There are few situations that provoke greater anxiety than being called to see a child who is seriously ill. This chapter outlines a basic approach to the emergency management of seriously ill children.

The seriously ill child

The rapid clinical assessment of the seriously ill child will identify if there is potential respiratory, circulatory or neurological failure. This should take less than 1 minute. Normal vital signs are shown in Figure 6.1 and how a rapid assessment is performed in Figure 6.2. Resuscitation is given immediately if necessary, followed by secondary assessment and other emergency treatment.

The seriously ill child may present with shock, respiratory distress, as a drowsy/unconscious or fitting child or with a surgical emergency. Their causes are listed in Figure 6.4. In children, the key to successful outcome is the early recognition and active management of conditions that are life-threatening and potentially reversible.

Summary

Regarding the seriously ill child:
- prevention of cardiopulmonary arrest is by early recognition and treatment of respiratory distress, respiratory or circulatory failure.

Vital signs

![Vital signs chart](image-url)

Figure 6.1 Variation in the normal range for respiratory rate, heart rate and systolic blood pressure with age.
Cardiopulmonary resuscitation

In adults, cardiopulmonary arrest is often cardiac in origin, secondary to ischaemic heart disease. In contrast, children usually have healthy hearts but experience hypoxia from respiratory or neurological failure or shock. If this occurs, irrespective of the cause, basic life support must be started immediately.

Basic life support (Fig. 6.5)

Advanced life support (Fig. 6.6)

Children who have been resuscitated successfully should be transferred to a paediatric high-dependency or intensive care unit.

---

**Assessment of the seriously ill child**

<table>
<thead>
<tr>
<th>The rapid clinical assessment: ABCDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Should take &lt; 1 min</td>
</tr>
</tbody>
</table>

**Airway and Breathing**

- Look, listen and feel for:
  - Airway obstruction or respiratory distress
  - Work of breathing (respiratory effort)
  - Respiratory rate
  - Stridor, wheeze
  - Auscultation for air entry
  - Cyanosis

**Circulation**

- Feel and assess:
  - Heart rate
  - Pulse volume
  - Capillary refill time (Fig 6.3)
  - Blood pressure

**Disability**

- Observe and note:
  - Level of consciousness (Box 6.1)
  - Posture – hypotonia, decorticate, decerebrate
  - Pupil size and reactivity

**Exposure**

---

**Resuscitation (if necessary)**

- Includes Basic/Advanced life support
- Consider:
  - Jaw and neck positioning
  - Oxygen
  - Suction and foreign body removal
  - Supporting breathing
  - Chest compression
  - Monitoring pulse oximetry and heart rate

---

**Secondary assessment**

- History from:
  - parents
  - witnesses
  - general practitioner
  - paramedical staff
  - police

- Examination including:
  - evidence of trauma
  - rash, e.g. meningococcal
  - smell, e.g. ketones, alcohol
  - scars, e.g. underlying congenital heart disease
  - MedicAlert bracelet

- Investigations
  - blood glucose

---

**Other emergency interventions**

---

**Box 6.1** AVPU rapid assessment of level of consciousness – more detailed evaluation is with the Glasgow Coma Scale (see Table 6.2)

<table>
<thead>
<tr>
<th>A</th>
<th>ALERT</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Responds to VOICE</td>
</tr>
<tr>
<td>P</td>
<td>Responds to PAIN</td>
</tr>
<tr>
<td>U</td>
<td>UNRESPONSIVE</td>
</tr>
</tbody>
</table>

A score of P means that the child's airway is at risk and will need to be maintained by a manoeuvre or adjunct.

---

**Cardiopulmonary resuscitation**

In adults, cardiopulmonary arrest is often cardiac in origin, secondary to ischaemic heart disease. In contrast, children usually have healthy hearts but experience hypoxia from respiratory or neurological failure or shock. If this occurs, irrespective of the cause, basic life support must be started immediately.

---

**Capillary refill time**

- Press on the skin of the sternum or a digit at the level of the heart
- Apply blanching pressure for 5 seconds
- Measure time for blush to return
- Prolonged capillary refill if >2 seconds

Normal <2 seconds.

---

**Figure 6.2** Assessment of the seriously ill child.

**Figure 6.3** Capillary refill time. Digital pressure for 5 seconds. Normal <2 seconds.

Capillary refill time is affected by body exposure in a cold environment.
### Presentation and causes of serious illness in children

<table>
<thead>
<tr>
<th>Presentation</th>
<th>Cause</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shock</td>
<td>Hypovolaemia</td>
<td>Dehydration – gastroenteritis, Diabetic ketoacidosis, Blood loss – trauma</td>
</tr>
<tr>
<td></td>
<td>Maldistribution of fluid</td>
<td>Septicaemia, Anaphylaxis</td>
</tr>
<tr>
<td></td>
<td>Cardiogenic</td>
<td>Arrhythmias, Heart failure</td>
</tr>
<tr>
<td>Respiratory distress</td>
<td>Upper airway obstruction (stridor)</td>
<td>Croup/epiglottis, Foreign body, Congenital malformations, Trauma</td>
</tr>
<tr>
<td></td>
<td>Lower airway disorders</td>
<td>Asthma, Bronchiolitis, Pneumonia, Pneumothorax</td>
</tr>
<tr>
<td>The drowsy or unconscious or seizing child</td>
<td>Post ictal Status epilepticus</td>
<td>Meningitis/encephalitis</td>
</tr>
<tr>
<td></td>
<td>Infection</td>
<td>Diabetic ketoacidosis, hypoglycaemia, electrolyte disturbances (calcium, magnesium, sodium), inborn error of metabolism</td>
</tr>
<tr>
<td></td>
<td>Metabolic</td>
<td>Trauma/non-accidental injury</td>
</tr>
<tr>
<td></td>
<td>Head injury</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Drug/poison ingestion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intracranial haemorrhage</td>
<td></td>
</tr>
<tr>
<td>Surgical emergencies</td>
<td>Acute abdomen</td>
<td>Appendicitis, Peritonitis</td>
</tr>
<tr>
<td></td>
<td>Intestinal obstruction</td>
<td>Intussusception, Malrotation, Bowel atresia/stenosis</td>
</tr>
</tbody>
</table>

