Paediatric anaesthesia: Challenges with induction

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KEY POINTS

- Anxiety in children at induction of anaesthesia is common, and it is important to develop several strategies to overcome this problem.
- Children with behavioural disorders needing an anaesthetic can be managed using non-pharmacological and pharmacological methods to minimise distress.
- Children's rights and consent should be considered when performing the induction of anaesthesia.
- Specific co-morbidities may require modifications to standard induction processes; e.g difficult IV access, the unfasted child and the unwell child.

INTRODUCTION

The conduct of paediatric anaesthesia presents many unique challenges. One of the most striking is the variability of behaviour and responses of children and their parents at induction. Behavioural problems, the need for restraint, difficult IV access and co-morbidities add complexity and can make the art of maintaining a calm and smooth induction incredibly difficult. This tutorial will discuss six of the common problems that arise at induction and how these may best be overcome.

CHALLENGE 1: THE ANXIOUS CHILD

Children who are distressed at induction are more likely to experience distress on emergence, and into the post operative period (1).

Known risk factors include

- Children with previous behavioural problems (e.g distress or anxiety) during a health care encounter or greater than five previous hospital admissions have an increased risk of high anxiety at induction(2).
- Anxious parents
- Behavioural disorders including autistic spectrum disorder (ASD), attention deficit disorder (ADD) and attention deficit hyperactivity disorder (ADHD).
- Age specific considerations
    - 0 -12 months: Demonstrate general distress but it is not until several months later that they demonstrate fear responses(3). Children of this age also respond to separation with soothing and distraction. For this reason pharmacological anxiolytics are seldom used, and parental presence is usually at the discretion of the anaesthetist.
    - 1-2 years: Increasing attachment and fear with increased mobility and strength. Premedication again seldom used in this group, but use of distraction techniques may be of benefit.
    - 2 to 5 years: Increased likelihood of separation anxiety from parents. At this age increased physical strength and inability to rationalise behaviour may make them a particularly important age group to assess for anxiolytic strategies.

- 5 years to Adolescence: Increased sense of self and potential harm. School aged children may respond to explanation and reason. Distraction techniques are also particularly useful in this age. A pilot study looking specifically at adolescents found over 80% of this age group reported significant anxiety at the time of induction. Underlying baseline anxiety, depression, somatization (physical symptoms occurring secondary to psychological distress) and fearful temperament are predictors of this phenomenon(4).

Non-pharmacological anxiolysis:

A Cochrane review (5) of 28 trials divided these heterogeneous interventions into five main categories. Below is a summary of their findings:

- Child interventions (Passive): Different studies showed variable response to videos in terms of anxiety reduction. One study suggested a video of patient's choice may decrease anxiety, but another using a fairytale video could not demonstrate such a difference.
- Child interventions (Interactive): When compared with parental presence only, clowns or clown doctors significantly lessened children's anxiety in the operating/induction room in three trials with a total of 133 children. Video game usage also decreased anxiety compared to controls and patients who had received midazolam.
- Child interventions (Mask introduction): A single study on mask familiarity showed no reduction in anxiety but better co-operation
- Parental presence: Parental presence does not decrease a child's anxiety, and is less effective than a premedication. It is, however, important to recognize that the majority of studies demonstrating this are from a similar patient group and may not reflect cultural, religious and ethnic variations.(6)
- Parental interventions: Children of parents having sham acupuncture may be less anxious.

It is important to use age appropriate distraction techniques. There is increasing research being done into use of modern technology including tablet devices and virtual reality. It is important to consider all the available resources, and not disregard simple games or the expert storyteller as a distraction method.

