Paediatric airway disorders

PD Bull

Impairment of the airway in infants and children causes anxiety to the patient, the parents and the health-care staff responsible for the child. This article outlines and explains paediatric airway impairment and aims to improve understanding of the various diseases.

Airway impairment in infants and children is responsible for anxiety not only to the patient, but also to the parents and health-care staff caring for the child. While the underlying causes of airway impairment are wide-ranging, certain features remain common:

- Usually a noisy airway
- Obvious distress with agitation
- Increased respiratory rate
- Use of accessory muscles of respiration
- Tachycardia
- Recession – intercostal, sternal
- Paradoxical abdominal movement; as the chest wall recesses, so the abdomen distends
- Tracheal tug
- Failure to thrive in chronic cases, as shown by a growth chart
- Cyanosis – a late sign
- Impaired conscious level – a very late sign
- Bradycardia, especially in small babies – signifies impending asystole.

It is important to correct the obstruction at an early stage before the downward spiral becomes uncontrollable.

An obstructed airway is usually noisy. Stertor is a low-pitched snoring or gasping noise produced by obstruction above the larynx, usually oropharyngeal in origin. It may be affected by altered levels of wakefulness or by changing position.

Stridor is a higher pitched noise produced in the larynx or upper trachea as a result of narrowing within a tubular airway. It is not usually altered by position but is worse on exertion such as feeding. A reduction in stridor or stertor will also occur as airflow is further reduced by obstruction, and does not necessarily indicate improvement.

MONITORING AND ASSESSMENT

Any child with airway obstruction should be carefully monitored, paying particular attention to:

- Oxygen saturation – measured peripherally
- Pulse rate
- Respiratory rate
- Temperature
- Level of consciousness.

Arterial blood gases may be required to determine the need for active intervention in more chronic airway obstruction. Normal levels of blood gases are Pa_{O_2} (arterial pressure of oxygen) of 11–13 kPa, and Pa_{CO_2} (arterial partial pressure of CO_2) of 4.6–5.9 kPa.

INVESTIGATION OF AIRWAY OBSTRUCTION

A good history and clinical examination are essential. The child should be undressed to allow proper inspection of the chest and abdomen for movement and for cutaneous stigmata such as haemangioma.

Adequate lighting is important to allow assessment of cyanosis. If the condition persists, a chest X-ray is valuable. Barium contrast radiology will identify a vascular ring indenting the oesophagus (and by presumption, the trachea) and may, less predictably, reveal a tracheo-oesophageal fistula.

Examination of the oropharyngeal and supraglottic airway can be assessed in the awake baby or cooperative older child by fibreoptic laryngoscopy. In babies, the flexiscope should be passed orally and is well tolerated. The typical features of laryngomalacia are easily seen. It is not possible to see beyond the level of the cords in this way.

The definitive assessment of the structure and function of the airway is by endoscopy under

Mr PD Bull is Consultant Ear Nose and Throat Surgeon, Sheffield Children's Hospital, Western Bank, Sheffield S10 2TH

general anaesthetic. No other technique allows visualization of the airway below the cords or allows a relaxed prolonged assessment. It is a dynamic evaluation and the child must be breathing spontaneously. Only in this way can cord movement, laryngomalacia and tracheomalacia be properly identified. Rigid instruments give a technically higher quality view than flexible as a rule and the procedure can be televised and recorded.

CAUSES OF AIRWAY OBSTRUCTION

Supralaryngeal

Hypertrophy of the tonsils and adenoids results in marked and chronic upper-airway obstruction and causes obstructive sleep apnoea. Such cases should be assessed by overnight oximetry and early surgical treatment is dramatically beneficial. This condition mainly affects small children and operation at a young age may be required (Li et al, 2002).

Figure 1. Unilateral posterior choanal atresia.

