I. Introduction

Obstruction of the upper airway (larynx and trachea) is potentially life-threatening. The cardinal feature is stridor (a harsh noise during inspiration), which is due to narrowing of the air passage in the oropharynx, subglottis or trachea. If the obstruction is below the larynx, stridor may also occur during expiration. Like the wheeze in asthma, the loudness of the stridor does not indicate the severity of the obstruction. There may also be hoarseness and a barking or seal-like cough. The severity of the obstruction is best assessed by the degree of sternal and subcostal recession, and the respiratory and heart rate. Increasing agitation or drowsiness, or central cyanosis, indicates severe hypoxaemia and hypercapnia and the need for urgent intervention.

II. Differential diagnosis of upper airway obstruction

1. Collapse of airway due to muscle tone loss or build-up of secretions due to poor cough reflex:
   - Depressed conscious level from any cause.
   - Drug or alcohol intoxication or overdose.
   - Bulbar palsy.
   - Myopathy.

2. Airway inflammation and oedema:
   - Infective:
     - Upper respiratory tract infection in an infant.
     - Viral croup.
     - Bacterial tracheitis.
     - Epiglottitis.
     - Severe tonsillitis.
   - Non-infective:
     - Recurrent croup.
     - Anaphylaxis.

3. Space-occupying lesion or structural abnormality:
   - Intranasal, pharyngeal or in upper trachea:
     - Adenoidal hypertrophy.

III. Croup

Croup is a condition characterised by inspiratory stridor, hoarse voice, barking cough and a variable degree of respiratory distress.

- Acute viral laryngotracheobronchitis (viral croup).
  This is the commonest type of laryngotracheal infection (representing over 95% of cases). Peak incidence is in the second year of life, and most hospital admissions are between 6 months and 5 years of age. The stridor is usually preceded by fever (<38.5°C) with coryza, and symptoms tend to be worse at night. If narrowing is minor, the stridor will be present only when the child hyperventilates or is upset. As the narrowing progresses, the stridor becomes both inspiratory and expiratory, and is present even when the child is at rest. Children under 3 years in particular may develop features of increasing obstruction and hypoxaemia with marked sternal and subcostal recession, tachycardia and agitation. If the infection extends distally to the bronchi, wheeze may also be audible.

- Recurrent or spasmodic croup. Some children have repeated episodes of croup without preceding fever and coryza. The symptoms are of sudden onset at night, and often persist for only a few hours. The condition is associated with atopic disease (e.g. asthma, eczema, hay fever). The episodes can be severe, but are more commonly self-limiting.

- Bacterial tracheitis or pseudomembranous croup.
  This dangerous condition is one of the important complications of measles but may occur without that antecedent. Infection of the tracheal mucosa with Streptococcus pneumoniae, Staphylococcus aureus or Haemophilus influenzae B results in copious purulent secretions and mucosal necrosis. The child appears...
toxic with a high fever, with marked signs of respiratory obstruction. In the UK, over 80% of these children need intubation and ventilatory support to maintain an adequate airway. The croupy cough and the absence of drooling help to distinguish this condition from epiglottitis. Clinical and radiological signs of segmental collapse and consolidation related to bronchial occlusion are usual. The cough is often persistent and ineffective in clearing the secretions, the illness has a prolonged course, and the restoration of normal mucosa usually takes several weeks. The condition is much less common than the two preceding ones.

Emergency treatment of croup

- These children (and their parents) may be very frightened. Do not alarm them further by putting instruments in the child’s throat, by giving painful injections or by trying to place an IV cannula. Crying increases their oxygen demand and may increase laryngeal obstruction and even cause total airway obstruction. Keep the child on their parent’s lap and explain the condition and the treatment. Tell the mother to alert the nurses or doctors if the child breathes more quickly or has marked sternal recession. These are danger signs for hypoxaemia.

- Ensure adequate oral fluid intake.

Many children who are admitted to hospital have hypoxaemia. Humidified oxygen should be given through nasal cannulae or a face mask held just in front of the child’s face. Do not use nasopharyngeal catheters to give oxygen, as this can frighten the child.

Crying increases their respiratory distress, and even cause total airway obstruction. In the UK, over 80% of these children need intubation. This should be done by an anaesthetist. Monitor the oxygen saturation with an oxygen monitor. If the foreign body is causing symptoms of stridor, coughing and respiratory distress, emergency management of choking is required (see Section 1.12 on Basic Life Support, which describes acute choking management).

Inhaled foreign body (see Section 5.2.C)

Suspect the diagnosis if there has been a sudden onset of cough and stridor in a well child. Ask the parents and child whether there has been any access to peanuts or other food, toys or other small objects that could have been put in the mouth.