Pharmacological anxiolysis:

The practice of premedication is heterogeneous across institutions and can be dependent on institutional culture and patient populations. Nonetheless, whatever the practice in your institution, there are some key factors for safe and successful premedication:

- Give the premedication enough time to work
- Ensure adequate monitoring facilities are available
- Select appropriate agents based on previous experiences, severity of anxiety or behavioural disturbance and co-morbidities.
- Consider combination therapies using lower dose ranges of each agent: e.g.
    - Oral ketamine (3 mg/kg) plus midazolam (0.3 mg/kg)
    - Oral ketamine 3mg/kg and clonidine 3mcg/kg
- Consider possible contraindications (e.g. unfasted, difficult airway, critically unwell, end organ dysfunction such as liver or renal failure)

There are a number of excellent freely available articles that cover the topic of perioperative anxiety in more detail. (13, 14)

CHALLENGE 2: THE CHILD WITH A BEHAVIOURAL DISORDER

Wide ranges of behavioural disorders exist. These include ASD, ADD and ADHD (see above). Some children may not have a specific diagnosis, but parental reporting of difficulties with behaviour should also be considered when planning in the perioperative period. Also consider the implication of developmental delay on how the child will respond when stressed (see age specific considerations above).

Parents or carers form a vital part of a smooth perioperative pathway. Discussion with the parents regarding behaviour and compliance is important to assess likelihood of peri-operative co-operation. This includes the usual rituals and routines of the child, and how these can be disrupted as little as possible. Asking the parents about the signs of the child becoming upset, any specific triggers and what strategies the family use to try and ease this will assist with recognition of increasing distress.

Children with ASD are more likely to have associated co-morbidities(15) including seizure disorders, sleep apnoea and developmental delay. A study looking at the experience of children with ASD in the peri-operative period found that children with ASD were more likely to receive no premedication or a non-standard premedication (anything other than oral midazolam)(16). It may be that children with this condition are not receiving a premedication when they may benefit from it. Children with ASD need a tailored anxiolytic strategy, best formulated by assessing their preoperative behaviour and talking to their parents. Another literature review strongly suggests premedication, as part of a 'flexible' preoperative process, e.g measure height and weight at home, talk to the parents before the day of surgery, minimise waiting time and provide access to a quiet room(15). This is important because difficulties with social interactions form a prominent feature of the disorder, and placing the child in a crowded, noisy room may lead to increased distress, and lessen co-operation.

Children with ADHD can be less cooperative at induction of anesthesia and have a greater incidence of post operative maladaptive behaviors.(17)

It is also important to consider the implications of therapy on anaesthetic practice. Children with ASD, ADD and ADHD can be medicated with a wide range of psychoactive drugs and stimulants. There have been case reports of increased drug requirements for sedation and anaesthesia, and various haemodynamic effects e.g. refractory hypotension with risperidone (18). There is currently no clear evidence based guidelines on perioperative management of stimulant medication and the decision is usually made by the prescribing doctor and the parent or guardian(19).

MEDICATIONS USED FOR PREMEDICATION IN PAEDIATRIC ANAESTHETIC PRACTICE

All of the agents listed below are potentially sedating and as such it is a baseline requirement that children are directly (and continuously) observed post administration

Drug doses for this table were largely taken from the Australian Medicines Handbook Children's Dosing Companion. Some variation from country to country may occur. PLEASE REFER TO YOUR NATIONAL / LOCAL HOSPITAL POLICY FOR SPECIFIC DOSING GUIDELINES IF DISCREPANCY WITH BELOW DOSES OR ANY UNCERTAINTY OCCURS

