired by high-dose corticosteroids and so a similar delay is advisable where possible
 - where not possible because of frequent relapse, give **INACTIVATED** vaccines after a shorter delay and check for an antibody response
- Continue penicillin prophylaxis until oedema has resolved

NEPHROTIC SYNDROME • 5/5

- If zoster non-immune (VZV – IgG negative) and on high-dose corticosteroids, give Zoster immunoglobulin
- after definite zoster contact, a contact will be infectious two days before the onset of the rash, and cease when all lesions are crusted over
- can be given up to 10 days after exposure. Contact consultant microbiologist on duty for release of VZIG
- if zoster immunoglobulin not available, use aciclovir
- varicella vaccine (live vaccine) is available and should be given if a suitable opportunity arises between relapses
- Pneumococcal vaccine in children:
 - ≥ 2-yr-old use inactivated polysaccharide vaccine Pneumovax II
 - < 2-yr-old use the inactivated conjugate vaccine Prevenar, and revaccinate with the Pneumovax brand when children 2-yr-old

Refer for specialist advice if:

- Steroid-resistant disease
 - non-responsive after four weeks of daily prednisolone, but start discussions with the specialist centre in the third week
- Steroid-dependent disease
 - two consecutive relapses during corticosteroid treatment or within 14 days of cessation
- Significant steroid toxicity
- < 1-yr-old or > 12-yr-old at first presentation
- Mixed nephritic/nephrotic picture – for example, macroscopic (not microscopic) haematuria, renal insufficiency or hypertension

Indicators of poor prognosis

- Age of presentation: < 2-yr-old or > 12-yr-old
- Macroscopic haematuria
 - microscopic haematuria is seen in up to one-third of patients
- Hypertension
- Impaired renal function
- Low serum C3
- Steroid resistance
 - proteinuria persisting after four weeks of daily prednisolone

RENAL CALCULI • 1/4

RECOGNITION AND ASSESSMENT

Definition

- The presence of crystalline material within the urinary tract

Symptoms and signs

- Non specific recurrent abdominal pain
- Dysuria or strangury
- Classical renal colic
- Urinary infection (particularly *Proteus spp*)
- Macroscopic or microscopic haematuria
- Passage of stones
- Renal failure

Initial investigations

- Renal ultrasound scan
- Plain abdominal film
- Urine 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 orally if symptomatic for urinary tract infection, adjusted once sensitivities available
- antibiotic treatment is unlikely to eradicate organism in the presence of stones

OUT-PATIENT MANAGEMENT

Investigations in patients with proven renal calculi

- Fasting (before breakfast) blood sample for:
 - creatinine
 - calcium
 - phosphate
 - alkaline phosphatase
 - uric acid
 - magnesium
 - venous bicarbonate
 - pH (warm arterialized 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 the request form) for:
 - sodium
 - potassium
 - urea
 - calcium
 - magnesium
 - oxalate
 - phosphate
 - citrate
 - uric acid
 - cystine
 - creatinine
 - pH (to coincide with blood pH)

RENAL CALCULI • 2/4

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	Infection with urea-splitting organisms, especially in children with urinary stasis	No
Calcium oxalate	Hard grey-brown rough surface	Hypercalciuria (any cause) Hyperoxaluria	Yes
Calcium phosphate	Large smooth pale friable	Infection Renal tubular acidosis Vitamin D toxicity Idiopathic hypercalciuria Immobilization Hyperparathyroidism Sarcoidosis	Yes
Cystine	Pale-yellow crystalline Maple syrup	Cystinuria	Yes
Uric acid	Hard yellow	Lesch-Nyhan syndrome Dietary Induction in haematological malignancies	No
Xanthine	Smooth soft brown yellow	Xanthinuria	No
Dihydroxyadenine	Friable grey-blue	Adenine phosphoribosyl transferase deficiency	No

* Radiolucency depends on the amount of calcium in the stone and an individual patient can have more than one type of stone, each with different radiolucencies

