Assessment and management of the predicted difficult airway in babies and children

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Learning objectives

After reading this article you should be able to:

- identify a child with a predicted difficult airway
- formulate a clear plan for the management of a child with a difficult airway
- know which equipment is available, and appropriate, for use in managing the difficult paediatric airway

Abstract

It is essential that all anaesthetists have a strategy for managing the predicted difficult paediatric airway. The majority of children who have difficult airways are identifiable preoperatively. The situation where a child is unexpectedly difficult to bag-and-mask ventilate, intubate, or both is rare. Therefore anaesthetists usually have adequate time for thought and preparation with regard to ultimately securing the airway.

Inadequate airway assessment can contribute to poor airway outcomes. This article outlines the anatomical and physiological differences present in the child and describes clinical assessment of the paediatric airway. Equipment available for managing the predicted difficult airway in a child is also reviewed. Video laryngoscopy, for example, has become more popular in recent years and may increasingly be incorporated into difficult airway algorithms of the future.

Emphasis is placed on planning, preparation and practice: the three Ps of the difficult paediatric airway.

Keywords Airtraq®; difficult airway; difficult intubation; fibreoptic bronchoscope; Glidescope®; paediatric; supraglottic airway devices; video laryngoscope

Infant anatomy and physiology

There are a number of key differences between the anatomy and physiology of the paediatric and adult airway and respiratory system (Tables 1 and 2). This distinction has major implications for airway management and intubation techniques in the paediatric population.[1]

Prediction of the difficult airway

The difficult airway may be defined as one where holding a mask airway is not straightforward, or bag-and-mask ventilation is considered difficult to achieve using conventional equipment. Difficult intubation may be defined as one where three or more attempts are made to intubate the trachea, or obvious abnormalities are present which make the use of advanced airway techniques necessary from the outset.

The overall incidence of difficult airways in children is unknown; however, an incidence of 4.7% has been reported in children with cleft palate (with 7% in those younger than 6 months) and 1.25% in children with cardiac anomalies.[2,3]

Predicting the difficult airway involves taking an adequate history, carrying out an examination and reviewing relevant investigations. Formal assessment of the airway is done less commonly in children than in adult practice. This may be because of lack of validated assessment tests in children, anxiety in the child and non-compliance due to factors such as developmental delay. However, the importance of carrying out a good assessment preoperatively cannot be over-emphasized, as this will have a direct bearing on the airway management plan.

Relatively common syndromes that are associated with difficult airway management are summarized in Table 3.[4,5] A review of any previous anaesthetic charts will provide valuable information. Children who have undergone extensive facial surgery to correct dysmorphic features may be more difficult to assess and may be more difficult to intubate following corrective surgery, despite being apparently unremarkable in their facial features.[6]

As the child grows the effect of their condition may change. For example management of the child with Treacher Collins syndrome may become more difficult with age. Alternatively in the older child with Pierre Robin syndrome, the palate will be closed and the mandible has usually grown, so the airway in Pierre Robin children improves and is easier to manage as the child gets older. In children with many of the mucopolysaccharidoses, depending on the type, they may have deteriorating respiratory function, increasing soft tissue involvement, increasing cardiac compromise, and therefore even more difficulties with the management of their airway as they get older.[7]

Indicators of difficult intubation in adult practice have not been validated for paediatric use but it is still important to formally assess the airway and to document the results.

Predictors of a difficult airway include:

- high Mallampati score
- limited mouth opening
- dysmorphic features
- micrognathia.

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Anatomical features of the paediatric airway

	Infant	Practical implications
Tongue	Large relative to the mandible	Obstruct early, oral airway useful
Larynx	Cephalad	
Epiglottis	<4 months level C1–3 >6 months level C3–4 (cf. adult C3–6) Hard and narrow in older patients Large and omega shaped	Straight-bladed laryngoscope useful
Narrowest part of airway	Cricoid ring in child cf. laryngeal inlet in adult	Uncuffed tubes more commonly used
Cricothyroid membrane	Short and small	Difficult cricothyroidotomy
Trachea length	5 cm in newborn, 8 cm at 1 year	Endobronchial intubation more common
Carina	T2 in newborn and T4 at 1 year	

Table 1

- retrognathia
- the inability to slide the lower jaw in front of the upper jaw
- poor dentition
- decreased neck mobility.

Signs of airway compromise include tachypnoea, stridor, use of accessory muscles, weak or absent cry, and a history of sleep apnoea or difficulty with breathing during feeding.

Children with facial abnormalities will usually have undergone a range of investigations. These will include imaging e.g. CT and MRI scans which are useful. Sleep studies may highlight abnormal sleep patterns and obstructive sleep apnoea. The results of these assessments will impact both on the anaesthetic management perioperatively as well as the plans for postoperative care.

Preparation

Most paediatric patients need to be anaesthetized for intubation. A few older children may be able to cooperate with an awake fibreoptic intubation if sufficiently prepared. The parents and child should be informed of the risks associated with the difficult airway, for example local trauma, airway swelling, bleeding, pain and possible failure of the airway management plan, which may lead to a tracheostomy in certain cases.

Plan

Individualized plans will need to be made for each child with use of a decision-making tree for tracheal intubation when this is anticipated to be difficult, as shown in Figure 1.

Physiological features of the paediatric airway

High metabolic rate 7–9 ml/kg/minute	Desaturate quickly, less reserve
Diaphragmatic breathers	Diaphragmatic splinting will compromise ventilation
Functional residual capacity encroaching on closing capacity	Intubation more likely required in the young

Table 2

Premedication

Anticholinergics may be advantageous to decrease secretions and decrease the chance of laryngospasm, for example atropine 20 μg/kg intravenously or rarely intramuscularly, glycopyrronium 10 μg/kg intravenously, or atropine 40 μg/kg orally. However, this is used more and more rarely as a routine except possibly in ENT procedures. More commonly in the context of fibreoptic intubation, an anticholinergic may be given intravenously on induction of the patient. A sedative such as midazolam up to 0.5 mg/kg (maximum 20 mg) orally can be useful in the anxious child so long as this is not in the situation of imminent airway obstruction, in which case sedation should be avoided. In some circumstances, H_2-blocking drugs and metoclopramide should be considered.

Induction and maintenance of anaesthesia

Inhalational induction is well tolerated in children, particularly in children with a difficult airway and many anaesthetists favour this method in this group.[8] A carefully titrated intravenous induction using propofol with the aim of maintaining spontaneous ventilation may be suitable. However, the traditional approach to the difficult airway is to maintain spontaneous ventilation via inhalational induction and maintenance of anaesthesia with sevoflurane. It should be remembered that the child may become apnoeic with either an intravenous (IV) or gas induction. Never assume that a child's airway will remain patent, as the muscles of the tongue and pharynx relax on induction regardless of the method. The airway may become obstructed early, making it difficult to increase the depth of anaesthesia. Some anaesthetists use a total intravenous anaesthesia (TIVA) technique with propofol and remifentanil or alfentanil as an alternative to gaseous induction. It may be necessary to use an airway adjunct e.g. a Guedel oropharyngeal airway in order to maintain anaesthesia, and this may be necessary prior to gaining IV access. Use of non-depolarizing muscle relaxants are relatively contraindicated unless bag-and-mask ventilation is deemed satisfactory. To achieve advancement of the tracheal tube it is preferable to rely on adequate depth of anaesthesia from the volatile agent supplemented if necessary by topical lignocaine, a bolus of short-acting opiate,