UPPER RESPIRATORY TRACT INFECTION AND PAEDIATRIC ANAESTHESIA
ANAESTHESIA TUTORIAL OF THE WEEK 246

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QUESTIONS

Before reading the tutorial, try to answer the following questions true or false. The answers can be found at the end of the tutorial. More than one statement may be correct for each question.

1. Postulated mechanisms of viral-induced airway hyperreactivity include:

   a. Release of chemical mediators
   b. Activation of M2 receptors resulting in increased acetylcholine release
   c. Increased smooth muscle constrictor response to tachykinins
   d. Vagal response

2. Risk factors for perioperative adverse respiratory complications are:

   a. Nasal congestion
   b. Copious secretions
   c. Passive smoking
   d. Airway surgery
   e. Parent's confirmation that the child has a cold
   f. Reactive airway disease
   g. History of snoring

3. Which of the following should be considered when deciding to cancel or proceed with an elective surgery in a child with URTI?

   a. Child's age and presenting symptoms
   b. Type of surgery to be performed
   c. Need for endotracheal intubation
   d. Frequency of the child's URTI
   e. Anaesthetist's comfort and experience

4. The following statements apply to the anaesthetic management of a child with URTI:

   a. Goals are to minimize secretions and limit stimulation of the airway
   b. The airway should be suctioned after the child loses the eyelash reflex
   c. Preoperative bronchodilator with or without steroid has no role in attenuating bronchoconstriction triggered by airway instrumentation
   d. Sevoflurane is a better induction agent than propofol
   e. An ETT should be used in preference to a LMA or facemask to secure the airway
   f. There is no difference in adverse respiratory events when intravenous or inhalation techniques are used to maintain anaesthesia
   g. The general consensus is to remove the ETT awake rather than deep

INTRODUCTION

Upper respiratory tract infection (URTI) is the most common reason for children to visit the emergency department or outpatient clinic in the United States. Most adults experience 2 to 4 URTIs per year, whilst most children experience 6 to 8 URTIs per year. Approximately 200 viruses cause the infection that produces the clinical syndrome of cough, nasal congestion and discharge, sore throat and sneezing. Airway hyper-reactivity is common after an URTI, and has important clinical implications in anaesthesia. Ninety-five percent of URTIs are secondary to viral causes, with rhinoviruses accounting for 30-40 percent of infections.

PATHOPHYSIOLOGY OF AIRWAY HYPER-REACTIVITY

Several mechanisms of airway hyper-reactivity after viral URTI have been postulated, including chemical mediators and neurologic reflexes. Bronchoconstriction may be linked to the release of inflammatory mediators at the site of viral damage such as bradykinin, prostaglandin, histamine, and interleukin. Stimulation of muscarinic M2 receptors present on vagal nerve endings usually results in inhibition of acetylcholine release. Viral neuraminidases are thought to inhibit these receptors and increase the release of acetylcholine, leading to bronchoconstriction. Atropine has been shown to block airway hyper-reactivity, which supports a vagal component to the response. Tachykinins play an important role in smooth muscle contraction and are normally inactivated by neutral endopeptidase. Viral infections may inhibit the activity of this endopeptidase, which results in an increased smooth muscle constrictor response to tachykinins.

DIFFERENTIAL DIAGNOSIS OF URTI

A number of other infections present with cough, nasal congestion, nasal discharge and sore throat and mimic the signs and symptoms of viral URTI. Important differential diagnoses to consider include:

Infectious

- Croup
- Influenza
- Epiglottitis
- Streptococcal sore throat
- Herpes simplex
- Bronchiolitis
- Pneumonia

Non-infectious

- Allergic or vasomotor rhinitis
- Asthma
- Foreign body aspiration
- Gastro-oesophageal reflux

RISK FACTORS FOR PERIOPERATIVE ADVERSE RESPIRATORY EVENTS

A history of URTI or other respiratory disease increases the risk of perioperative adverse respiratory events such as:

- Coughing
- Breath holding
- Laryngospasm
- Bronchospasm,
- Airway obstruction,
- Oxygen desaturation less than 90% (for 10 seconds or more)
- Atelectasis,
- Post-extubation stridor,
- Pneumonia,
- Unanticipated tracheal intubation or re-intubation.

The risk of perioperative complications is greatest in the presence of acute infection but remains increased for 2-6 weeks after URTI. Airway reactivity is increased for up to 6-8 weeks following an URTI. Children undergoing major surgery may have increased perioperative complications, particularly infective complications. Most adverse perioperative events are easily manageable and have no lasting effect.

The incidence and risk factors for perioperative adverse respiratory events have been investigated in large cohort studies (Tait et al, Parnis et al, von Ungern Sternberg et al). Children with active and recent URTI (within 2-4 weeks) have significantly more episodes of breathholding, oxygen desaturation and severe coughing compared with children with no URTI.

Independent risk factors for adverse respiratory events in children with active URTI include:

- Intubation
- Prematurity (<37 wks)
- History of asthma or atopy
- Family members who smoke
- Airway surgery
- Presence of copious secretions
- Nasal congestion
- Parental confirmation ‘my child has a cold’
- Snoring

Induction of anaesthesia with an inhalation agent (sevoflurane, halothane) is associated with more respiratory complications compared to induction with propofol; induction with thiopentone is associated with the highest risk of respiratory complications. There are fewer airway complications when the anaesthetist is more experienced. Respiratory complications are higher when neuromuscular blocking agents are not reversed.