RENAL CALCULI • 3/4

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 is 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 ratio consistently > 0.7 mmol/mmol indicates hypercalciuria
- Oxalate: creatinine ratio is age-dependent, and suggestive of hyperoxaluria if it exceeds the following thresholds (mmol/mmol):
 - < 6-months-old: 0.35
 - 6 to 11 months-old: 0.2
 - 1 to 2-yrs-old: 0.18
 - 3 to 6-yrs-old: 0.11
 - 7 to 14-yrs-old: 0.08
 - > 14 yrs-old: 0.065
- Uric acid/creatinine ratio is age-dependent, and suggestive of hyperuricaemia if it exceeds the following thresholds (mmol/mmol):
 - < 1-yr-old: 1.5
 - 1 to 2-yrs-old: 1.26
 - 3 to 6-yrs-old: 0.83
 - 7 to 10-yrs-old: 0.67
 - 11 to 14-yrs-old: 0.45
 - > 14-yrs-old: 0.4

- Magnesium: creatinine ratio < 0.2 mmol/mmol may increase stone formation
- Calcium: citrate ratio < 0.6 mmol/mmol 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* infection by prompt treatment if symptomatic
- Advise liberal fluid intake
 - adolescent 3 L/day
 - pre-puberty 1.5 L/day
- Additional measures for recurrent stone formation or idiopathic hypercalciuria (in order):
 - dietary assessment to optimize oxalate, vitamin C, calcium, and vitamin D intake
 - reduced sodium intake in idiopathic hypercalciuria, if sodium excretion > 3 mmol/kg per day

RENAL CALCULI • 4/4

- high fibre diet with cellulose or whole wheat flour to reduce calcium and oxalate absorption
- potassium citrate in patients with low urinary citrate
- bendroflumethiazide to reduce calcium and oxalate excretion (unlicensed)
- phosphate Sandoz tablets dissolved in water – NB these can cause diarrhoea and worsen the prognosis in children with stones that have developed as a result of infection
- For large stones that are unlikely to pass, surgical removal or lithotripsy may be required
- modality of treatment determined by location and size of the stone
- generally, stones < 2 cm suitable for lithotripsy
- larger stones treated by percutaneous nephrolithotomy (PCNL) or by open operation
- nephrectomy may be advised where kidney function is poor

RENAL FAILURE • 1/4

RECOGNITION AND ASSESSMENT

Definition

- Acute renal failure: 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:
 - neonates < 0.6 mL/kg per hr
 - infant/child < 300 mL/m² per day

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
 - good response to diuretics after correction of hypovolaemia
- Renal
 - haemolytic uraemic syndrome (see **Haemolytic uraemic syndrome**)
 - acute nephritis (see **Glomerulonephritis**)
 - acute tubular necrosis or renal vein thrombosis
 - unrecognized chronic renal failure (oliguria usually not a feature)
 - acute-on-chronic renal failure (e.g. dehydration or infection)

- Post-renal
 - urinary tract obstruction (rare)

Assessment

- Hydration (under or over)
- Weight
- Skin (turgor/oedema)
- Ascites
- BP/capillary refill
- Jugular venous pressure (JVP)
- Urine output

Immediate investigations

- See separate **guidelines for specific causes**
- Blood
 - full biochemical profile, including bicarbonate
 - FBC
- Urine
 - urinalysis for blood, protein, nitrites and leucocytes
 - osmolality
 - electrolytes
- Renal ultrasound scan
 - size and appearance of kidneys
 - inflammation and 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

RENAL FAILURE • 2/4

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**
- Volume overload/hypertension
 - low serum sodium usually indicates fluid overload
 - furosemide 1mg/kg IV immediately (no faster than 4 mg/min): if no urine output after 30 min, give a further 1 mg/kg and if still no urine a third 1 mg/kg after 30 min
- Once toxicity develops, the following (see Table 1) are holding measures whilst dialysis is set up
 - give salbutamol either by nebulizer or IV as first-line emergency treatment, followed by calcium resonium (even if salbutamol effective) to start to reduce the potassium load
 - if ECG still unstable, give calcium gluconate
 - 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 **consultant on call**