Management

If the foreign body is causing symptoms of stridor, coughing and respiratory distress, emergency management of choking is required (see Section 1.12 on Basic Life Support, which describes acute choking management). In addition, call an ENT surgeon for laryngoscopy (if available). A laryngeal foreign body may present very acutely with cyanosis or loss of consciousness. Therefore urgent direct laryngoscopy may be necessary. In the absence of an ENT surgeon, tracheostomy or cricothyrotomy may be necessary (see Section 8.2 for cricothyrotomy procedure).

**TABLE 5.1.A.1 Severity of croup**

<table>
<thead>
<tr>
<th>Sign</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper airway noise</td>
<td>Hoarse voice, barking cough, mild stridor intermittently on inspiration only</td>
<td>As before, with stridor constant and also some on expiration</td>
<td>Stridor usually decreases as exhaustion occurs</td>
</tr>
<tr>
<td>Effort of breathing</td>
<td>Mild increase, some intercostal recession</td>
<td>Further increase in effort, nasal flare, tracheal tug, accessory muscle usage</td>
<td>Major increase in effort gives way to exhaustion and poor but gasping effort</td>
</tr>
<tr>
<td>Efficacy of breathing</td>
<td>Not distressed by effort. No cyanosis, SaO2 may be normal</td>
<td>Distressed by effort. Cyanosis not usually visible but SaO2 is low</td>
<td>Cyanosis visible if haemoglobin is in normal range, SaO2 is very low</td>
</tr>
<tr>
<td>Conscious level</td>
<td>Alert, usually still playing</td>
<td>Anxious and distressed. Not playing, little interaction, drowsy</td>
<td>Conscious level severely reduced, causing respirations to slow, reflex gasps and apnoeas</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>Mild increase in heart rate</td>
<td>Rapid heart rate</td>
<td>Severe tachycardia progresses to bradycardia and hypoxic cardiac arrest</td>
</tr>
</tbody>
</table>

**Emergency treatment of croup**

- These children (and their parents) may be very frightened. Do not alarm them further by putting instruments in the child’s throat, by giving painful injections or by trying to place an IV cannula. Crying increases their oxygen demand and may increase laryngeal obstruction and even cause total airway obstruction. Keep the child on their parent’s lap and explain the condition and the treatment. Tell the mother to alert the nurses or doctors if the child breathes more quickly or has marked sternal recession. These are danger signs for hypoxaemia.

- Ensure adequate oral fluid intake.

Many children who are admitted to hospital have hypoxaemia. Humidified oxygen should be given through nasal cannulae or a face mask held just in front of the child’s face by the parent. Do not use nasopharyngeal catheters to give oxygen, as these can precipitate dangerous paroxysms of coughing and total airway obstruction.

Milder cases of croup should not routinely be given oxygen, as this can frighten the child.

- Croup can be a very painful condition. Even if the child does not have a high temperature, prescribe regular paracetamol, but do not force the child to take this.

- There is very good evidence that steroids help. Children with mild, moderate or severe croup all benefit from steroids. Give 0.6 mg/kg dexamethasone once or twice a day. This should be given orally, as it works just as well as if given parenterally. If the child vomits, repeat it or give the same dose intramuscularly. An expensive but effective treatment is nebulised budesonide 2 mg in 2 mL; it may be repeated 30–60 minutes later.

- Nebulised adrenaline (5 mL of 1 in 1000 adrenaline nebulised, preferably with oxygen) will bring rapid and effective relief for severe croup. The relief lasts only for about 1 hour, but it can be repeated (although the effect diminishes), and this treatment gives the steroids time to start working. Arrange for the child to be seen quickly by an anaesthetist. Monitor the oxygen saturation with a pulse oximeter.

- A few children need intubation. This should be done under general anaesthetic. If there is doubt about the diagnosis, or difficulty in intubation is anticipated, an ENT surgeon capable of performing a tracheostomy should be present. In intubated children, 1 mg/kg prednisolone every 12 hours reduces the duration of intubation.

- Severely ill or toxic children and those with measles croup should receive an antibiotic effective against Streptococcus pneumoniae, Haemophilus influenzae and Staphylococcus aureus. If available, cefuroxime 150 mg/kg/day in four doses IV or ceftriaxone 80 mg/kg IV or IM once daily. An alternative is chloramphenicol 25 mg/kg IV 8-hourly.

Inhaled foreign body (see Section 5.2.C)

Suspect the diagnosis if there has been a sudden onset of cough and stridor in a well child. Ask the parents and child whether there has been any access to peanuts or other food, toys or other small objects that could have been put in the mouth.

