

The preparation of children for surgery

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INTRODUCTION

Good preoperative assessment and preparation of children for surgery is essential. This article reviews the preparation of children for elective and emergency surgery, including psychological preparation.

WHY DO CHILDREN REQUIRE A DIFFERENT APPROACH?

The physiological, psychological and social differences between children and adults necessitate a tailored approach to preoperative preparation.

Physiological

Most children presenting for elective surgery are systemically well and require little in the way of physiological assessment and investigation. Some children can present with complex congenital disease or unusual syndromes that may require specific preoperative investigation and preparation. Previously fit children presenting for emergency surgery may become very unwell, very quickly – this group of children must be recognised so that their condition is optimised prior to surgery.

Psychological

In comparison to adults, children are more likely to demonstrate behavioural issues at induction of

anaesthesia. Psychological development is related to the age of the child (Table 1).

Behavioural issues can result in a stormy anaesthetic induction and post-operative psychological difficulties such as nightmares, phobias, fears and negativism. Post-operative psychological problems are more likely to occur in:

- Children aged between two and three years old
- Children displaying a withdrawn affect pre-operatively
- A difficult, stressful induction
- A child with a history of multiple procedures.

It is important to be aware of these factors and to manage them effectively. This will improve the peri-operative experience for the child, and help shape long term attitudes to healthcare.

Safeguarding children

All staff working with children should be trained in basic child protection. Children are inherently vulnerable by virtue of their dependant status. Evidence of abuse or neglect may be encountered by the anaesthetist in a variety of ways, including direct disclosure. It is important to remember that the child's safety should have primacy over all other considerations. Act upon

Summary

Preparation of children for surgery is essential.

All children should be weighed and examined carefully prior to surgery.

For elective procedures, a pre-assessment visit may be helpful.

Children presenting for emergency surgery may be critically ill and require thorough assessment and resuscitation prior to induction of anaesthesia.

Table 1. Psychological developmental milestones

Age	Psychological developmental stage
<9 months	Babies are able to accept surrogates to parent and respond well to physical contact, talking and rocking.
1-3 years	Children are 'bonded' to parents, and more likely to display separation anxiety. Stormy inductions are most frequent and post-operative behavioural problems are more likely.
3-6 years	Children are more likely to display literal thinking: use euphemisms and metaphors with care. A clear explanation of events and description of procedures will reduce post-operative anxiety.
7-12 years	Children can think logically about real objects, but have trouble understanding hypothetical concepts. They are more independent and should be given simple honest explanations and the opportunity to participate (e.g. hold their own mask for induction)
Adolescents	Reasoning and mature 'adult-like' defence mechanisms have developed. Clear explanation and the opportunity to make decisions are essential to minimise anxiety.

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any suspicions by discussing concerns with colleagues and if possible, involving professionals specifically trained in child protection.

ELECTIVE SURGERY

Children are frequently admitted on the day of surgery. Day case surgery has been shown to reduce post-operative behavioural problems and should be encouraged where possible. Over 60% of paediatric surgery in the USA is now completed as a day case procedure.

Day surgery minimises disruption to families but leaves little time for preparation or for the child to adjust to their surroundings. Pre-admission programmes are now used in the majority of UK children's hospitals to help prepare for surgery.

Common approaches to pre-assessment include:

- Telephone screening - this is particularly useful if the child lives far away from the hospital.
- Nurse-led pre-assessment clinics - for children who live close to the hospital.

Many institutions have produced a standard proforma for pre-assessment as part of the pre-operative pathway, which allows a thorough history to be taken. Hospital patient records, including clinic letters should be retrieved for review. The child can be screened for suitability for day surgery, the requirement for further investigation, and the precautions required for anaesthesia in order to reduce day-of-surgery cancellations, also whether an anaesthetist needs to see the child for further assessment prior to surgery.

Table 2 (following page) lists a selection of common issues encountered in pre-operative screening and their implications. It is helpful to use this table during pre-assessment to identify high-risk patients.

The child's social situation is important when assessing suitability for day surgery. The family should have access to suitable transport from the hospital with one carer free, (i.e. not driving), should ideally live less than one hour from the hospital, and must have access to a telephone. An adult should be present at home for 24 hours after surgery. It is advisable for the family to purchase suitable analgesics in advance.

Pre-assessment visit

Explanation of procedures

Allow time to explain the peri-operative sequence of events to the parent and child. Preparation of the parent is crucial in reducing parental and therefore the child's anxiety. Parents should be encouraged to ask questions about any concerns they may have. If the parents are anxious, the child is more likely to display signs of anxiety themselves.

Explain using:

- Videos
- Play
- Booklets and written instructions
- Face-to-face discussions.

If using interpreters, check for understanding and supplement by written explanation and instructions in the patient's own language whenever possible.

Preoperative instructions

Written instructions used in addition to verbal information reduce confusion and increase compliance. Give particular emphasis to peri-operative fasting and instructions regarding regular medication.