Metabolic acidosis

- Consider sodium bicarbonate – discuss with **consultant on call**

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 serum potassium < 3.5 mmol/L or there are ongoing losses
- If potassium > 6.0 mmol/L, ECG monitoring essential
 - 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

RENAL FAILURE • 3/4

Table 1: Emergency treatment of hyperkalaemia

Treatment	Dose	Onset	Mode of action
Salbutamol infusion	4 mcg/kg over 5 min	Immediate. Effect maximal at 60 min	Shifts potassium into cells
Calcium gluconate 10%	0.5 mL/kg IV (max 20 mL) over 5-10 min. Monitor ECG Do NOT administer through same line as bicarbonate	5 min	Antagonizes effect of high potassium
Sodium bicarbonate 4.2% infusion (only if patient acidotic)	1 mmol/kg IV (2 mL/kg of 4.2%) Do NOT administer through same line as calcium	5 min. Effect may last several hours	Shifts potassium into cells
Glucose/insulin infusion	Glucose 0.5 g/kg IV (5 mL/kg 10% glucose) over 15–30 min, insulin 0.5 unit/kg/hr Not effective if glucose given in immediate preceding period	30 min. Effect may last several hours Frequent glucose stix checks	Shifts potassium into cells
Ion exchange resin	Calcium resonium 125-250 mg/kg 6 hrly (max 15 g/dose) orally/rectally	Orally 2 hr Rectally 30 min (irrigate to remove residue)	Removes potassium from body

- 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
- the amount and rate of replacement depends on estimation of losses and response to initial supplementation. If in doubt discuss with **consultant on call**

RENAL FAILURE • 4/4

SUBSEQUENT MANAGEMENT

Fluid and sodium balance

- Once normal hydration restored, aim to replace insensible loss (300-400 mL/m² per day) + urine output + other losses
- In anuric patients (as opposed to oliguric) patients, 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 0.18% 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 dietician
- A low protein high energy diet is ideal (aim for energy intake of 400 kcal/m²)
- Avoid high potassium foods
- Be realistic about what a child will take

Indications for dialysis

- Fluid overload
- Uncontrolled hypertension (for height-related 97th centiles, see **Hypertension**)

- Potassium toxicity (as indicated by features listed previously)
- Metabolic acidosis (pH < 7.2) unresponsive to base supplementation
- Convulsions
- Loss of general well being ± alteration in conscious level (see **Glasgow Coma Score**)
- Spontaneous resumption of renal function likely to be delayed
 - acute-on-chronic renal failure
 - haemolytic-uraemic syndrome

MONITORING TREATMENT

- Accurate fluid balance
- Re-assess fluid intake at least 12 hly
- Record weights, plasma sodium and PCV as indicators of hydration
- Respond promptly to increase in urine volume, fall in serum creatinine and increase in urine osmolality by increasing fluid intake to prevent prolonged oliguria
- Once diuresis begins, increase electrolyte replacement, including potassium
 - once stable, reduce fluid intake gradually to avoid prolonged diuretic phase

RENAL INVESTIGATIONS • 1/4

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 albumin:creatinine ratio (**must** be first urine specimen voided in the morning) – elevation confirms glomerular proteinuria

Protein:creatinine ratio

- Best performed on first urine specimen voided in the morning
- Upper limit of normal < 20 mg/mmol
- Significant proteinuria > 100 mg/mmol
- Heavy proteinuria (nephrotic) > 1000 mg/mmol

Timed 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 specimens passed during the night
- empty bladder on rising in morning and collect sample
- record time from bladder emptying at night to bladder emptying in morning

- Calculate protein output as mg/m² per hr (see BNFC for Surface area)
- Upper limit of normal 2.5 mg/m² per hr
- Heavy proteinuria > 40 mg/m² per 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