Management

If the foreign body is causing symptoms of stridor, coughing and respiratory distress, emergency management of choking is required (see Section 1.12 on Basic Life Support, which describes acute choking management). In addition, call an ENT surgeon for laryngoscopy (if available). A laryngeal foreign body may present very acutely with cyanosis or loss of consciousness. Therefore urgent direct laryngoscopy may be necessary. In the absence of an ENT surgeon, tracheostomy or cricothyrotomy may be necessary (see Section 8.2 for cricothyrotomy procedure).
Acute epiglottitis
This is a severe infection caused by Haemophilus influenzae. Peak incidence is at 2–3 years of age. It is less common than croup, but important, as the diagnosis needs to be made fast because rapid progression of stridor in the ill toxic child may be fatal within hours if not promptly treated. Cough is not a prominent feature, and the stridor has a soft quality, often with an expiratory component. The child tends to drool and assume an upright posture.

Unlike croup, epiglottitis is always severe and progression is rapid. It is always a medical emergency. Fortunately, since the introduction of Haemophilus influenzae type B (HiB) vaccine the disease has become much less common in those countries where the vaccine is used.

**Management**
- Elective intubation under general anaesthetic is the treatment of choice. Often a much smaller diameter than the usual endotracheal tube for the child’s age will be needed because the airway is so swollen internally. The endotracheal tube still needs to be the right length for the child’s age. This is why children’s endotracheal tubes should not be pre-cut to size. The diagnosis is confirmed by laryngoscopy under general anaesthetic or by laryngoscopy under general anaesthetic just prior to intubation (‘cherry-red epiglottis’). An ENT surgeon must be present if possible.
- While the child is anaesthetised, the following procedures should be performed: blood cultures, throat swab and IV line.
- Recommended antibiotic therapy is chloramphenicol 50mg/kg IV immediately, then 25mg/kg IV 6-hourly. If available, ceftriaxone or cefotaxime 50mg/kg IV 6-hourly or ceftriaxone 80mg/kg once daily IV or IM should be effective.
- Following intubation the child will be able to breathe humidified air spontaneously, ideally with nasal continuous positive airway pressure (CPAP) (see Section 1.25 and 8.3). Sedation (discuss with anaesthetist) may be required in order to prevent self-extubation, but the child will then usually require assisted ventilation. Most children will be ready for extubation after 48 hours.

An alternative is to fix the child’s arms to their thorax using a bandage to stop them pulling out the endotracheal tube but the stress to the child caused by this may have a deleterious effect on recovery. If possible, have a relative sit with the child to reassure them.

**Angioneurotic oedema**
See Section 5.1.B on anaphylaxis. There are usually areas of painless swelling obvious in other areas of skin and mucous membranes. The eyes, lips and tongue are particularly likely to be affected. Stridor is caused by laryngeal oedema.

**Management**
- Give adrenaline, 10 micrograms/kg IM.
- Give adrenaline, 5mL of 1 in 1000 nebulised with 100% oxygen.
- Give 100% oxygen.
- Give hydrocortisone, 4mg/kg IV over 15 minutes or IM and repeat 8 hourly as required.
- Give chlorphenamine, 250 micrograms/kg IV or orally (maximum dose 2.5mg) or
  - 6 months to 6 years 2.5mg and repeat up to 4 times in 24 hours
  - 6–12 years 5mg and repeat up to 4 times in 24 hours
  - 12–18 years 10mg and repeat up to 4 times in 24 hours
- Give Ringer-lactate or Hartmann’s solution or 4.5% albumin (if available), 10–20mL/kg, if the child is shocked.
- Intubation or even tracheostomy may be required (contact the ENT team).

**Airway/inhalational burns (see Section 7.3.1.b)**
Such burns are caused by inhalation of hot gases or toxic vapours. They may be associated with extensive skin burns. Be aware that airway obstruction may develop even if it is not obvious on first assessment.

**Management**
- Admit the child to a high-dependency unit (if available).
- Give hydrocortisone, 4 mg/kg IV 6-hourly.
- Give Ringer-lactate or Hartmann’s solution or 4.5% albumin boluses (10–20mL/kg) for shock as required.
- Intubation or tracheostomy may be necessary if indicated by assessment.