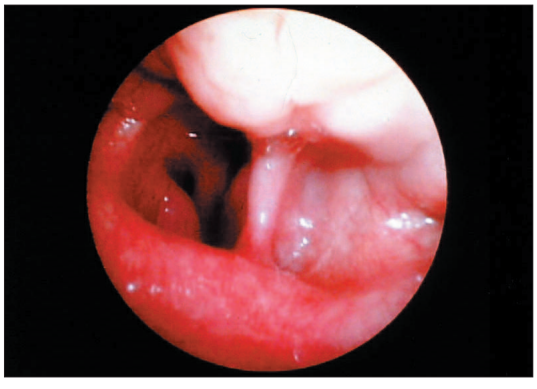
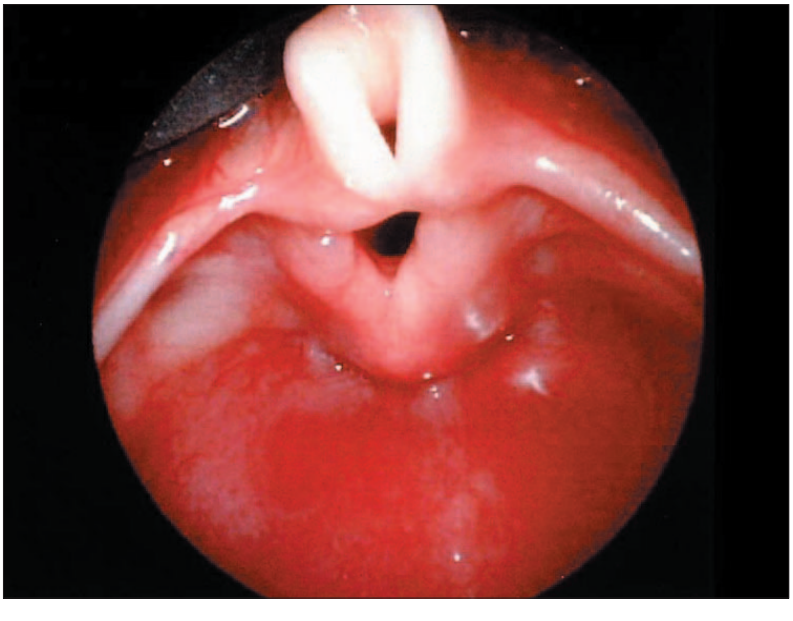


Figure 2. The typical appearance of laryngomalacia with an elongated epiglottis and insuction of the supraglottic structures.



Micrognathia (hypoplasia of the lower jaw) in Treacher Collins syndrome or Pierre Robin syndrome results in posterior displacement of the tongue and consequent oropharyngeal obstruction. If there is a cleft palate, the tongue may prolapse through the cleft and make obstruction complete. The obstruction can be relieved in the short term with a nasopharyngeal prong airway. In the longer term, tracheostomy may be required if there is no improvement with growth.

Posterior choanal atresia (*Figure 1*) results from failure of posterior canalization of the nose. It can be bilateral or unilateral. In bilateral cases there is severe respiratory difficulty, which is relieved by crying. Treatment is surgical.

Congenital cystic hygroma usually affects the head and neck and may cause severe obstruction of the airway. Treatment is difficult but often urgent as the obstruction may be life-threatening. It is usually by surgery, but sclerosants such as OK 432, a material derived from streptococcal culture, may be injected into macrocystic lesions.

Laryngeal causes

Congenital laryngeal disorders: Laryngomalacia (*Figure 2*) is the most common cause of neonatal stridor and results from insuction of the supraglottic structures. The stridor has a characteristic fluttering or high-pitched quality, and occurs at the end of inspiration. The epiglottis is long and tubular, and the laryngeal mucosa oedematous. There is always a degree of associated gastro-oesophageal reflux. Most cases will resolve by the age of 2 or 3 years but surgical treatment by division or reduction of the aryepiglottic folds is required if the child fails to thrive. Anti-reflux medication, for example with Gaviscon (R&C, Hull), is beneficial (Denoyelle et al, 2003).

Croup is an acute inflammatory process in the larynx in babies and toddlers affecting predominantly the subglottis, i.e. within the confines of the cricoid cartilage. It is usually infectious but may be allergic in nature. There will be increasing respiratory distress with stridor. If the condition persists, the baby will become exhausted and gas exchange and cardiovascular stability will decompensate. Rapid deterioration will ensue. There is usually a dramatic response to nebulized adrenaline and/or budesonide. In severe cases, endotracheal intubation and respiratory support will be required (Farmer and Wohl, 2001).

Acute epiglottitis, much feared because of its rapid onset and high mortality, causes dysphagia and stridor. The child is toxic and pyrexial and will be drooling because of the pain on swallow-

ing. The voice will be phlegmy and hoarse. Urgent intervention is essential to safeguard the airway, usually by endotracheal intubation. The condition has become uncommon since the widespread use of *Haemophilus influenzae* B vaccine (McVernon et al, 2004).