**Figure 6.4** The main modes of presentation of serious illness in children and their causes.
Paediatric emergencies

Basic life support

SAFE approach

Check responsiveness:
- Ask ‘Are you all right?’
- Stimulate
- Do not shake children with suspected cervical spine injury

No response

Open airway:
- Head tilt, chin lift
- Jaw thrust (if unsuccessful)

No breathing

Check breathing for max 10 secs:
- Look, listen, feel

Breathe
- Remove any obvious obstruction
- Give 5 initial rescue breaths

Check pulse for max 10 secs:
- >1 year old – carotid
- <1 year old – brachial

No pulse or <60/min

Compress chest
- Rate: 100 compressions/min
- Compression: Ventilation ratio for all children:
  - Two rescuers – 15:2
  - Lone rescuer – 30:2

Figure 6.5 Basic life support. (Adapted from Resuscitation Guidelines, Resuscitation Council (UK), 2005.)
Advanced life support

Establish Basic Life Support

Airway and Breathing
Intubate and ventilate with high concentration O₂

Circulation
Once intubated:
Compression rate 100/min continuously
Ventilation rate 10/min
Establish intravenous access, if delay use intraosseous route

Technique to establish intraosseous infusion in the tibia
• 18 gauge trochar with needle
• Anterior surface, 2–3 cm below tibial tuberosity

Airway and Breathing

Intubate and ventilate with high concentration O₂

Circulation

Once intubated:
Compression rate 100/min continuously
Ventilation rate 10/min
Establish intravenous access, if delay use intraosseous route

Attaching defibrillator/monitor
Assess rhythm

Formula for endotracheal tube size by age in whole years
Internal diameter (mm) = (age/4) + 4
Length for oral tube (cm) = (age/2) + 12
Length for nasal tube (cm) = (age/2) + 15

Shockable

Ventricular fibrillation (VF) or pulseless
Ventricular tachycardia (VT)

Check monitor - still VF/VT:
1st DC shock 4 J/kg or AED
Continue CPR for 2 min

Check monitor - still VF/VT:
2nd DC shock 4 J/kg or AED
Resume CPR for 2 min

Epinephrine (adrenaline)
10 μg/kg (0.1 ml/kg of 1 in 1000 solution) IV or IO
3rd DC shock 4 J/kg or AED
Resume CPR for 2 min

Check monitor - still VF/VT:
Amiodarone 5 mg/kg IV
4th DC shock 4 J/kg or AED
Resume CPR for 2 min cycles
Give epinephrine (adrenaline) before every other shock

During CPR:
Correct reversible causes:
• Hypoxia
• Hypovolaemia
• Hypo/hyperkalaemia
• Hypothermia <33 °C
• Tension pneumothorax
• Tamponade
• Toxins
• Thromboembolism

Check electrode position and contact
Establish IV/IO access

Epinephrine (adrenaline)
10 μg/kg (0.1 ml/kg of 1 in 1000 solution) IV or IO
3rd DC shock 4 J/kg or AED
Resume CPR for 2 min

During CPR:
Correct reversible causes:
• Hypoxia
• Hypovolaemia
• Hypo/hyperkalaemia
• Hypothermia <33 °C
• Tension pneumothorax
• Tamponade
• Toxins
• Thromboembolism

Check electrode position and contact
Establish IV/IO access

Epinephrine (adrenaline)
10 μg/kg (0.1 ml/kg of 1 in 1000 solution) IV or IO
3rd DC shock 4 J/kg or AED
Resume CPR for 2 min

Non-shockable

Pulseless electrical activity (PEA) or asystole

Ventilate with high concentration O₂
Continue CPR

Epinephrine (adrenaline)
10 μg/kg (0.1 ml/kg of 1 in 1000 solution) IV or IO
3rd DC shock 4 J/kg or AED
Resume CPR for 2 min

Consider reversible causes and alkalisising agents

During CPR:
Correct reversible causes:
• Hypoxia
• Hypovolaemia
• Hypo/hyperkalaemia
• Hypothermia <33 °C
• Tension pneumothorax
• Tamponade
• Toxins
• Thromboembolism

Check electrode position and contact
Establish IV/IO access

Epinephrine (adrenaline)
10 μg/kg (0.1 ml/kg of 1 in 1000 solution) IV or IO
3rd DC shock 4 J/kg or AED
Resume CPR for 2 min

Consider reversible causes and alkalisising agents

Epinephrine (adrenaline)
10 µg/kg (0.1 ml/kg of 1 in 1000 solution) IV or IO
3rd DC shock 4 J/kg or AED
Resume CPR for 2 min

Consider reversible causes and alkalisising agents

Figure 6.6 Advanced life support. (Adapted from Resuscitation Guidelines, Resuscitation Council (UK), 2005.)
Management of the seriously injured child