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### TABLE 5.1.A.1  Contrasting features of croup and epiglottitis

<table>
<thead>
<tr>
<th>Feature</th>
<th>Croup</th>
<th>Epiglottitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset</td>
<td>Over days</td>
<td>Over hours</td>
</tr>
<tr>
<td>Preceding coryza</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Cough</td>
<td>Severe, barking</td>
<td>Absent or slight</td>
</tr>
<tr>
<td>Able to drink</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Drooling saliva</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Appearance</td>
<td>Unwell</td>
<td>Toxic, very ill</td>
</tr>
<tr>
<td>Fever</td>
<td>38.5°C</td>
<td>38.5</td>
</tr>
<tr>
<td>Stridor</td>
<td>Harsh, rasping</td>
<td>Soft</td>
</tr>
<tr>
<td>Voice muffled</td>
<td>Hoarse</td>
<td>Reluctant to speak</td>
</tr>
<tr>
<td>Need for intubation</td>
<td>1%</td>
<td>80%</td>
</tr>
</tbody>
</table>
Diphtheria (see Section 6.1.C for further details on management)

Diphtheria is characterised by gradual onset of stridor in a child (usually 2 to 3 years old) with neck oedema and ulcerating lesions of the tonsillar bed forming a grey membrane. Bleeding may occur at the site and down the nose. The diagnosis may be confirmed by throat swab and urgent Gram stain. There will usually be no evidence of DTP vaccination.

5.1.B The child with anaphylaxis

**BOX 5.1.B.1 Minimum standards**
- ABC of resuscitation.
- Adrenaline.
- Oxygen.
- Salbutamol by nebuliser or spacer.
- Hydrocortisone.
- Antihistamine.

**Introduction**

Anaphylaxis is an immunologically mediated reaction to ingested, inhaled or topical substances, which may progress to life-threatening shock and/or respiratory distress. Common causes include allergies to penicillin, anaesthetic agents, blood transfusion, radiographic contrast media, and certain foods, especially nuts.

Consider the diagnosis of anaphylaxis if any of the following symptoms are present when there is a history of previous severe reaction, rapidly progressive or increasingly severe symptoms, a history of asthma, eczema or rhinitis (atopy).

This situation is potentially life-threatening and may result in a change in conscious level, collapse, or respiratory or cardiac arrest.

**Management**

See Figure 5.1.B.1.

Remove the source of allergen if possible (e.g. take down the blood giving set if blood transfusion is the cause).

The key to anaphylaxis treatment is intramuscular adrenaline.

Remove allergen

Assess airway

Partial obstruction/stridor

Adrenaline 10 micrograms/kg IM (0.1 mL/kg of 1 in 10 000) Nebulised adrenaline 5 mL of 1 in 1000 Repeat nebuliser every 10 minutes as required Hydrocortisone 4 mg/kg initial dose, then 2–4 mg/kg 6-hourly

Intubation with cricoid pressure or surgical airway or laryngeal mask

Adrenaline IM 0.1 mL/kg of 1 in 10 000 Nebulised salbutamol 2.5 mg < 5 years; 5 mg if > 5 years Repeat nebuliser every 15 minutes as required Hydrocortisone 4 mg/kg initial dose, then 2–4 mg/kg 6-hourly Consider aminophylline 5 mg/kg IV over 30 minutes

Bag-mask ventilation

Assess breathing

Wheeze

Apnoea Adrenaline IM 0.1 mL/kg of 1 in 10 000 Nebulised salbutamol 2.5 mg < 5 years; 5 mg if > 5 years Repeat nebuliser every 10 minutes as required Hydrocortisone 4 mg/kg initial dose, then 2–4 mg/kg 6-hourly Consider aminophylline 5 mg/kg IV over 30 minutes

Bag–mask ventilation

Assess circulation

No pulse Basic and advanced life support

Ringer-lactate or Hartmann’s solution 10 – 20 mL/kg IV bolus, reassess and repeat as required up to 40 mL/kg

Reassess ABC

No problems

Chlorpheniramine three times a day for 48 hours to prevent recurrence

FIGURE 5.1.B.1 Pathway of care for anaphylaxis in a child. Note: Adrenaline should be repeated every 5 minutes. If repeated doses are ineffectual, use an IV infusion of adrenaline (see below)
Airway: assessment and resuscitation
- If there is no problem with the airway, assess breathing.
- If stridor is present there is obstruction (usually at the larynx):
  - Give 10 micrograms/kg adrenaline IM, then 5mL adrenaline 1 in 1000 nebulised.
  - Give 100% oxygen.
  - Consider intubation, and call for anaesthetic and ENT assistance.
- If there is stridor with complete obstruction, intubate or create a surgical airway (see Section 8.2).

Breathing: assessment and resuscitation
- If there is no problem with breathing, assess the circulation.
- If there is no breathing, give five rescue breaths using a bag-valve-mask with 100% oxygen and assess the circulation.
- If the child is wheezing, give 10 micrograms/kg adrenaline IM and salbutamol (either by nebuliser 2.5mg if under 5 years of age or 5mg if over 5 years, nebulised with 100% oxygen) or 1000 micrograms (5 puffs) of a metered dose inhaler via a spacer and repeated as required.