PO= Per Oral, IM= Intramuscular, IV= Intravenous, PR= Per Rectum, IN=Intranasal

Drug	Route	Dose and route of administration	Time to effect	Specific practice points
Benzodiazepines				
Midazolam	PO IM IV	0.5mg/kg up to 20mg Max 0.3mg/kg if combined with ketamine 0.2mg/kg 0.1-0.2mg/kg	20-30 mins 3-5 mins 2-3 mins	May cause ataxia. Keep child in bed or on parents lap. Consider as first line in children with known seizure disorder. Some suggestion of improved nursing and parental satisfaction(2)
Diazepam	PO PR IV	0.1-0.5 mg/kg 0.5 mg/kg 0.05-0.3 mg/kg	15-30 mins 5-10 mins 1-3 mins	Long elimination half lives means drug effect may be prolonged. Not to be used in infusions (binds to plastic tubing). No difference PO diazepam vs PO midazolam(7)
Temazepam	PO	0.3mg/kg up to 20mg maximum	45-60 mins	Prolonged drug effect- up to 3 hours.
NMDA Receptor Antagonist				
Ketamine	PO	2-5mg/kg up to 150mg maximum	20-30 mins	Emergence reactions including hallucinations may occur. Caution in unstable cardiac disease and raised intracranial pressure. Can cause increased secretions. May be useful in difficult airway/ airways disease(8).
Alpha Agonists				
Clonidine	PO	2.5- 4mcg/kg	30 mins	Hypotension. Dry mouth. Sinus arrhythmia and arrest have been described. Clonidine may provide superior parental satisfaction and mask acceptance compared to midazolam(9).
Dexmedetomidine	PO IN	3mcg/kg 1-2mcg/kg	30 mins 30-60 mins	Side effects include hypotension, bradycardia and prolonged sedation. Dose dependent reduction in volatile anaesthetic requirements. A 2014 systematic review supports that dexmedetomidine may be a better premedication than midazolam, but the implications of common side effects should be considered prior to administration(10).
Other				
Melatonin	PO	0.5mg/kg	20-30mins	Similar sedation to midazolam with reduced propofol requirements(11).
Trimeprazine	PO	2mg/kg	15-60 mins	Antihistamine similar to tricyclic antidepressants. Not used clinically as anti-psychotic.In some countries not licensed for children < 2yrs due to marked sedation and respiratory depression. Can cause prolonged QTc (caution with pre-existing cardiac disease, low potassium and TCA). Prolonged sedation makes day case use inappropriate(12).

CHALLENGE 3: THE RESISTANT CHILD - RESTRAINT AND CONSENT

Children are often reluctant to have a stranger hold a mask on their face (mask acceptance) or insert an intravenous cannula. The question then becomes what to do when a patient refuses these interventions. How much restraint is ok? Who can enforce it?

In a USA based survey of paediatric anaesthetists, 44% of respondents used restraint in the majority of children <1 year of age, whereas only 2% did so in children >11 years(20). In a similar UK based survey, the majority of respondents rarely or never allow a child to be restrained by staff members, the size of this majority growing with the increasing age of the child from 214 (74%) under 1 year to 261 (88%) over 6 years. Notably 110 (25%) had cancelled a case within the past 5 years and 196 respondents (45%) had cancelled at least one case during their entire career because of child refusal (21). Local policy and laws will dictate the exact requirements for consent. For example, in the UK and Australia the laws surrounding consent in children is guided by the concept of 'Gillick competence' where in order to withhold consent a child must have sufficient understanding and intelligence to enable him or her to fully understand what is proposed(22). This means if a child is capable and refuses treatment but is held down against their will, we would be enforcing treatment without consent. In this sense every effort should be made to follow children's wishes. The 2003 working group of the Confederation of European Specialists in Paediatrics (CESP) stated that children may effectively refuse treatment or procedures that are not necessary to save their lives or prevent serious harm(23).

There are a limited number of specific guidelines on restraint in paediatrics. Local policies should be consulted to ensure local protocols are adhered to. Homer and Bass (21) reference the UK Royal College of Nursing guidelines on procedural restraint, outlining the difference between restraint and holding still. These guidelines distinguish these two techniques through the amount of force applied and consent. The American Society of Pediatricians has a statement on the use of physical restraint in the acute care setting(24). In this context it outlines restraint as physical or mechanical methods to restrict movement. This statement is not specific to anaesthetics but an example of this in anaesthetic practice would be wrapping a patient in a blanket to keep arms and legs still. Therapeutic holding as per this same statement is the physical restraint of a patient by at least two people to assist the patient who has lost control of behavior to regain control of strong emotions. Consistently, across the available resources, there is emphasis on the importance of explaining this type of intervention to the child and their parents, and ensuring the child is not injured in any way during this process. The 'competent' child also has the right to refuse a treatment or intervention.