**Primary survey**

**Airway and cervical spine**
- Assume cervical spine damage
  - Neck movements may injure spine
- Only use jaw thrust and chin lift to open airway
  - No neck extension
  - Secure neck with rigid cervical collar and sandbags
  - Discontinue immobilisation only after cervical spine X-rays and neurological examination are found to be normal

**Breathing**
- Give high-flow O₂ via face mask.
  - If inadequate commence ventilation
  - Asymmetry of percussion note or breath sounds
    - Consider: pneumothorax or haemothorax, which need to be drained immediately, misplaced endotracheal tube

**Circulation and haemorrhage control**
- Bleeding from superficial wound?
  - If in shock, is there internal bleeding?
  - Consider X-rays of chest and pelvis
  - Shock does not occur from isolated head injury beyond infancy
  - Apply pressure to stop bleeding.
  - Insert two large venous cannulae
  - Take blood for FBC, group and cross-match
  - Give crystalloid 20 ml/kg and reassess
  - Seek surgical opinion, as likely to be ruptured liver, spleen or fractured pelvis or long bone

**Disability**
- Assess consciousness
  - Secure airway
  - Provide respiratory support if Glasgow Coma Scale < 8 or at ‘P’ on AVPU scale

**Exposure**
- Assess pupil size and reactivity
  - If unequal or abnormal – serious head injury
  - Examine all parts of body
  - Consider analgesia
  - Consider gastric tube (not nasal tube in head injury)
  - Remove all clothing
  - Avoid hypothermia and embarrassment!

**Secondary survey (once condition stabilised)**

**Examine**
- Perform further investigations
  - Identify all injuries
  - Provide emergency treatment and definitive care

---

**The seriously injured child**

Management of the seriously injured child must take account of potential injury to the cervical spine and other bones and internal injuries (Fig. 6.7).

**Shock**

Shock is present when the circulation is inadequate to meet the demands of the tissues. Critically ill children are often in shock, usually because of hypovolaemia due to fluid loss or maldistribution of fluid, as occurs in sepsis or intestinal obstruction.

**Why are children so susceptible to fluid loss?**

Children normally require a much higher fluid intake per kilogram of body weight than adults (Table 6.1). This is because they have a higher surface area to volume ratio and a higher basal metabolic rate. Children may therefore become dehydrated if:
Shock is often from hypovolaemia
- the early signs of compensated shock are from increased sympathetic tone – tachycardia, pallor and peripheral vasoconstriction (prolonged capillary refill time); its recognition is important as at this stage it is reversible
- fluid therapy is the key to its successful treatment.

Management priorities

**Fluid resuscitation**
Rapid restoration of the intravascular circulating volume is the priority (Fig. 6.8). This will usually be with 0.9% saline, or blood if following trauma.

**Subsequent management**
If there is no improvement following fluid resuscitation or there is progression of shock and respiratory failure, a paediatric intensive care unit should be involved and transfer arranged as the child may need:

---

**Box 6.2 Clinical signs of shock**

<table>
<thead>
<tr>
<th>Early (compensated)</th>
<th>Late (decompensated)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tachypnoea</td>
<td>Acidotic (Kussmaul) breathing</td>
</tr>
<tr>
<td>Tachycardia</td>
<td>Bradycardia</td>
</tr>
<tr>
<td>Decreased skin turgor</td>
<td>Confusion/depressed cerebral state</td>
</tr>
<tr>
<td>Sunken eyes and fontanelle</td>
<td>Blue peripheries</td>
</tr>
<tr>
<td>Delayed capillary refill (&gt;2 s)</td>
<td>Absent urine output</td>
</tr>
<tr>
<td>Mottled, pale, cold skin</td>
<td>Hypotension</td>
</tr>
<tr>
<td>Core–peripheral temperature gap (&gt;4°C)</td>
<td>Decreased urinary output</td>
</tr>
</tbody>
</table>

---

**Table 6.1 Fluid intake at different ages**

<table>
<thead>
<tr>
<th>Body weight</th>
<th>Fluid requirement/24 h</th>
<th>Volume/kg per hour (approximate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First 10 kg</td>
<td>100 ml/kg</td>
<td>4 ml/kg</td>
</tr>
<tr>
<td>Second 10 kg</td>
<td>50 ml/kg</td>
<td>2 ml/kg</td>
</tr>
<tr>
<td>Subsequent kg</td>
<td>20 ml/kg</td>
<td>1 ml/kg</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples of calculations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight of child</td>
</tr>
<tr>
<td>Infant 7 kg</td>
</tr>
<tr>
<td>Child 18 kg</td>
</tr>
<tr>
<td>Adolescent 62 kg</td>
</tr>
</tbody>
</table>

---

Figure 6.8 Initial fluid resuscitation in shock.
• tracheal intubation and mechanical ventilation
• invasive monitoring of blood pressure
• inotropic support
• correction of haematological, biochemical and metabolic derangements
• support for renal or liver failure.

The febrile child

Most febrile children have a brief, self-limiting viral infection. Mild localised infections, e.g. otitis media or tonsillitis, may be diagnosed clinically. The clinical problem lies in identifying the relatively few children with a serious invasive bacterial infection which needs prompt treatment.