Circulation: assessment and resuscitation
- If there is no problem with the circulation, observe the child.
- If there is no pulse, start basic life support, assess the rhythm and treat.
- If the child is shocked, give 10 micrograms/kg adrenaline IM and 20mL/kg IV bolus of Ringer-lactate or Hartmann's solution. It may be necessary to give adrenaline IV if shock is present (see below for dosage).

Reassess ABC and continue to give 100% oxygen
- If there is airway deterioration, repeat IM adrenaline 10 micrograms/kg with or without intubation.
- If the child is still wheezy, repeat IM adrenaline 10 micrograms/kg and hydrocortisone 4mg/kg IV by slow injection. Consider giving aminophylline 5mg/kg by slow IV injection over 20–30 minutes followed by a 1mg/kg/hour IV infusion or salbutamol 4–6 micrograms/kg IV slow injection followed by an IV infusion of 0.5–2.0 micrograms/kg/minute.
- If the child is still shocked, repeat IM adrenaline 10 micrograms/kg and give a further bolus of 10mL/kg Ringer-lactate or Hartmann's solution. If there is a poor response then give a further 10mL/kg and consider giving an adrenaline infusion (see below). Intubation and ventilation may be needed if there is a poor response as now a total of 40mL/kg of crystalloids have been given by bolus.
- If there is no problem, observe the child.
- If there are no symptoms other than rash or itching:
  - Give oral antihistamine (chlorphenamine, 250 micrograms/kg).
  - Give oral steroids (0.5–1 mg/kg oral prednisolone).

Adrenaline
Adrenaline is given intramuscularly unless there is intracardiac shock or cardiac arrest, in which case it should be given IV or by the intra-osseous route.
- If repeated IM injections of adrenaline are not effective or last only a short time, start giving adrenaline IV. For treatment of children in severe shock:
  - Place 1mg (1 mL of 1 in 1000 adrenaline) in 50 mL of Ringer-lactate solution.
  - Then give 2–5 mL (40–100 micrograms) in a child (depending on size) and 1 mL (20 micrograms) in an infant under 1 year of age. Give IV slowly using a peripheral vein or ideally a central vein, if possible with ECG monitoring.
  - Repeat as required.
  - An infusion of adrenaline at 0.05–2.0 micrograms/kg/minute may be needed (preferably via a central vein and using a syringe pump).

5.1.C The child with tonsillitis, otitis media, mastoiditis or retropharyngeal abscess

BOX 5.1.C.1 Minimum standards
- Antibiotics: penicillin/amoxicillin/erythromycin.
- Quinolone antibiotic ear drops.
- Adrenaline nose drops.
- Wicking.

Tonsillitis
Tonsillitis is a common childhood disorder. The bacteria most commonly involved are beta-haemolytic streptococci, Streptococcus pneumoniae and Haemophilus influenzae, and around 50% of attacks are viral.
Classic symptoms include pyrexia and sore throat.
Swallowing solid food is difficult, and fluid intake must be encouraged. Painful cervical lymphadenopathy is the rule, and referred earache from the IXth cranial nerve is common. Febrile convulsions may occur in younger children, who may also present with acute abdominal pain without any throat symptoms, due to mesenteric lymphadenitis.

**Examination**
- Tender lymphadenopathy beneath and/or behind the mandible.
- Red enlarged tonsils with or without purulent exudate.

**Differential diagnosis**
Diphtheria and infectious mononucleosis (see Section 6.1.C for diphtheria and later in this section for infectious mononucleosis).

**Treatment**
- Give paracetamol (20 mg/kg 4- to 6-hourly) for pain relief. Bear in mind that attacks are often viral, and often antibiotics are not needed.
- Penicillin is still an effective antibiotic, and in serious cases in hospital give penicillin 12.5 mg/kg four times daily orally. If the child is allergic to penicillin, erythromycin may be used.
- Rarely there is acute partial airway obstruction due to massive tonsillar enlargement. In this case use IV benzylpenicillin 25 mg/kg 6-hourly and IV hydrocortisone 4–8 mg/kg, and then a further dose 4 hours later if needed at 4 mg/kg.

**Recurrent tonsillitis**
- If the number of attacks increases with age rather than decreasing, tonsillectomy is appropriate if it is safe to perform in the healthcare facilities available.
- As a rule of thumb, six attacks per year for 2 years over the age of 5 years could indicate a case for tonsillectomy.
- If the number of attacks increases with age rather than decreasing, tonsillectomy is appropriate if it is safe to perform in the healthcare facilities available.
- As a rule of thumb, six attacks per year for 2 years over the age of 5 years could indicate a case for tonsillectomy.
- It is often said that peritonsillar abscess (quinsy) is an indication, but one attack of quinsy is not enough to warrant the operation.