There is controversy as to suitable fasting limits for breast and formula milk, resulting in a lack of uniformity between institutions. Even the concept of solids and liquids is difficult to fully appreciate. For example gelatine (jelly) is ingested as a solid, but turns to liquid in the stomach; cows milk is ingested as a liquid, but turns to solid (curds) in the stomach. There is some evidence that human milk and whey-based formula empties from the stomach faster than cows-milk (casein) based formula. This may be due to the higher protein content of casein formulas. There is great variability in gastric emptying. Table 3 shows some standard fasting guidelines for elective surgery.

Table 3. Preoperative fasting times

	Time before surgery
Solids	6 hours
Milk (formula)	6 hours
Milk (breast)	4 hours
Clear fluids	2 hours

In recent years, there has been a greater emphasis on preventing unnecessary pre-operative fasting in children. There are many reasons to encourage clear fluids up to 2 hours before surgery.

- Infants and small children are less able to tolerate dehydration, especially in hot environments.
- Nausea and vomiting is more frequent in children starved for a long period of time.
- Hypoglycaemia can be avoided.
- Paradoxically, there may be an increase in gastric contents through increased secretion if starvation is prolonged.
- Pre- and postoperative behaviour is improved by minimising fasting times.

Some units require the parent to sign a form at pre-assessment to ensure that they have understood pre-operative instructions.

Consent

The pre-operative visit is the ideal opportunity to gain surgical consent for the procedure if this has not been obtained already. Consent should be obtained from the parent with parental rights, and child if they are old enough to understand. Anaesthetists should understand the local rules about who may give and obtain consent.

In some countries, an older child's consent can be accepted provided they can fully understand

- The procedure
- Potential complications
- The implications of not having the procedure.

Often a child younger than sixteen years is assumed to lack such understanding, but the child may want to countersign the consent

Table 2. Common issues encountered in pre-operative screening and their implications

Problem	Implication for anaesthesia and surgery
Potential airway problems	Airway management in most children is not usually problematic. Abnormal airway anatomy associated with difficult ventilation or intubation may be found in syndromes such as Pierre Robin (airway improves with age), Treacher Collins and the mucopolysaccharidoses (airway worsens with age). Intubation can be extremely challenging in these patients.
Asthma [see article “Anaesthesia in patients with asthma, bronchiolitis and other respiratory disease”, page 58]	<p>Markers for poorly controlled and brittle asthma:</p> <ul style="list-style-type: none"> • Recurrent admission to hospital (including HDU or PICU) • Regular oral steroids and nebulised bronchodilators. <p>Previous use of NSAIDs should be established: while some children’s asthma control is worsened by NSAIDs, the majority are not.</p>
Behavioural issues/ additional needs	<p>Attention deficit hyperactivity disorder (ADHD) does not usually present peri-operative problems.</p> <p>Autism: Pre-operative visits may be difficult due to the child’s requirement for familiarity and routine.</p> <ul style="list-style-type: none"> • A quiet room with toys helps keep the child calm pre-operatively • Parents will often have successful coping methods • Discuss with the parents: <ul style="list-style-type: none"> - Sedative premedication - Alternative approaches – e.g. successful distraction techniques for the child - When to abort anaesthesia - Possible use of ‘therapeutic restraint’ – this should be avoided if possible. <p>Patients with additional needs/ learning disabilities may need reasonable adjustments to the perioperative routine to allow them to tolerate the hospital experience. These should be discussed case by case with the parents/ carers.</p>
Congenital heart disease [see article page 46]	<p>This may be cyanotic, acyanotic, corrected or palliated.</p> <p>Further investigation and optimisation will depend on functional reserve and previous history and liaison with the cardiologist or paediatrician is essential.</p> <p>Medications should be carefully documented and, in general, continued. Anticoagulants require careful consideration. Consider endocarditis prophylaxis.</p>
Heart murmur	<p>Innocent murmurs tend to be quiet, early in systole, unaccompanied by abnormal signs or symptoms.</p> <p>Pathological murmurs are diastolic, pansystolic or late systolic, loud or continuous, often associated with suggestive signs or symptoms:</p> <ul style="list-style-type: none"> • Failure to thrive • Recurrent chest infections • Reduced exercise tolerance compared to their peers • Hypertension • Radio-femoral pulse delay • Syncope • Cyanotic episodes. <p>If there is any doubt as to the nature of a murmur, it must be further assessed before surgery goes ahead. Give antibiotic prophylaxis as dictated by the surgery being undertaken and current guidelines.</p>