Factors which need to be considered are:
• past medical history
• illness of other family members
• if a specific illness is prevalent in the community

Initial assessment, investigations and management

Some diagnostic clues to evaluating the febrile child are shown in Figures 6.9 and 6.10. Infants and toddlers often present with non-specific signs. If they are suspected of having a severe bacterial infection, urgent investigations called a septic screen (Box 6.3) are performed and intravenous antibiotic therapy given immediately to avoid the illness becoming more severe and to prevent rapid spread to other sites of the body. In febrile infants less

The febrile child

Upper respiratory tract infection
Very common, may be coincidental with another more serious illness

Otitis media
Always examine tympanic membranes in febrile children

Tonsillitis
Erythema or exudate on the tonsils

Stridor
Epiglottitis? Viral croup? Bacterial tracheitis?

Pneumonia
In infants, only raised respiratory rate and increased respiratory effort may be present, with no abnormality on auscultation – diagnosis may require chest x-ray

Septicaemia
Can be difficult to recognise in absence of rash before shock develops. Need to start antibiotics on clinical suspicion without waiting for culture results

Meningitis/encephalitis
Lethargy, loss of interest in surroundings, drowsiness or unconscious or seizures. Neck stiffness, arching of the back, bulging fontanelle, positive Kernig’s sign (pain on leg straightening)? Only non-specific symptoms and signs may be present in young children < 18 months

Seizure
Febrile convulsion? Meningitis? Encephalitis?

Periorbital cellulitis
Redness and swelling of the eyelids. May spread to orbit of the eye

Rash
Viral exanthem? Purpura from meningococcal infection (Fig.6.10)?

Urinary tract infection
Urine sample needed for any seriously ill young child or any febrile illness that does not settle

Abdominal pain
Appendicitis? Pyelonephritis? Hepatitis?

Diarrhoea
Gastroenteritis? Fever with blood and mucus in the stool: Shigella, Salmonella or Campylobacter

Osteomyelitis or septic arthritis
Suspect if painful bone or joint or reluctance to move limb

Prolonged fever
Bacterial infection e.g. UTI, bacterial endocarditis Other infections – viral, fungal, protozoal Kawasaki’s disease Drug reaction Malignant disease Connective tissue disorder

Figure 6.9 Some diagnostic clues to evaluating the febrile child.
than 2 months old, identifying serious bacterial infection is unreliable from clinical examination alone, and a septic screen and antibiotic therapy are indicated. Other factors which influence the selection of which children to investigate and treat are shown in Figure 6.11. Children who are not seriously ill can be managed at home with regular review by the parents as long as they are given clear instructions (e.g. what clinical features should prompt reassessment by a doctor).

**Figure 6.10** The glass test for meningococcal purpura. Parents are advised to suspect meningococcal disease if their child is febrile and has a rash that does not blanche when pressed under a glass. (Courtesy of Dr Parviz Habibi)

**Box 6.3  Septic screen**

- Full blood count including differential white cell count
- Blood culture
- Acute-phase reactant, e.g. C-reactive protein
- Urine for microscopy, culture and sensitivity
- CSF (unless contraindicated) for microscopy, culture and sensitivity
- Chest X-ray

**Summary**

**The febrile child:**
- upper respiratory tract infection (URTI) is an extremely common cause
- check for otitis media
- serious bacterial infection must be considered
- if fever in an infant is unexplained, exclude a urinary tract infection
- the younger the child the lower the threshold for performing a septic screen and starting antibiotics.

**Figure 6.11** Evaluation of the need for urgent investigation and treatment in the febrile child.

**Threshold for urgent investigation (septic screen) and intravenous antibiotics**

- **Low**
  - Young age (treat if <2 months old)
  - Systemically ill
  - High or prolonged fever
  - Features of potentially serious illness, e.g. osteomyelitis, septic arthritis, sepsicaemia, meningitis/encephalitis
  - No localising features
  - Predisposition to infection, e.g. immunodeficiency

- **High**
  - Older child
  - Not systemically ill
  - Low grade fever
  - No features of potentially serious illness
  - Localised, minor illness, e.g. URTI, otitis media
  - Normal child

**Factors indicative of illness severity**
Septicaemia

Bacteria may cause a focal infection or proliferate in the bloodstream, leading to septicaemia. In septicaemia, the host response includes the release of inflammatory cytokines and activation of endothelial cells which may lead to septic shock. The commonest cause of septic shock in childhood is meningococcal infection, which may or may not be accompanied by meningitis. Fortunately, its incidence in the UK has fallen markedly since immunisation was introduced. *Pneumococcus* is the commonest organism causing bacteraemia, but it is unusual for it to cause septic shock. In neonates, the commonest causes of septicaemia are group B streptococcus or Gram-negative organisms acquired from the birth canal.

Clinical features

See Box 6.4.

Management priorities

Children with septic shock will need to be rapidly stabilised and may require transfer to a paediatric intensive care unit.

Antibiotics

Choice depends on the child’s age and any predisposition to infection.

Fluids

Significant hypovolaemia is often present, owing to fluid maldistribution, which occurs due to the release of vasoactive mediators by host inflammatory and endothelial cells. There is loss of intravascular proteins and fluid which may occur due to the development of a ‘capillary leak’ caused by endothelial cell dysfunction. Circulating plasma volume is lost into the interstitial fluid. Central venous pressure monitoring and urinary catheterisation may be required to guide the assessment of fluid balance. Capillary leak into the lungs causes pulmonary oedema, which may lead to respiratory failure, necessitating mechanical ventilation.

Circulatory support

Myocardial dysfunction occurs as inflammatory cytokines and circulating toxins depress myocardial contractility. Inotropic support may be required.