Congenital laryngeal webs (*Figure 3*) are rare and often associated with congenital subglottic stenosis. The diagnosis is apparent on laryngoscopy. Tracheostomy is often necessary and treatment is by laryngotracheal reconstruction with cartilage grafting.

Congenital vocal cord paralysis is more likely to be present in babies with neurological disorders. It prevents cord abduction and may require tracheostomy.

Acquired laryngeal disorders: Laryngeal haemangioma is not usually present at birth but develops over the first 2 or 3 months of life. There is increasingly severe stridor and a cutaneous haemangioma is almost always apparent. Diagnosis is confirmed by endoscopy and treatment can be expectant, as resolution will occur eventually, or by excision. The airway may need to be maintained by tracheostomy. The haemangioma will involute in response to large doses of steroids, but this therapy is reserved for life-threatening cases which cannot otherwise be controlled.

Trauma to the neck, either blunt or sharp, can result in damage to the airway. This ranges from bruising and oedema to laryngotracheal separation (*Figure 4*). There will be hoarseness of the voice and pain in the throat. If the integrity of the airway is breached there will be obvious surgical emphysema and increasing respiratory distress. Urgent intervention is then required. Intubation may not be possible and tracheostomy may be necessary as an emergency to prevent death. Burns caused by the inhalation of hot gases or even flames will cause damage and oedema in the airway and urgent intervention is required while the airway can still be intubated.

Laryngeal papillomatosis (*Figure 5*) results from infection with human papilloma virus (HPV) types 6 and 11. Infection often occurs in-utero and the mother may have genital condylomata. Half of all of cases present before the age of 5 years, and many at a few months old. There is progressive loss of voice and airway obstruction. Examination of the larynx reveals multiple papillomata, mainly on the cords, but they can occur anywhere in the upper aerodigestive tract. Treatment is by repeated removal of the lesions by forceps, laser or powered microshaver. In recalcitrant cases, α-interferon or intralesional cidofovir can be used (Derkay et al, 1998; Gelder et al, 2003; Wiatrak et al, 2004).

Subglottic stenosis (SGS) is usually the result of endotracheal intubation but can on rare occasions be congenital. It most commonly occurs in premature low birth weight babies who require ventilation for lung immaturity. Established SGS will require laryngotracheal reconstruction or cricotracheal resection to repair the airway. Long-term tracheostomy may be required (Bath and Bull, 1999).

A foreign body (FB) in the airway must always be suspected if a previously well child suddenly

Figure 4. Separation of the trachea as a result of blunt trauma.

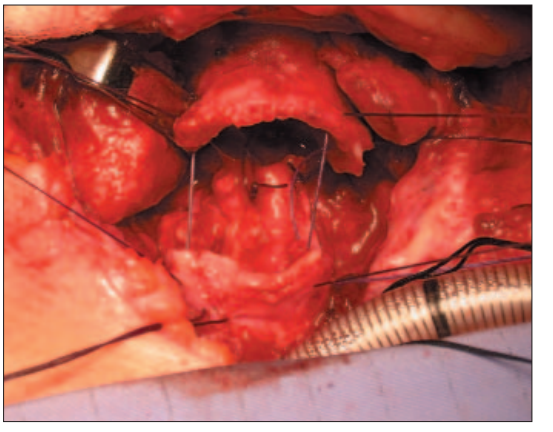


Figure 3. A laryngeal web.

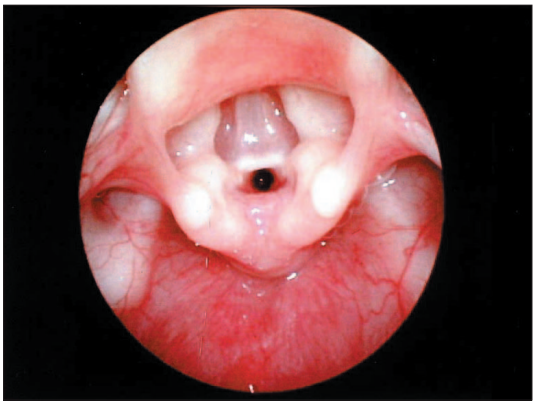


Figure 5. Laryngeal papillomata.

has acute respiratory distress, especially if associated with coughing. FB should also be suspected in causes of persistent or unexplained respiratory infection, especially if there are radiological changes. A normal chest X-ray, however, does not rule out an inhaled FB. Very rarely, a food bolus impacted in the oesophagus may compress the trachea and give rise to respiratory difficulties. If the diagnosis of inhaled FB is suspected, the child should undergo bronchoscopy under general anaesthetic. Rigid instruments are more suited to FB removal than flexible scopes.