SODIUM EXCRETION

- Fractional sodium excretion (FE_{Na}) assesses capacity to retain sodium
- ensure normal sodium intake (dietician 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_{Na}) and creatinine (U_{Cr})

RENAL INVESTIGATIONS • 2/4

- blood sample immediately after voiding for plasma sodium (P_{Na}) and creatinine (P_{Cr})
- enter results into equation (using same units for U and P; $1000 \mu\text{mol} = 1 \text{ mmol}$)
- $FE_{Na} = \frac{U_{Na}}{P_{Na}} \frac{P_{Cr}}{U_{Cr}} \times 100$
- normal values for FE_{Na}
 - 0 to 3-months-old < 3
 - > 3-months-old < 1

PLASMA CREATININE

- Mean and upper limit dependent on height but can be determined roughly from the child's age

Table 1:

Age	Height (cm)	Mean ($\mu\text{mol/L}$)	Upper limit
Up to 2 weeks		66	87
2 weeks to 6 months	50	44	58
6 months to 1 yr	60	34	49
2 yrs	87	28	39
4 yrs	101	33	43
6 yrs	114	38	52
8 yrs	126	42	57
10 yrs	137	46	62
12 yrs	147	52	69
Adult female	163	68	89
Adult male	174	86	108

GLOMERULAR FILTRATION RATE (GFR)

- Serial measurements of glomerular filtration rate (in mL/min per 1.73m^2) predict rate of deterioration when renal function impaired

Table 2:

Age	Mean GFR (mL/min/ 1.73m^2)	Range (2 SD)
Up to 1 month	48	28–68
1–6 months	77	41–103
6–12 months	103	49–157
1–2 yrs	127	63–191
2–12 yrs	127	89–165

RENAL INVESTIGATIONS • 3/4

Plasma creatinine method

- Estimates the GFR in children with reasonable accuracy from the P_{Cr} and height, using the following formula:

$$\text{GFR(mL/min } 1.73\text{m}^2) = \frac{40 \times \text{height (cm)}}{P_{Cr} (\mu\text{mol/L})}$$

- Not suitable for children:
 - < 3-yrs-old
 - with muscle disease/wasting
 - with normal kidneys

$^{51}\text{Cr-EDTA}$ slope clearance

- Use only when GFR needs to be determined very accurately
- Complete Nuclear Medicine request card
- Provide height and weight of child
 - correct result for surface area and expressed as per 1.73 m^2
 - if result expressed as mL/min 'correct' for surface area (see BNFC for Surface area)

RENAL ULTRASOUND MEASUREMENTS

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 yrs	65	54–72
3–6 yrs	75	64–88
6–9 yrs	80	73–86
9–12 yrs	86	73–100

- Measurements of pelvicalyceal size at hilum of kidney:
 - < 5 mm - definitely normal
 - 5–10 mm - equivocal
 - > 20 mm - implies hydronephrosis

RENAL INVESTIGATIONS • 4/4

ISOTOPE SCANS

Dynamic imaging (MAG3)

Indications

- To assess differential renal function between and within each kidney
- To assess obstruction in dilated system – excretion delayed
- To assess drainage six months after pyeloplasty
- Indirect cystography in older children before and/or after surgical correction of reflux

Operational notes

- Complete Nuclear Medicine request card
- 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
- When assessing obstruction in dilated system or outcome of pyeloplasty, give furosemide 0.5 mg/kg IV at 100 mcg/kg/min (max rate 500 mcg/kg/min or 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}Tc-DMSA)

Indications

- To assess function and prognosis in a multicystic kidney
- To locate an ectopic kidney
- To identify renal scars after recovery from acute infection

Operational notes

- Complete Nuclear Medicine request card
- Scan kidney 2-6 hr after injection
- Sedation rarely required