Disseminated intravascular coagulation (DIC)

Abnormal blood clotting causes widespread microvascular thrombosis and consumption of clotting factors. If bleeding occurs, clotting derangement should be corrected with fresh frozen plasma and platelet transfusions.

Steroids

There is no evidence that steroids are of benefit in septic shock.

Summary

**Septicaemia:**
- the most common cause of septic shock in children is meningococcal disease
- may occur without meningitis
- early antibiotic therapy and fluid resuscitation are life-saving
- may need admission to paediatric intensive care for multi-organ failure.

Coma

In coma, there is disturbance of the functioning of the cerebral hemispheres and/or the reticular activating system of the brainstem. The level of awareness may range from excessive drowsiness to unconsciousness. It is assessed by rapidly using AVPU or the Glasgow Coma Scale (Table 6.2).

The immediate assessment of a child in coma is shown in Figures 6.12 and 6.13. The causes, clinical features and investigations of coma are listed in Table 6.3. In contrast to adults, most children have a diffuse metabolic insult rather than a structural lesion.

The history, examination and investigation of coma are directed towards the cause. Treatment should be directed to treatable causes, especially infection.

---

**Box 6.4 Clinical features of septicaemia**

<table>
<thead>
<tr>
<th>History</th>
<th>Examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever</td>
<td>Fever</td>
</tr>
<tr>
<td>Poor feeding</td>
<td>Purpuric rash</td>
</tr>
<tr>
<td>Miserable</td>
<td>(meningococcal septicaemia)</td>
</tr>
<tr>
<td>Lethargy</td>
<td>Irritability</td>
</tr>
<tr>
<td>History of focal infection, e.g.</td>
<td>Shock</td>
</tr>
<tr>
<td>meningitis, osteomyelitis,</td>
<td>Multi-organ failure</td>
</tr>
<tr>
<td>gastroenteritis, cellulitis</td>
<td></td>
</tr>
<tr>
<td>Predisposing conditions, e.g.</td>
<td></td>
</tr>
<tr>
<td>sickle cell disease,</td>
<td></td>
</tr>
<tr>
<td>immunodeficiency</td>
<td></td>
</tr>
</tbody>
</table>

---

**Coma**

In coma, there is disturbance of the functioning of the cerebral hemispheres and/or the reticular activating system of the brainstem. The level of awareness may range from excessive drowsiness to unconsciousness. It is assessed by rapidly using AVPU or the Glasgow Coma Scale (Table 6.2).

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The history, examination and investigation of coma are directed towards the cause. Treatment should be directed to treatable causes, especially infection.
Initial assessment and management of coma

**Primary assessment and resuscitation**

- **Airway** – is it secure?
- **Breathing** – is respiratory effort sufficient?
- **Circulation** – treat shock
- **Disability** – check blood glucose
  - AVPU or Glasgow Coma Scale
- **Exposure** – e.g. look for meningococcal purpuric rash

**Secondary assessment and emergency treatment**

**Examination**

- Is there raised intracranial pressure – abnormal breathing, posture, pupils (Fig. 6.13), fundi (papilloedema or retinal haemorrhages)?
- Bradycardia and hypertension suggest impending brain stem herniation

Treat the treatable:

- hypoglycaemia
- poisoning
- diabetes mellitus
- septicaemia/meningitis
- herpes simplex encephalitis

Intubate and ventilate if necessary, transfer to paediatric/neurosurgical intensive care unit

<table>
<thead>
<tr>
<th>Table 6.2 Glasgow Coma Scale, incorporating Children’s Coma Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Glasgow Coma Scale</strong></td>
</tr>
<tr>
<td><strong>(4-15 years)</strong></td>
</tr>
<tr>
<td><strong>Response</strong></td>
</tr>
<tr>
<td>Eyes</td>
</tr>
<tr>
<td>Open spontaneously</td>
</tr>
<tr>
<td>Verbal command</td>
</tr>
<tr>
<td>Pain</td>
</tr>
<tr>
<td>No response</td>
</tr>
<tr>
<td><strong>Best motor response</strong></td>
</tr>
<tr>
<td>Verbal command</td>
</tr>
<tr>
<td>Obeys</td>
</tr>
<tr>
<td>Localises pain</td>
</tr>
<tr>
<td>Withdraws</td>
</tr>
<tr>
<td>Abnormal flexion</td>
</tr>
<tr>
<td>Extension</td>
</tr>
<tr>
<td>No response</td>
</tr>
<tr>
<td>Painful stimulus</td>
</tr>
<tr>
<td>Oriented and converses</td>
</tr>
<tr>
<td>Disoriented and converses</td>
</tr>
<tr>
<td>Inappropriate words</td>
</tr>
<tr>
<td>Incomprehensible sounds</td>
</tr>
<tr>
<td>No response</td>
</tr>
<tr>
<td><strong>Best verbal response</strong></td>
</tr>
<tr>
<td>Oriented and converses</td>
</tr>
<tr>
<td>Smiles, orientated to sounds, follows objects, interacts</td>
</tr>
<tr>
<td>Disoriented and converses</td>
</tr>
<tr>
<td>Inappropriate words</td>
</tr>
<tr>
<td>Incomprehensible sounds</td>
</tr>
<tr>
<td>No response</td>
</tr>
</tbody>
</table>

A score of <8 out of 15 means that the child’s airway is at risk and will need to be maintained by a manoeuvre or adjunct.