**Indications for tonsillectomy**
In the past, tonsillectomy was performed all too often. Sleep-related upper airway obstruction (see Section 5.1.D) is a good reason for undertaking tonsillectomy, and about 15% of tonsil operations are currently done for this reason.

**Peritonsillar abscess (quinsy)**
This is a complication of tonsillitis, and it presents with a unilateral swelling of the soft palate, deflecting the uvula to the opposite side, with associated trismus. Surgical drainage is often necessary as well as IV penicillin as described above.

**Acute suppurative otitis media (ASOM)**
Acute suppurative otitis media is a mucosal infection of the middle ear and mastoid air cells, arising via the Eustachian tube. *Streptococcus pneumoniae* and *Haemophilus influenzae* are the bacteria most commonly involved, and about 50% of cases are caused by viruses.

The symptoms are hearing loss, earache and fever. Pain is due to the bulging tympanic membrane from accumulated pus. Rupture leads to otomhoea with rapid symptom improvement. Localising signs may be absent in infants, who may present with fever and systemic illness. On examination the tympanic membrane is red and bulging.

**Treatment**
- Many cases of otitis media are incorrectly diagnosed: any child who is crying or has a fever will tend to have pink eardrums. Earache often presents at night. This is usually due to Eustachian tube obstruction occurring when the child is sleeping, from accumulated mucus in the postnasal space resulting in a negative pressure in the ear, which wakes the child up with discomfort. Paracetamol, plus sitting up and drinking, will open the Eustachian tube and thus relieve the symptoms. Antibiotics are unnecessary.
- In true otitis media with bulging eardrums, treat the child as an outpatient and always give an antibiotic as described below. It is not safe to withhold antibiotic treatment. Give oral amoxicillin 40 mg/kg twice a day for 7–10 days. If amoxicillin is not available give co-trimoxazole (trimethoprim 4 mg/kg/sulfamethoxazole 20 mg/kg twice a day) for 7–10 days.
- Paracetamol relieves pain and reduces fever.
- Ephedrine nose drops (0.5%) given 8-hourly for a maximum of 5 days may help to open the Eustachian tube and speed resolution.
- If the eardrum is perforated, the ear must be kept dry until the resulting perforation has healed. This is achieved by teaching the parent to undertake wicking as follows. Roll a clean soft absorbent cotton cloth or strong tissue paper into a wick. **Never use a cotton-tipped applicator, or flimsy paper that will fall apart in the ear, or a stick of any kind.** Place the wick in the ear and remove it after a few seconds, when it is wet. Repeat until the ear is dry. Wicking should be undertaken at least three times daily, usually for 1 to 2 weeks, until pus is no longer present. The parent must not leave anything in the ear after wicking, must not put oil or any other fluid in the ear, and should prevent the child from going swimming or putting their head under water until the ear has been dry for at least 2 weeks.
- Check that the child has recovered at follow-up 1 week later. If ear pain or discharge persists, treat the child for 5 more days with the same antibiotic and continue wicking the ear. Follow up in 5 days.

**Chronic otitis media**
If pus has been draining from the ear for 2 weeks or longer and there is perforation of the ear drum, the child has a chronic otitis media infection.

**Treatment**
- Treat as an outpatient.
- Keep the ear dry by wicking (see above).
- Instil topical antibiotic ear drops (always without steroids, see Section 5.1.C) for 2 weeks. Drops containing quinolones (norfloxacin, ofloxacin, ciprofloxacin) are more effective than other antibiotic drops; 0.3% ciprofloxacin drops (5 drops for 2 weeks). If ear pain or discharge persists, treat the child for 5 more days with the same antibiotic and continue wicking the ear. Follow up in 5 days.
- Topical antiseptics and steroids should not be used.
Treatment

- Give IV benzylpenicillin 50 mg/kg IV 6-hourly plus chloramphenicol 50 mg/kg 8-hourly IV OR plus flucloxacillin 50 mg IV 6-hourly both for 5 days and then orally (penicillin 25 mg/kg four times daily and chloramphenicol 50 mg/kg 8-hourly) for another 5 days. Alternatively, give ceftriaxone 100 mg/kg IV/IM for 10 days. If there is no improvement within 24–48 hours or if the child’s condition deteriorates, surgical drainage is necessary.

- The key is to provide drainage for the mastoid system.

- If it is not possible to do a full-scale mastoidectomy (due to lack of equipment or expertise), a dramatic improvement, in conjunction with intravenous antibiotics, may be obtained by incising the abscess (avoiding the mastoid tip in the small child where the facial nerve may be exposed) and opening into mastoid air cells.

- If signs of meningitis or a brain abscess (indicated by a reduced level of consciousness, a fit or localised neurological signs) are seen or suspected, give high-dose IV antibiotics as for meningitis (see Section 5.16.8) and refer the child immediately to an appropriate specialist.