PREOPERATIVE ASSESSMENT

Based on the medical history and physical examination, a child with URTI can be categorized as having mild, uncomplicated disease or more severe symptoms. Those with mild URTI have clear rhinorrhea, appear otherwise healthy, and have clear lungs to auscultation and no fever. Overtly sick children have fever >38°C, purulent nasal discharge, productive cough and are ill-appearing with signs of pulmonary involvement. Most children with mild URTI can be safely anaesthetized without significant morbidity and those children with more severe symptoms should have elective surgeries postponed for at least 4 weeks. Perioperative adverse respiratory events can be anticipated and are easily recognizable and treatable.

Laboratory tests (chest X-ray, white blood cell count, nasopharyngeal swabs or aspirates) are available to confirm the diagnosis of URTI but they are seldom necessary, not cost-effective and may not be practical in a busy surgical setting. Chest X-ray may be considered if physical examination suggests signs of lower respiratory tract involvement. Measurement of oxygen saturation is a useful discriminator to detect the child with lower respiratory tract infection.

SHOULD SURGERY BE POSTPONED IN ANY CHILD WITH URTI?

'Blanket' cancellation may be the most conservative approach but it is not practical in the current environment of increasing caseloads and pressure to expedite surgery. It avoids complications but it increases emotional and economic burdens on parents.

Assessment of the suitability of any child with URTI symptoms for surgery is multifactorial and includes the child's age and presenting symptoms, urgency and type of the procedure, and presence of comorbidity. Respiratory complications of anaesthesia are higher on children < 1 years of age, and there should be a low threshold to cancelling surgery in children in this age group. The frequency of URTI experienced by the child should also be considered since it may be difficult to schedule the child during a symptom-free interval for elective surgery if he/she experiences 6-8 URTI episodes per year.

The decision to postpone or proceed with surgery for children with URTI should be made on an individual basis by considering the presence of identified risk factors and the anaesthetist's own comfort and experience with anaesthetizing children with URTI. My practice is to proceed with the anaesthetic if the child appears healthy with no symptoms other than clear rhinorrhea, will not require an ETT, and will not undergo surgery involving the airway. I postpone an elective case if the child has purulent nasal discharge, productive cough and/or fever, or there are clinical signs suggesting lower respiratory tract involvement such as desaturation or wheeze. I have a low threshold for cancellation if the child is undergoing major elective surgery. Ultimately the decision to proceed or postpone surgery in a child with URTI rests on the anaesthetist after consultation with surgeon and parents who should be fully informed of the risks.

ANAESTHETIC MANAGEMENT

The goals of anaesthetic management of a child with URTI symptoms are to minimize secretions and avoid or limit stimulation of a potentially irritable airway.

The airway should only be suctioned under deep anaesthesia. The child should be well hydrated and a humidifier may be helpful to clear secretions and prevent bronchial mucus plugging.

Anticholinergics (e.g. atropine or glycopyrrolate) have been advocated, but a recent study failed to show significant benefit of glycopyrrolate compared to placebo to reduce the incidence of perioperative adverse respiratory events in children with URTI undergoing various types of surgery (e.g. otolaryngology, urology, orthopaedic, and general surgery).

Preoperative bronchodilators given 10-30 minutes prior to surgery have been shown to reduce bronchoconstriction and reduce perioperative respiratory events. Combining a $ß_2$ agonist such as

salbutamol with inhaled corticosteroids is more effective in minimizing bronchoconstriction due to intubation compared with inhaled $ß_2$ agonist alone.

Tracheal intubation should be avoided if possible, particularly in children less than 5 years. An LMA or facemask are preferable alternatives where appropriate. Lubricating the LMA with lignocaine gel reduces the incidence of airway complications in children with URTI.

The incidence of adverse respiratory events is less when propofol is used as the induction agent compared with sevoflurane. Intravenous or inhalation techniques may be used to maintain anaesthesia provided anaesthesia is sufficiently deep. Use of sevoflurane for induction and maintenance results in fewer complications compared to sevoflurane for induction and isoflurane for maintenance. There is no consensus on the optimum depth of anaesthesia at which extubation of the trachea or removal of the LMA should be done. Many anaesthetists would prefer to remove the airway when the patient is awake to enable the patient to clear secretions and better protect the airway. Others would argue that removal of the airway under deep anaesthesia avoids reflex airway constriction. One study showed no difference in the incidence of complications when the ETT was removed awake or under deep anaesthesia in children with URTI.

CONCLUSION

Children with active and recent URTI (within 4 weeks) are at increased risk of perioperative respiratory complications. Awareness of risk factors will guide the anaesthetist in deciding whether to proceed, and to tailor the anaesthetic to optimize the child's condition. Informed consent, good clinical judgment and experience are crucial factors in the decision-making process

ANSWERS TO QUESTIONS

1. a. T
   b. F – Inhibition of airway M2 receptors by viral neuraminidases results in an increased acetylcholine release and bronchoconstriction.
   c. T
   d. T

2. TTTTTTT

3. TTTTT

4. a. T
   b. F – It is important to suction the airway when the child is deeply anesthetized
   c. F – Administration of bronchodilators alone or in combination with steroids preoperatively has been suggested to minimize bronchoconstriction triggered by airway manipulation.
   d. F – The incidence of adverse respiratory events is less when propofol is used as the induction agent compared with sevoflurane.
   e. F – The risk of airway complication in children with URTI: ETT > LMA > face mask.
   f. T
   g. F – There is no consensus on the optimum depth of anaesthesia at which the ETT or LMA should be removed.

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