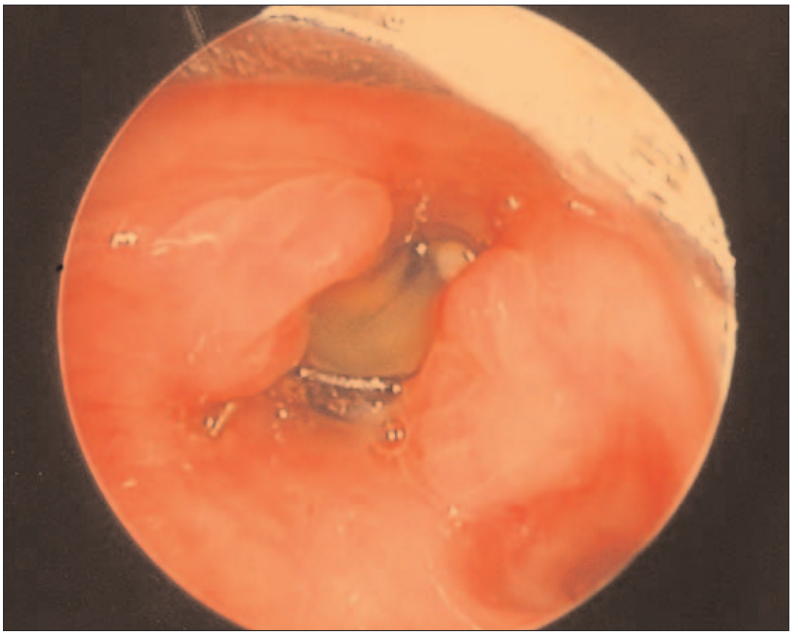
Tracheal causes of airway obstruction

Foreign body: In the same way that a FB in the larynx can cause acute airway obstruction, so the same is true of FB in the trachea. It may lodge in the trachea or pass down into a bronchus. A sufficiently large FB can occlude the airway completely and result in death, but most are smaller. Commonly inhaled FBs are foodstuffs, particularly peanuts, and small parts that become detached from toys. Bronchoscopy is required for confirmation of the diagnosis and removal of the FB (*Figure 6*).

Tracheomalacia: Usually associated with some other anomaly such as tracheo-oesophageal fistula, and can cause severe obstruction particularly on crying. Some cases will improve spontaneously with growth but others will require surgery to hitch the trachea forwards to the aorta (aortopexy).

Tracheal compression: Enlarged para-tracheal nodes (for example, from lymphoma) can compress the trachea and cause a progressive airway reduction. The cause is apparent on a chest X-ray or computed tomography scan and treatment is the management of the underlying disease.

Figure 6. Granulations around a foreign body in the bronchus.



KEY POINTS

- Airway obstruction in childhood requires urgent and expert assessment.
- The definitive investigation is airway endoscopy under anaesthetic.
- Many of the conditions causing airway obstruction in children are rare, but nonetheless serious.
- The common condition of laryngomalacia and reflux requires expert assessment, but does not always need surgical intervention.

AIRWAY ENDOSCOPY

The conclusive examination of any child with airway problems is by airway endoscopy. Flexible fibreoptic examination can be undertaken in the outpatient clinic and gives good dynamic information. It is limited to observation of the supraglottic airway.

Rigid airway endoscopy under general anaesthesia forms the mainstay of all investigations and allows appropriate surgical correction of many of the conditions encountered. At the same time modern equipment makes this a safe and controllable procedure. A rigid telescope is introduced into the airway through a laryngoscope held in place by a suspension technique and a camera is attached to the telescope. An unequalled view of the airway is obtained by this means. The examination can be minute and unhurried. The images obtained can be recorded for the medical dossier and to demonstrate the findings to the parents. **HM**

Conflict of interest: none

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