

# Principles of paediatric anaesthesia

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## Abstract

This article provides an overview of the practical aspects of paediatric anaesthesia, with particular emphasis on airway and fluid management. Common dilemmas that may be encountered during preoperative assessment are highlighted, including the child with asthma, obstructive sleep apnoea and the particularly anxious child. In light of the findings of the fourth National Audit Project (NAP4), strategies for managing the child with the difficult airway are discussed. The rationale for the use of isotonic perioperative fluids is outlined, along with the management of intraoperative blood loss. The increasingly recognized problem of emergence delirium is also discussed.

**Keywords** Asthma; blood loss; difficult airway management; emergence delirium; fluid management; obstructive sleep apnoea

**Royal College of Anaesthetists CPD Matrix:** 1B02, 2A01, 2A03, 2A05, 2D02, 2D04

## Preparation and preoperative assessment

All patients should be seen by an anaesthetist before undergoing a general anaesthetic. The aim of preoperative assessment is to identify pre-existing medical conditions and any potential anaesthetic risk factors, plan perioperative care and also to answer questions and allay fears.

Appropriate and timely assessment, ideally a couple of weeks before the procedure, will allow any treatable illnesses, such as upper respiratory tract infections, to be dealt with in time for surgery, and it will also allow any necessary investigations to be performed and acted upon.

Herbal medicines are increasingly used in the general population and they, as well as traditional medicines, can be a cause of drug interactions.

Latex allergy is the commonest cause of intraoperative anaphylaxis in children. This should be considered in children with conditions requiring repeated exposure to latex, such as spina bifida and cerebral palsy, as well as atopic children, and those with allergies to certain nuts and fruits (bananas, kiwi, avocado).

Vaccinations elicit inflammatory responses and this may lead to confusion if an anaesthetic is given soon after, as any vaccine-related fever may be wrongly attributed to postoperative complications. There is no contraindication to vaccinating children before elective surgery but it is considered good practice to delay surgery

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## Learning objectives

After reading this article, you should be able to:

- identify the perioperative significance of conditions affecting the airway including asthma and obstructive sleep apnoea
- formulate a management plan for dealing with the anxious or uncooperative child, and the child suffering from emergence delirium
- discuss the anaesthetic management of the child with the difficult airway and the anticipated difficult intubation
- outline the recommendations for intraoperative and post-operative fluid management in children, including administration of blood components

for 2 days after an inactivated vaccine and 14–21 days for live attenuated vaccines so as to avoid such misinterpretations.

Examination of well children may reveal little, but it is reassuring for parents to see a thorough assessment being made. Routine preoperative blood tests are not required in healthy children undergoing minor surgery, but should be reserved for children with specific medical conditions which may require particular perioperative management, such as renal impairment and electrolyte abnormalities. Mild anaemia is not uncommon in children and does not require treatment before surgery.

Several topical local anaesthetic creams are available, namely EMLA (eutectic mixture of local anaesthetics, containing prilocaine 2.5% and lidocaine 2.5%), ametop (amethocaine 4%) and LMX4 (lidocaine 4%), which take roughly 1 hour, 45 minutes and 30 minutes, respectively to work.

Paracetamol and non-steroidal anti-inflammatory drugs are commonly prescribed preoperative analgesics, and anxiolytics are becoming more widely used.

The majority of children presenting for routine surgery will be healthy, although childhood obesity is an increasing problem. For those children with comorbidities, clinical networks have an important role in providing specialist guidance and support.

## Commonly encountered anaesthetic dilemmas

### Asthma

Not all children who wheeze have asthma as wheezing can also be a manifestation of a respiratory tract infection in an otherwise well child. Wheezing is associated with a greater risk of perioperative bronchial hyperreactivity.<sup>1</sup> Well-controlled asthmatics tolerate anaesthesia much better than those with poor control. The severity of asthma can be determined according to the frequency of use of inhalers, whether agents other than inhalers are required, whether oral steroids have been prescribed in recent weeks, and whether there have been any hospital admissions with or without admission to intensive care (British Thoracic Society guidelines).

Elective surgery should be postponed if the child has had a chest infection or an exacerbation of asthma within 2–4 weeks prior to the date of surgery.

Anaesthetic management should involve continuation of regular inhaled medication, often with an extra dose of Ventolin prior to transfer to theatre. The aim of anaesthesia is to avoid

airway irritation. Depending on the procedure, it is better to avoid intubation if possible, and drugs that cause histamine release (atracurium and morphine) should be used circumspectly in all but mild asthmatics. Propofol is an appropriate induction agent but ketamine should be considered in brittle asthmatics due to its intrinsic bronchodilator properties.