CHALLENGE 4: THE UNFASTED CHILD OR POTENTIAL FULL STOMACH

Some clinical circumstances require anaesthesia to commence prior to adequate fasting. Children are also more prone to gastric stasis with minimal trauma, opioid analgesia, and pain(25). The place of paediatric rapid sequence induction remains controversial. At times, even when a rapid sequence induction is indicated, performance is impossible e.g. difficult IV access or non-compliance with pre-oxygenation(25). In this setting attempts should be made either to site an IV prior to induction or minimize disturbing the patient during an inhalational induction (e.g. movements or cannulation when 'light'). It is important to have suction available and voice concerns about potential aspiration to other staff. The anaesthetist should also ensure airway assistant is comfortable performing cricoid pressure.

For general information about rapid sequence induction please refer to ATOTW 331.

CHALLENGE 5:THE CHILD WITH DIFFICULT IV ACCESS

Careful assessment of venous options prior to any attempts will allow selection of the best site. Application of a topical local anaesthetic agent can be used to reduce pain associated with cannulation without negatively impacting on success rates(26). Parental application (e.g at home prior to presenting to hospital) of these agents has also been shown to be effective(27). If an IV induction is planned it is reasonable to use topical local anaesthetic agents when able.

Use of specialized lights for vein identification or transillumination in infants can be helpful. Ultrasound can be of use if available, the anaesthetist has the expertise, and the patient is cooperative. The ultrasound can be used either real time or to identify and mark the location of veins that are not visible/ palpable. Be sure to maintain the arm in the same position during scanning and the cannulation attempt.

If an IV induction is considered essential or desirable but an IV cannot be placed IM ketamine can be used as a general anaesthetic agent. The IO (intraosseous) route has been successfully used for rapid induction of anaesthesia with minimal complication(28).

It is also well known that cannula placement is easier in the anaesthetized patient (immobile and vasodilated) and an inhalational induction may be preferred in patients with a history of difficult access. All of the strategies outlined above for vein localization can be used following a gas induction. Whilst not routine, in a patient with difficult access some anaesthetists will perform airway instrumentation without IV access. This allows establishment of a more secure airway (LMA/ ETT). The key to this approach is ensuring the patient is sufficiently deep (with slower heart rate, no response to stimulation such as jaw thrust, non-divergent eyes and mid-sized pupils) prior to airway instrumentation to avoid coughing or airway stimulation resulting in laryngospasm or regurgitation. A dose of IM suxamethonium 4mg/kg can facilitate paralysis if required although it takes longer than the IV route to achieve adequate muscle relaxation and muscle fasciculations may not be visible.

CHALLENGE 6: THE UNSTABLE OR UNWELL CHILD

The increased work and sympathetic surge associated with being stressed or upset prior to induction can cause clinical decompensation in unwell or unstable children with limited physiological reserve. This can occur before induction agents have been given. Alternatively the critically ill patient may make little attempt to 'fight' induction - a marker of how unwell they are. Cautious premedication in a monitored and supervised environment may be appropriate and may decrease the induction doses required. Preparation is again vitally important in these patients. If possible, attach monitoring prior to induction and ensure resuscitation drugs are immediately available. When administering any agents, start 'low and slow', using small doses slowly titrated to effect. Propofol is used less commonly in these circumstances with many practitioners favoring agents such as ketamine, midazolam, fentanyl and remifentanil.

For a more comprehensive summary of intubation of sick children please refer to ATOTW 169.

SUMMARY

Anyone who has spent time in paediatrics will have been witness to inductions of anaesthesia that have gone very well, or been very difficult. Outlined above are some of the challenges faced in the day-to-day conduct of paediatric anaesthesia. Flexibility in planning and implementation of an induction strategy will allow a tailored perioperative pathway for each patient. Assessment of children for factors that may complicate induction including pre-operative anxiety, possible behavioural problems, need for restraint, fasting status, critical illness and difficult IV access may allow selective use of appropriate pharmacological and/or non-pharmacological strategies. This will hopefully improve the child and their parents' experience of what can be an incredibly stressful and difficult event.

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