URINARY TRACT INFECTION • 1/4

RECOGNITION AND ASSESSMENT

Treat UTI in infants promptly to reduce risk of renal scarring

Symptoms and signs

Neonates	<ul style="list-style-type: none"> ● 'Septic baby' ● Prolonged or severe jaundice ● Failure to thrive ● Recurrent vomiting
Infants	<ul style="list-style-type: none"> ● Septic or febrile child ● Changes in voiding pattern ● Screaming on passing urine ● Malodorous urine (fishy rather than ammoniacal)
Pre-school	<ul style="list-style-type: none"> ● Febrile illness ● Abdominal or flank pain ● Frequency, urgency, dribbling, wetting, dysuria ● Secondary enuresis ● Malodorous urine ● Haematuria
Older children	<ul style="list-style-type: none"> ● Loin or lower abdominal pain ● Frequency, urgency, dysuria ● Secondary enuresis ● Haematuria

Investigations

- Screening (all ward referrals)
 - stick test fresh urine for blood, protein, leucocytes and nitrites
- Culture urine in asymptomatic children with:
 - urine nitrites + or
 - urine leucocytes ++ or more
- Culture urine in symptomatic children with:
 - urine containing any blood, protein, leucocytes or nitrites
- If child acutely unwell, measure urinary electrolytes
- If infection associated with poor renal function, arrange ultrasound scan urgently

URINARY TRACT INFECTION • 2/4

Collection and handling of specimens

- Bag or pad urine specimens can be used for urinalysis but if positive, a second specimen collected by one of the following methods is necessary for microbiology:
 - Mid-stream urine (MSU) – the preferred option in those old enough to co-operate
 - Clean catch in sterile container:
 - in babies too young to co-operate
 - eliciting lateral abdominal reflex may provoke micturition
 - Suprapubic aspiration (rarely required)
 - ultrasound scan to confirm a full bladder
 - lie patient supine with legs held in frog position by assistant
 - cleanse suprapubic skin with alcohol
 - use 21 G 3.5 cm needle
 - insert midline 1-2 cm above symphysis pubis perpendicular to skin
 - advance needle whilst applying gentle suction, urine aspirated on insertion
- Handling specimens
 - use plain white-topped sterile bottles for hospital-collected samples
 - keep specimen in fridge at 4°C until transfer to laboratory
 - during working hours, transfer specimens to laboratory within 2 hr
 - out-of-hours, keep specimen in fridge until laboratory open
 - state date and time of collection on specimen bottle

Interpretation of laboratory results

Consider culture results in light of symptoms at presentation

- Pyuria
 - normal < 10 x 10⁶/L in boys, < 20 x 10⁶/L in girls
 - vulvitis, vaginitis or balanitis can also give rise to high counts
 - viruses (echovirus, adenovirus and CMV) can cause sterile pyuria
- Colony counts
 - organism count > 10⁶ organisms/mL pure growth confirms infection in properly collected and stored mid-stream sample. Certainty reduced to 80% with bag/pad urine
 - low counts do not exclude infection
 - high fluid intake to obtain specimens will reduce colony counts in genuine infection

URINARY TRACT INFECTION • 3/4

IMMEDIATE TREATMENT

If child unwell, do not delay treatment while trying to obtain urine specimen

- High fluid intake
- Antibiotics
 - if serious systemic disturbance (fever > 39°C, pale/mottled, drowsy, vomiting) with possible septicaemic component, give a single dose of gentamicin IV and cefuroxime IV for seven days
 - if minor systemic disturbance, give cefalexin or trimethoprim orally for five days depending on culture sensitivities

SUBSEQUENT MANAGEMENT

- Follow-up culture (48 hr after antibiotic stopped) to ensure eradication of the organism in children with recurrent symptoms or uropathy (but not if antibiotic prophylaxis given)
- Prophylaxis for children < 2-yrs old following treatment of acute infection until the results of investigations are available (see **Treatment in Out-patient management**)
- Renal ultrasound scan (normally 6-8 weeks) in all definite or suspected infections, unless previous scan available

DISCHARGE POLICY

- Patients can go home when:
 - symptoms mild, or severe symptoms controlled
 - taking oral antibiotics and

tolerating them

- renal function normal or returning to previous values in those with impaired function
- Out-patient review in 10–12 weeks with results of ultrasound scan