**Figure 6.12** Initial assessment and management of coma.

**Figure 6.13** Pupillary signs in coma.
<table>
<thead>
<tr>
<th>Cause</th>
<th>History and examination</th>
<th>Diagnostic investigations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infection</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meningitis or meningococcal</td>
<td>Fever</td>
<td>Full blood count</td>
</tr>
<tr>
<td>Meningococcal purpura</td>
<td>Irritability, lethargy, drowsiness</td>
<td>Culture of blood, urine, infected sites, CSF (unless contraindicated) for bacteria and viruses</td>
</tr>
<tr>
<td>Rash</td>
<td>Poor feeding</td>
<td>Acute-phase reactant</td>
</tr>
<tr>
<td>Seizures</td>
<td>Overseas travel</td>
<td>Rapid bacterial antigen/PCR tests for organisms</td>
</tr>
<tr>
<td><strong>Metabolic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>Previously diagnosed diabetes mellitus</td>
<td>Blood glucose, plasma electrolytes</td>
</tr>
<tr>
<td>Diabetic ketoacidosis</td>
<td>Diabetic ketoacidosis</td>
<td>Urine for glucose and ketones</td>
</tr>
<tr>
<td><strong>Inborn errors of metabolism</strong></td>
<td></td>
<td>Blood glucose, plasma electrolytes</td>
</tr>
<tr>
<td>Previous history of loss of consciousness</td>
<td>Sudden collapse</td>
<td>Blood gas analysis</td>
</tr>
<tr>
<td>Consanguinity</td>
<td>Developmental delay</td>
<td>Blood ammonia, lactate</td>
</tr>
<tr>
<td>Death or illness of siblings</td>
<td>Hepatomegaly</td>
<td>Plasma amino acids</td>
</tr>
<tr>
<td><strong>Hepatic failure</strong></td>
<td>Jaundice</td>
<td>Abnormal liver function tests</td>
</tr>
<tr>
<td>Abnormal bleeding</td>
<td></td>
<td>Prolonged prothrombin time</td>
</tr>
<tr>
<td><strong>Acute renal failure</strong></td>
<td>Oliguria</td>
<td>Abnormal creatinine</td>
</tr>
<tr>
<td>Hypertension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any acutely ill child</td>
<td>Known diabetes mellitus</td>
<td>Low blood glucose</td>
</tr>
<tr>
<td>Sudden onset of coma</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Poisoning</strong></td>
<td>Accidental – poison usually identified</td>
<td>Toxicology screen</td>
</tr>
<tr>
<td>Deliberate – tablets may be found, also illicit drugs and alcohol</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Status epilepticus or post-ictal</strong></td>
<td>Past history of seizures</td>
<td>Blood glucose</td>
</tr>
<tr>
<td>Neuroradiological lesions on the skin</td>
<td>Developmental delay</td>
<td>Blood gas analysis</td>
</tr>
<tr>
<td>Ongoing seizure activity, e.g. abnormal eye movements</td>
<td>Focal neurological signs</td>
<td></td>
</tr>
<tr>
<td><strong>Trauma – accidental/ non-accidental</strong></td>
<td>History of road traffic accident, fall, etc.</td>
<td>Radiological – plain X-rays or CT/MRI scans</td>
</tr>
<tr>
<td>Bruising, haemorrhage</td>
<td>Fractures – cervical spine, etc.</td>
<td></td>
</tr>
<tr>
<td>Focal neurology</td>
<td>Retinal haemorrhages</td>
<td></td>
</tr>
<tr>
<td><strong>Intracranial tumour or haemorrhage/infarct/ abscess</strong></td>
<td>Raised intracranial pressure: • headache worse on lying down • early morning vomiting • focal neurological signs, e.g. squint, ataxia • personality change • papilloedema/retinal haemorrhage • hypertension</td>
<td>Cranial CT/MRI scan Coagulation screen Screen for procoagulant disorders (protein C and S deficiency) Echocardiogram to exclude infective endocarditis</td>
</tr>
<tr>
<td><strong>Hypertension</strong></td>
<td>Symptoms and signs of raised intracranial pressure</td>
<td>Left ventricular hypertrophy on ECG or echocardiography</td>
</tr>
</tbody>
</table>
Status epilepticus

This is a seizure lasting 30 minutes or longer, or when successive seizures occur so frequently that the patient does not recover consciousness between them. After immediate primary assessment and resuscitation, the priority is to stop the seizure as quickly as possible (Fig. 6.14).

Management protocol for status epilepticus

1. Airway, Breathing, Circulation
2. Check blood glucose
   - If blood glucose is <3 mmol/L, give glucose IV and recheck blood glucose
3. Vascular access
   - Lorazepam 0.1 mg/kg IV
   - No response in 10 min
   - Stop fitting with anticonvulsant
4. Dexamethasone 0.1 mg/kg IV
   - No response in 10 min
   - diazepam 0.5 mg/kg PR or midazolam (buccal) 0.5 mg/kg
   - IV access
   - Lorazepam 0.1 mg/kg IV
   - No response in 10 min
   - Call senior help
   - Call anaesthetist or intensivist
   - Rapid-sequence induction with thiopentone
   - Mechanical ventilation
   - Transfer to PICU

All these drugs may cause or compound preexisting respiratory depression, and mechanical ventilation may be required.