Follow-up after 1 week

If the ear discharge persists despite ear wicking and ciprofloxacin drops, consider IV antibiotic treatment with antibiotics that are effective against Pseudomonas (such as gentamicin, azlocillin and ceftazidime), in addition to wicking. Do not give oral antibiotics for a chronically draining ear.

If chronic suppurative otitis media (CSOM) continues despite the above treatment, do not forget the possibility of TB.

Glandular fever/infectious mononucleosis

This is caused by the Epstein–Barr virus and may be similar in presentation to diphtheria.

Diagnosis

There are atypical lymphocytes on blood, monospot and Paul–Bunnell tests (usually but not always positive).

Management

- Do not give ampicillin, amoxicillin or Augmentin for throat infections until glandular fever has been excluded (there is a risk of a severe skin reaction). Antibiotics are unhelpful in glandular fever. Treatment is symptomatic.

- Give IV maintenance fluids if swallowing problems are causing dehydration.

- Give IV hydrocortisone 4 mg/kg 6-hourly if signs of airway obstruction occur.

- Intubation/tracheostomy is rarely indicated.

Acute mastoiditis

This is a complication of ASOM. The mucosa of the mastoid system is always inflamed in ASOM. Mastoiditis occurs when the mucosal inflammation spreads to the adjacent bone, causing osteitis, and eventually the outer cortex of the mastoid is breached, leading to a subperiosteal abscess behind the ear. The symptoms are similar to those of ASOM, but the signs include a forward displaced pinna with a tender fluctuant swelling in the post-auricular sulcus.

Complications

Not only is the outer cortex of the mastoid involved, but also the bone adjacent to both the middle and the posterior cranial fossa can be affected, occasionally leading to extradural abscess, meningitis and brain abscess.

Facial nerve paralysis may occur from the pressure of pus on an exposed facial nerve.

Retropharyngeal abscess

Most common in infants and young children, retropharyngeal abscess (RPA) is an abscess located behind the posterior pharyngeal wall (the retropharyngeal space).

RPA is usually caused by a bacterial infection originating in the nasopharynx, tonsils, sinuses, adenoids or middle ear, and can also result from a penetrating injury or a foreign body. It may result from suppuration of retropharyngeal lymph nodes from infected tonsil, adenoid, tooth or penetrating foreign body. The most common causative organisms are beta-haemolytic streptococci, Staphylococcus aureus, Haemophilus parainfluenzae and anaerobic organisms.

RPA is a relatively uncommon illness, and therefore may not receive prompt diagnosis in children presenting with stiff neck (limited neck mobility or torticollis), some form of palpable neck pain (which may be in ‘front of the neck’ or around the larynx), malaise, difficulty swallowing, high fever, stridor, trismus, dribbling of saliva, croupy cough or enlarged cervical lymph nodes. Early diagnosis is essential. Infection in the retropharyngeal space can pass down behind the oesophagus into the mediastinum, producing an extremely dangerous mediastinitis.

Peroral surgical drainage of the abscess by incision under anaesthetic (or without anaesthetic in an emergency) is often required. An ENT specialist (if available) must be called urgently.

Surgery may be required urgently to relieve obstruction, but not all patients with retropharyngeal abscesses require surgery. One study found that of 162 paediatric patients with retropharyngeal abscess, 126 required surgery initially, and of the 36 patients who were initially treated conservatively with high-dose antibiotics, 17 required surgery. Surgery is best undertaken using general anaesthesia undertaken by an experienced anaesthetist, as there is risk of rupture of the abscess during intubation. In patients who present with severe airway obstruction, tracheostomy may be required before surgical drainage.

High-dose IV antibiotics, such as ampicillin plus flucloxacillin plus metronidazole, cefuroxime or ceftriaxone plus metronidazole, or clindamycin plus metronidazole, are required in order to control the infection, and can be used to reduce the size of the abscess prior to surgery.
Chronic retropharyngeal abscess is usually secondary to tuberculosis of the cervical spine or spread from an infected lymph node, and the patient needs to be started on anti-TB treatment as soon as possible.

A CT scan (if available) is the definitive diagnostic test. A lateral X-ray of the neck will usually show swelling of the retropharyngeal space, with the following:
- increased prevertebral soft tissue shadow
- air and fluid level in the pre-vertebral area
- concavity or straightening of the cervical vertebral column
- the air column is pushed forward.

If the retropharyngeal space is more than half of the size of the C2 vertebra, it may indicate retropharyngeal abscess.

A chest X-ray will also be valuable to exclude pneumonia and to show the size of the mediastinum.