OUT-PATIENT MANAGEMENT

Investigations

- **Renal ultrasound scan**
 - all children with actual or suspected UTI
 - remember to check bladder emptying
- **Micturating cysto-urethrogram (MCUG).** Consider in:
 - male with abnormal voiding pattern or bladder outflow obstruction (e.g. posterior urethral valves, bilateral hydronephrosis ± hydroureters) – **mandatory**
 - children < 3-yrs-old with upper tract dilation where surgical treatment for obstruction is considered. Discuss with urologist beforehand as MCUG may not be required in classical PUJ obstruction suspected on ultrasound and MAG3
 - babies < 1-yr-old with proven infection and symptoms (e.g. fever). Discuss with parents, who may prefer prophylactic antibiotics for 1-2 years and DMSA scan for scars at 5 yrs
- MCUG is an invasive investigation
- urine must be sterile and child taking prophylactic antibiotics

URINARY TRACT INFECTION • 4/4

- **DMSA scan.** Consider in:
 - infection involving upper tract symptoms (fever, abdo/loin pain, raised CRP)
 - at 5-yrs-old to check for scarring in children with proven reflux or in those with proven infection at < 3 years who did not have an MCUG or DMSA at the time
 - defer until three months after infection to avoid detecting temporary changes
- **Indirect voiding cystography.** Consider in:
 - older child > 3-yrs-old with recurrent infection resistant to prophylaxis
 - uses MAG3 scan to detect gross reflux

Treatment

- Future infections
 - prompt antibiotic treatment – cefalexin normally first-line
- Prophylaxis
 - child < 3-yrs-old awaiting results of investigations
 - proven Grade 2 reflux until 2-yrs-old
 - proven Grade 3+ reflux until 3-yrs-old (provided infections well controlled)
 - any child with frequent symptomatic infections (≥ 3 urinary tract infections per year)
 - may be preferable to investigation in < 1-yr-old with asymptomatic or mildly symptomatic infection
 - prefer trimethoprim (10 mg/mL) 2 mg/kg orally daily (max 100 mg), or alternatively (in those > 3-months-old)

nitrofurantoin (5 mg/mL)
1 mg/kg orally daily

- give as a **single night-time dose** for at least 6 months or until surgical correction
- Surgical management of reflux
 - obstructive mega-ureters with reflux
 - failure to control infections with prophylaxis
 - neuropathic bladder

Management of children with renal scars

- All require annual BP checks throughout life, usually in primary care
- Females must book early when pregnant and inform Obstetric Team
- In cases of marked bilateral scarring
 - assessment of urinary protein excretion and renal function every three to four years
 - long-term follow-up in the renal clinic

ARTHRITIS • 1/2

RECOGNITION AND ASSESSMENT

Definition

- Acute, chronic or recurrent inflammation of a single or multiple joint which may be proximal or distal (see **Limping child**)

Symptoms and signs

- Pain
- Stiffness
- Gradual refusal to participate in usual activities
- Joint may be swollen, hot, red and/or tender

Differential diagnosis

- Juvenile idiopathic arthritis (JIA) is the most likely diagnosis
- JIA is arthritis of unknown aetiology before 16-yrs-old persisting for 6 weeks or more
- Differential diagnoses to consider include:
 - reactive arthritis (self-limiting in response to an infection)
 - non-accidental injury
 - systemic rheumatic diseases, such as SLE, dermatomyositis, vasculitis (including HSP and Kawasaki disease)
 - arthritis associated with inflammatory bowel disease
 - malignancy, especially leukaemia or neuroblastoma
 - rickets and other endocrine disease (e.g. IDDM, thyroid disease)
 - infectious causes e.g. TB, rheumatic fever, Lyme disease

- Rarer causes include:
 - inherited metabolic diseases and other genetic disorders
 - other infectious causes (e.g. Lyme disease, TB, rheumatic fever)
 - chronic recurrent multifocal osteomyelitis
 - auto-inflammatory diseases, including chronic infantile neurological cutaneous and arthritis syndrome