Figure 6.14 Management protocol for status epilepticus. (Adapted from Advanced Paediatric Life Support, BMJ Publishing Group, London, 2005.)
**Anaphylaxis**

In children, the most common causes are ingestion or contact with nuts, egg, milk or drugs. Urticaria and angioedema causing facial swelling are treated with an oral antihistamine (e.g. chlorphenamine) and observed over 2 hours for possible complications. Anaphylaxis is life-threatening, from laryngeal oedema, bronchoconstriction and shock. Its management is outlined in Figure 6.15. Children who have had a serious allergic reaction should carry an epinephrine (adrenaline) auto-injector (e.g. Epipen) with them so that treatment can be initiated immediately.

**Immediate management of anaphylaxis**

1. **History compatible with severe allergic reaction**
   - Stridor, wheeze, respiratory distress or shock
   - +/- urticaria

2. **Evaluate ABC**
   - Oxygen if available

3. **Epinephrine (adrenaline) IM**
   - (If profound shock – consider slow IV infusion of epinephrine (adrenaline) wheeze)
   - If stridor – consider inhaled epinephrine (adrenaline) salbutamol

4. **Repeat epinephrine (adrenaline) IM in 5 minutes**
   - If no improvement
   - If shock – give 20 ml/kg IV fluids

5. **Antihistamine (chlorphenamine) IM**
   - Hydrocortisone IM or slow IV

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**Apparent life-threatening events (ALTE)**

These occur in infants and are a combination of apnoea, colour change, alteration in muscle tone, choking or gagging, which are frightening to the observer. They may occur on more than one occasion. ALTEs may be the presentation of a potentially serious disorder, although often no cause is identified.

Management requires a detailed history and thorough examination to identify problems with the baby or in care-giving. The infant should be admitted to hospital. Causes and investigations to be considered are listed in Box 6.5. Multi-channel overnight monitoring is usually indicated.

In most, the episode is brief, with rapid recovery, and the baby is well clinically. Baseline investigations and overnight monitoring of oxygen saturation, respiration and ECG are found to be normal. The parents should be taught resuscitation and will find it helpful to receive follow-up from a specialist paediatric nurse and paediatrician.

Detailed specialist investigation and assessment will be required if clinical, biochemical or physiological abnormalities are identified.

**The death of a child**

The risk of death is four times greater during infancy than at any other age in childhood. In many, a serious condition will have been diagnosed before or after birth, such as a congenital abnormality or complications of prematurity. Deaths which occur suddenly and unexpectedly in infancy are known as sudden unexpected death in infancy (SUDI). In some, a previously undiagnosed congenital abnormality, e.g. congenital heart disease, will be found at autopsy. Rarely, an inherited metabolic
disorder is identified, in particular the fatty acid oxidation defect medium-chain acyl-CoA dehydrogenase deficiency (MCAD), which can very rarely result in sudden death in infants, but is increasingly identified in the UK from routine biochemical screening (Guthrie test) as the test for this disorder is being introduced more widely. After 1 month of age, in most instances of sudden and unexplained death, no cause is identified and the death is classified as sudden infant death syndrome (SIDS). The vast majority of such deaths, even when occurring several times in the same family, are due to natural causes. Rarely, the death may be due to suffocation or other forms of non-accidental injury. In 2003, in the UK, three mothers imprisoned after the loss of more than one infant had their convictions overturned. This followed concern about the standard of proof required from medical expert witnesses in the absence of eye witness evidence of harmful conduct and about the quality of the procedures adopted during the investigation of the deaths. Since then, new procedures have been recommended in order to prevent unwarranted incrimination of parents whilst also protecting other infants and children in the family from risk of injury.

**Sudden infant death syndrome**

This is defined as the sudden and unexpected death of an infant or young child for which no adequate cause is found after a thorough postmortem examination. There is marked variation in the incidence of SIDS in different countries, suggesting that environmental factors are important (Box 6.6). SIDS occurs most commonly at 2–4 months of age (Fig. 6.16). The risk for subsequent children is slightly increased.

In the UK, the incidence of SIDS has fallen dramatically during the last few years (Fig. 6.17), coinciding with a national ‘Back to Sleep’ campaign (Fig. 6.18). This advocates that:

- infants should be put to sleep on their back (not their front or side)
- overheating by heavy wrapping and high room temperature should be avoided
- infants should be placed in the ‘feet to foot’ position
- parents should not smoke near their infants

**Box 6.6** Factors associated with SIDS (based on data from Fleming P et al, *Sudden unexpected deaths in infancy*, The Stationery Office, London, 2000, with permission)

### The infant

- Age 1–6 months, peak at 12 weeks
- Low birthweight and preterm (but 60% are normal birthweight term infants)
- Sex (boys 60%)
- Multiple births

### The parents

- Low income*
- Poor or overcrowded housing
- Maternal age (mother aged <20 years has three times the risk of a mother aged 25–29 years, but 80% of affected mothers are >20 years old)*
- Single unsupported mother (twice the rate of supported mothers)
- High maternal parity*
- Maternal smoking during pregnancy (1–9 cigarettes/day doubles the risk; >20/day increases the risk fivefold)*
- Parental smoking after baby’s birth

### The environment

- The infant sleeps lying prone
- The infant is overheated from high room temperature and too many clothes and covers, particularly when ill

*Three of these four factors are present in over 40% of SIDS but only 8% of control families.

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**Figure 6.16** Age distribution of SIDS. (Based on data from Fleming P et al, *Sudden unexpected deaths in infancy*, The Stationery Office, London, 2000, with permission.)