If the child has been on a recent course of oral steroids, then perioperative supplementation may be required. There is evidence to suggest that non-steroidals have no detrimental effect in mild asthmatics but should probably be avoided in brittle asthmatics, particularly in those with nasal polyps.<sup>2</sup>

**Upper respiratory tract infection (URTI)**

The average child has up to seven episodes of URTI a year. Although it is advisable to avoid an anaesthetic for 2–4 weeks after an URTI due to airway irritability, morbidity remains low in otherwise well children.<sup>3,4</sup> Adverse events such as laryngospasm, bronchospasm and airway obstruction are more likely in children under 1 year of age, and in asthmatics, those having airway surgery and when an endotracheal tube is used.

**Obstructive sleep apnoea (OSA)**

Adenotonsillar hypertrophy is the commonest cause of snoring in children, although obesity is increasingly a problem. About 15% of children who snore have OSA (prolonged partial upper airway obstruction and/or intermittent complete obstruction that disrupts normal ventilation during sleep). OSA can lead to failure to thrive, day time fatigue and behavioural problems, and in severe cases eventually pulmonary hypertension and right heart failure.

If the clinical features of OSA are present then an ECG and pulse oximetry should be performed. If the ECG shows evidence of right ventricular strain, this should be investigated further with an echocardiogram. Polysomnography is considered the gold standard in the UK to determine the severity of OSA, and involves analysis of ECG, EEG, EOG, EMG, saturations and abdominal and chest wall movements during stages of sleep. However, it is time consuming and generally not performed if the clinical diagnosis of OSA is clear.

Anaesthetic considerations in OSA include the avoidance of sedative premedication and long acting opioids that can cause airway obstruction by reducing pharyngeal tone and inhibiting central responses to hypoxia and hypercapnoea. Airway obstruction may result in cardiovascular compromise and pulmonary oedema. Inhalational induction has the potential advantage of maintaining airway patency but can predispose to worsening airway obstruction and negative pressure pulmonary oedema. Intravenous induction is more likely to result in apnoea but ventilation via face mask and intubation are rarely a problem. Short-acting anaesthetic agents should be used where possible to allow rapid recovery. If intubation is necessary, it is probably safer to extubate awake as a deep extubation may be more likely to result in obstruction during emergence.

Postoperatively sleep apnoea can worsen, so nursing overnight in a high-dependency area is advisable.

**The anxious child**

Half (40–60%) of children experience significant preoperative anxiety. It is now well known that preoperative anxiety leads to adverse postoperative clinical outcomes, with both short

(emergence delirium) and long-term behavioural issues (sleep disturbance and separation anxiety). Concerns differ for different age groups (Table 1).<sup>5</sup>

Children with learning disabilities are more likely to have heightened anxiety and the disturbance of their routine may make them uncooperative and sometimes aggressive. It is important that they receive timely preoperative information appropriate to their age and level of understanding, familiarization with the ward and staff as appropriate, and a considered account of what to expect to satisfy their concerns.

Strategies to reduce anxiety include behavioural techniques and sedative premedication (especially oral midazolam 0.5 mg/kg and oral clonidine 4–5 µg/kg). There is evidence that behavioural interventions such as computer packages, video games, clowns and play therapists, improve compliance and reduce emergence delirium.<sup>6</sup> However, these techniques are time consuming and costly.

The benefit of parental presence in the anaesthetic room remains controversial, although the evidence suggests that a calm parent is helpful to the child while parental anxiety is very much transferred to the child. Parental presence overall is probably more helpful to the parent than the child.

**Airway challenges**

**Laryngospasm**

This is more commonly encountered in paediatric practice rather than adults and is particularly common in the hands of less experienced anaesthetists.

Being aware of what can trigger laryngospasm (commonly secretions or blood on the vocal cords) and following some very simple strategies can reduce the incidence significantly. Such simple techniques include inserting supraglottic airway devices, such as the laryngeal mask airway (LMA) only once an adequate depth of anaesthesia has been achieved, and removing any LMA while still in a deep plane of anaesthesia in situations where secretions may otherwise be trapped on the vocal cords (e.g. child with an upper respiratory tract infection).

Laryngospasm usually settles with high-flow oxygen and continuous positive airway pressure (CPAP), but if it continues, propofol 1 mg/kg IV can relax the vocal cords and, failing that, suxamethonium 0.1–0.2 mg/kg IV should be used. Rarely, anaesthesia needs to be deepened and an intubating dose of

Developmental differences in causes of childhood anxiety	
Infants	Less likely to experience anxiety from parental separation, accept parental surrogates
1–3 years	Experience separation anxiety
3–6 years	Concerns about body mutilation requiring simple explanations
7–12 years	More explanation required, need to feel in control
Adolescence	Concern about pain, awareness and losing control

**Table 1**

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