Investigations

- If child has features of other differential diagnoses that have radiological changes: X-rays of joints most affected and, if severe, as a baseline assessment to look for erosions
- Blood tests to exclude differential diagnosis or for JIA classification purposes (not useful to confirm the diagnosis of JIA): FBC, ESR, CRP, ASOT, rheumatoid factor, ANA (and ds-DNA auto-antibodies if SLE suspected)

ACUTE MANAGEMENT

- **Telephone** local paediatric rheumatology team for advice on management of musculoskeletal conditions and assessment of pyrexia of unknown origin
- **Analgesia/anti-inflammatory medication:** in order of increasing risk of side effects but also clinical effectiveness:
 - ibuprofen – naproxen – piroxicam (see BNFC for dose based on weight)

ARTHRITIS • 2/2

If JIA is a possible diagnosis, arrange early referral to local ophthalmologist to start screening program for uveitis – chronic anterior uveitis can be asymptomatic initially and can progress to irreversible loss of vision if referral delayed

- **Refer** all children with suspected JIA and autoinflammatory connective tissue diseases e.g. SLE, dermatomyositis, scleroderma and sarcoidosis for urgent appointment to paediatric rheumatology service
- Management will involve:
 - exploring differential diagnoses
 - disease education
 - physiotherapy and rehabilitation
 - optimising medical treatment including corticosteroid joint injections (nearly always under general anaesthetic), methotrexate, and the institution of shared care monitoring

LIMPING CHILD • 1/2

INTRODUCTION

Differential diagnosis varies with age

Common/important diagnoses

Any age	<ul style="list-style-type: none"> ● Trauma (including NAI) ● Septic arthritis ● Reactive arthritis ● Juvenile Idiopathic Arthritis (JIA) ● Malignancy ● Referred pain (e.g. from hip to knee)
Age 0-4 yr	<ul style="list-style-type: none"> ● Developmental Dysplasia of the Hip (DDH) ● Transient synovitis ● Non-Accidental Injury (NAI)
Age 4-10 yr	<ul style="list-style-type: none"> ● Perthes ● Transient synovitis
Age 11-16 yr	<ul style="list-style-type: none"> ● Slipped upper femoral epiphysis (SUFE) ● Gonococcal septicaemia

History

Ask about:

- Trauma
- Fever: shivering/sweating
- Recent viral illness
- Swollen joints
- Stiff joints
- Sickle cell
- Delayed presentation

Examination

General

Look for:

- Fever
- Rash
- Pallor
- Bruising
- Impaired growth

Musculoskeletal

Check:

- Gait
- Joint swelling
- Range of movement
- Leg lengths
- Weakness
- Spinal configuration/movement

LIMPING CHILD • 2/2

INITIAL INVESTIGATIONS

- FBC and film
- ESR
- CRP
- If febrile, blood cultures
- X-ray symptomatic joint (and normal side) and, if origin of pain uncertain, request X-rays of adjacent joints
- where SUFE a possibility, request AP and frog views of hips
- if effusion suspected, confirm with ultrasound scan, if available
- Other investigations (e.g. muscle enzymes, autoantibodies, bone scan) may be useful – dependent on clinical assessment

MANAGEMENT

- If there are any features consistent with septic arthritis- see **Osteomyelitis and septic arthritis**:
 - severe pain or local tenderness
 - range of movement < 75% normal
 - temperature > 37.5°C
 - WBC > 13 x 10⁹/L
 - ESR > 20 mm/1st hr
 - CRP > 10 mg/L
 - effusion on USS
- OR
- X-ray abnormal or suggests orthopaedic problem (e.g. Perthe's, SUFE)

- Refer to Orthopaedics for diagnostic aspiration/washout – **before** starting antimicrobials

DISCHARGE POLICY

- If blood tests and X-ray normal, irritable hip (reactive arthritis) likely
- discharge with analgesia 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