**Figure 6.17** Decline in the number of deaths from SIDS in the UK from 1.9/1000 live births in 1989 to 0.41 in 2004.
parents should seek medical advice promptly if their infant becomes unwell
parents should have the baby in their bedroom for the first 6 months of life
parents should avoid bringing the baby into their bed when they are tired or have taken alcohol, sedative medicines or drugs
parents should avoid sleeping with their infant on a sofa, settee or armchair.

Following the sudden death of a child
The sudden death of a child is one of the most distressing events that can happen to a family. If close family members are absent, arrangements should be made for them to come, if this is possible. The family should be spoken to sympathetically and in private (see Ch. 5). An outline of the recommended management after an infant has died suddenly and unexpectedly is shown in Figure 6.19.

Summary

Sudden infant death syndrome (SIDS):
- is the commonest cause of death in children aged 1 month to 1 year
- the peak age is 2–4 months
- has been dramatically reduced by lying babies on their back to sleep.

Following an unexpected death:
- the parents should be offered the opportunity to see and hold their child
- the coroner must be informed and a postmortem performed
- the parents should be informed about the postmortem, that investigations will be performed and that the police will be involved and reassured that this is standard practice
- follow-up and bereavement counselling should be offered.
### Management of the sudden unexpected death of an infant

| Resuscitation | Infant found dead at home – take to Accident and Emergency Department
<table>
<thead>
<tr>
<th></th>
<th>Initiate resuscitation unless inappropriate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Care of parents</td>
<td>Should be cared for by specific member of staff</td>
</tr>
<tr>
<td></td>
<td>History should be obtained</td>
</tr>
<tr>
<td>Baby pronounced dead</td>
<td>Detailed clinical examination by consultant</td>
</tr>
<tr>
<td></td>
<td>Remove endotracheal tube and intraosseous needles but retain venous lines</td>
</tr>
<tr>
<td></td>
<td>Retain child’s clothes and any bedding and nappy for police</td>
</tr>
<tr>
<td></td>
<td><strong>Investigations performed:</strong></td>
</tr>
<tr>
<td></td>
<td>• Nasopharyngeal aspirate for virology and bacteriology</td>
</tr>
<tr>
<td></td>
<td>• Blood for toxicology, metabolic screen (on Guthrie card), chromosomes if dysmorphic</td>
</tr>
<tr>
<td></td>
<td>• Blood culture</td>
</tr>
<tr>
<td></td>
<td>• Urine (catheter specimen) – for biochemistry, toxicology and freeze immediately</td>
</tr>
<tr>
<td></td>
<td>• Lumbar puncture – CSF for virology and routine culture, if clinically indicated</td>
</tr>
<tr>
<td></td>
<td>SUDI paediatrician, coroner, police and primary care team and other healthcare professionals informed</td>
</tr>
<tr>
<td>Breaking the news to the parents</td>
<td>Performed by the paediatrician. Explain that the police and coroner will be involved, a post-mortem is required, tissue blocks and slides will be taken and retained permanently as part of the medical record.</td>
</tr>
<tr>
<td></td>
<td>Give parents the opportunity to donate tissues and organs</td>
</tr>
<tr>
<td></td>
<td>Inform them that the involvement of the police does not imply that they are being blamed for their child’s death</td>
</tr>
<tr>
<td>Parents offered to see and hold their baby</td>
<td>Parents should be offered the opportunity to see and hold their child. Encourage as helps them accept the reality of their child’s death. They may wish to see the child again within the next few days. The family may wish a minister of religion to be called.</td>
</tr>
<tr>
<td>Initial strategy discussion</td>
<td>SUDI paediatrician and supervising police officer</td>
</tr>
<tr>
<td></td>
<td>Social services review to identify if previously involved or any child protection issues</td>
</tr>
<tr>
<td>Home visit within 24 hours</td>
<td>Police visit the home to talk with the parents and examine the place where the baby died</td>
</tr>
<tr>
<td></td>
<td>SUDI paediatrician may also attend</td>
</tr>
<tr>
<td></td>
<td>Detailed history obtained</td>
</tr>
<tr>
<td></td>
<td>Report compiled for the coroner</td>
</tr>
<tr>
<td>Post-mortem</td>
<td>Performed by paediatric pathologist</td>
</tr>
<tr>
<td></td>
<td>Preliminary post-mortem result</td>
</tr>
<tr>
<td>Case discussion</td>
<td>Multi-agency meeting, including SUDI paediatrician, police, GP/health visitor and, where appropriate, the social worker</td>
</tr>
<tr>
<td></td>
<td>All relevant information reviewed</td>
</tr>
<tr>
<td></td>
<td>Possibility of abuse or neglect considered</td>
</tr>
<tr>
<td></td>
<td>Report is sent to the coroner</td>
</tr>
<tr>
<td></td>
<td>Paediatrician writes a detailed letter to the parents providing information about the cause of the infant’s death and arranges to meet them</td>
</tr>
<tr>
<td>Follow-up and bereavement counselling</td>
<td>Follow-up to provide family an opportunity to discuss the final results of the postmortem and consider its implications for future pregnancies. Genetic counselling may be indicated.</td>
</tr>
<tr>
<td></td>
<td>Bereavement counselling – available from health professionals and other agencies</td>
</tr>
</tbody>
</table>

**Figure 6.19** A recommended approach to the management of the sudden unexpected death of an infant. There are local variations in its implementation. (Adapted from *Sudden Unexpected Death in Infancy*. RCPCH, London, 2004.)
Further reading


Resuscitation Council (UK) 2005 Updated guidelines on paediatric life support