**Mediastinal tumours (see Section 5.14)**
These often present with the slow onset of stridor in a child with other symptoms and signs (e.g., pallor, lethargy) may be precipitated or aggravated by mediastinal radiotherapy used for treatment of malignant causes.

**Management**
- X-ray the chest and mediastinal inlet.
- Intubation may be required as a temporary measure.
- Treat the primary cause.

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**5.1.D The child with sleep-related upper airway obstruction**

**Introduction**
The incidence of sleep-related upper airway obstruction depends on the method of diagnosis (it affects 1–3% of preschool children). It is associated with both enlargement of the tonsils/adenoids and reduced tone or diameter in the upper airway.

Groups at risk are children with any of the following:
- Pierre-Robin sequence
- craniofacial syndromes
- Down’s syndrome
- cerebral palsy
- neuromuscular disease
- sickle-cell disease
- Prader–Willi syndrome.

**Presenting features**
- Snoring: this occurs in more than 10% of healthy 4- to 5-year-olds, and in most cases is benign.
- Sleep disturbance and restlessness.
- Apnoeic episodes followed by inspiratory gasps.
- Sleeping with the head extended.
- Subcostal and sternal recession during sleep.
- Mouth breathing and halitosis.
- Daytime hyperactivity, poor concentration and irritability (young children).
- Daytime sleepiness (older children).
- Pulmonary hypertension.
- Heart failure.

These features may be associated with developmental delay, impaired cognitive function and behavioural disorders. The disorder is insidious – the child may appear completely normal when awake, and the problem is most or only apparent during rapid eye movement (REM) sleep.

**Investigations**
A sleep observation or study is most useful. This can be done either by direct observation of the child during sleep with the chest and face exposed, or by video recording at home during sleep by the parents, looking for the following:
- chest wall recession
- snoring
- sleep position
- nocturnal restlessness.

It is also useful to monitor oxygen saturation ($\text{SpO}_2$) during sleep. An abnormal result would be a lowest level of less than 87% or more than three dips below 90% during the night.

Also consider the following investigations:
- barium swallow: to assess bulb function and exclude tracheal compression
- upper airway endoscopy: to assess the structure and dynamics of the upper airway
- lateral X-ray of the post-nasal space: to assess the size of the adenoids.

**Measurement of oxygen saturation ($\text{SpO}_2$)**
Methodological issues that affect this measurement include the following:
- the instruments used (e.g., functional vs. fractional haemoglobin)
- exclusion of motion artefact
- averaging
- altitude
- inclusion of apnoeic pauses.

**Normal data**
In children outside infancy, a normal oximetry recording should have the following:
1. a median $\text{SpO}_2$ level of $\geq 95$
2. no more than four desaturations of $\geq 4\%$ per hour
3. no abnormal clusters of desaturation defined as $\geq 5$ in a 30-minute period.

Widely used criteria for abnormality in nocturnal oximetry recordings are falls of more than 4% below baseline and...
desaturations below 90%. The measure that correlates best with poor academic performance is the lowest level of SpO₂ (nadir) during the night (normal value is > 87.5%).

Adverse effects of hypoxaemia
These include the following:
- poor weight gain
- developmental delay
- poor cognitive function
- pulmonary hypertension
- cyanotic apnoeic episodes.

Treatment
- Time: the airway enlarges with growth.
- Obstruction is worse with infections and may need a rescue course of steroids (e.g. prednisolone 0.5 mg/kg once daily for up to 7–10 days).
- Topical steroids/decongestants.
- Tonsil-adenoidectomy.
- Nasal CPAP.
- Nasopharyngeal tube (in infants).
- Tracheostomy.

Nasal CPAP (see Section 1.25)
This is an effective non-invasive treatment, but it is associated with the following potential problems:
- compliance
- side effects:
  - skin sores
  - nose bleeds
  - conjunctivitis
  - aerophagy.

Reference

5.2 Lower airway disorders

5.2.A Bronchiolitis

Clinical features of bronchiolitis
- Infants are coryzal, have a troublesome cough and may feed poorly or even be unable to suck and feed. There may be vomiting.
- The nose is often obstructed by secretions.
- On examining the chest, there may be hyperinflation, chest wall indrawing, nasal flaring, grunting, wheeze and fine crackles at the lung bases.
- Young infants may present with apnoeic/hypoxaemic episodes which may be recurrent and life-threatening.
- There may be hypoxaemia, with SaO₂ less than 94%, with or without cyanosis.
- Some infants will have such severe respiratory distress that there is gasping; this is pre-terminal.

Treatment
Only supportive treatment (e.g. oxygen, gentle suction of the nose, and fluids) is of benefit. Antibiotics and bronchodilators have no role. However, in the most severe cases and unless you are certain that pneumonia is not present,