Diabetes	<p>Ask about normal blood sugar and current insulin regimen. Involve the diabetic nurse if possible.</p> <p>Agree careful instructions with respect to peri-operative insulin doses and fasting times.</p> <p>Book first on the list if possible. Regular testing of blood sugar is required peri-operatively.</p>
Down's syndrome [see article , page 27]	<p>Pay particular attention to co-existing cardiac conditions.</p> <p>Seek history suggestive of atlanto-axial subluxation or tracheal stenosis (neck pain, noisy breathing). These may be difficult to detect pre-operatively - maintain a high index of suspicion.</p> <p>Increased incidence of: behavioural problems, obstructive sleep apnoea, leukaemia, thyroid abnormalities, duodenal atresia, Hirschsprung's disease, epilepsy.</p>
Ex-premature babies	<p>Chronic lung disease (including requirement for postoperative oxygen), developmental delay, seizure disorders, gastro-oesophageal reflux and failure to thrive are common. Venous access may be difficult.</p> <p>Peri-operative apnoea and bradycardia are more frequent.</p> <p>Ex-premature babies less than 60 weeks post conceptual age (PCA) should not be discharged home on the day of surgery, and should ideally be monitored with a pulse oximeter for 12 hours postoperatively.</p>
Immunisations	<p>It is essential that the immunisation schedule is not interrupted by surgery. Occasionally, the child may be pyrexial after vaccination, in which case elective surgery may be postponed if the child is unwell.</p>
Obstructive sleep apnoea (OSA)	<p>Signs of OSA include snoring, nocturnal apnoea, daytime somnolence, behaviour disturbances, failure to thrive or obesity.</p> <p>OSA may be due to adenotonsillar hypertrophy or congenital abnormalities such as Aperts syndrome or Pierre Robin sequence, or follow interventions such as pharyngoplasty. Use opioids cautiously and monitor post-operative respiratory function, ideally with a pulse oximeter for 12 hours postoperatively.</p>
Previous bad experiences	<p>Peri-operative behavioural problems especially at induction are more frequent.</p> <p>Plan for alternative approaches: involve parents, play therapy if available, consider sedative premedication.</p>
Repeat procedures and anaesthetics	<p>These patients often have an established peri-operative routine.</p> <p>Anxiety may be minimised by keeping to this routine.</p>
Sickle cell disease [see article, page 35]	<p>This may be evident from the family history or a Sickledex test.</p> <p>Patients with severe disease (frequent painful crises, chest crises, or stroke) or major surgery may require a pre-operative top-up transfusion.</p> <p>The child should be first on the list to avoid excessive dehydration. Give intravenous peri-operative fluids and avoid hypothermia during surgery. Adequate analgesia and early mobilization are essential.</p>
Thalassaemia	<p>Suspect if there is a family history of anaemia in patients from endemic areas.</p> <p>FBC and cardiac investigation may be required.</p> <p>Pre-operative blood transfusion is sometimes necessary.</p>

form to demonstrate assent, when their parents have signed consent. This can give them some positive feelings of control of their situation.

The process becomes complicated in the infrequent event of the child consenting whilst the parent refuses. In many countries, a child under the age of 16 may not refuse consent against their parent's wishes. The legal implications are complex, depending on the country.

Play therapy

Young children learn and process experiences through playing. Some hospitals employ play specialists to assist in preparing children for surgery. The aims are to:

- Establish a rapport through normal play.
- Explore the child's interpretation of their operation.
- Prepare the child for their peri-operative experience, for example, by use of a doll to simulate anaesthetic induction.
- Identify children that fail to engage or those with particular anxiety issues that might be improved with targeted sessions prior to the date for surgery.

Investigations

Most children do not require routine pre-operative screening investigations unless there is a specific clinical indication such as anaemia or sickle cell disease.

Day of surgery

Conduct on the day of surgery will be dictated by whether there has been the opportunity for a pre-assessment visit. It is essential that all children are identified by name-band, consent is signed, and the operation site marked by the surgical team, as recommended by the WHO Safe Surgery Saves Lives team.

All patients should be assessed by the anaesthetist immediately prior to surgery.

The value of the pre-operative visit cannot be overstated: it is a final opportunity to consider the child's fitness for anaesthesia and surgery, and to prepare for the peri-operative period.

The main points to address include:

Fasting

Establish the fasting status. Children who are not adequately fasted should not undergo elective procedures. See above for fasting recommendations.

Preparation of child and parent

Before surgery, the anaesthetist should see the child and parent and conduct a pre-operative assessment.

Wear appropriate dress. An anaesthetist who looks unprofessional will not inspire confidence.

- Speak directly to the child using simple and age-appropriate language in the presence of the parents to help ensure a fuller understanding of proceedings.
- Aim to put yourself at the child's eye level, adapted as best as possible to the child's developmental stage and personality.
- Give an opportunity for the child and parents to ask questions and discuss options.

- Re-affirm or obtain consent.

Parents may be keen to hear about all the treatment alternatives and risks, while young children are often disinterested in these discussions. They tend to focus much more on the practicalities, for example, how long the operation takes, how they are going to feel afterwards, and what activities they may be temporarily excused from.

Clinical assessment of the child

Review the pre-assessment record and note any new history such as a recent upper respiratory tract infection (URTI), gastroenteritis or change in medications. The anaesthetist should examine all children pre-operatively, in the presence of the parents, with particular attention to the cardiorespiratory system. This examination also helps with establishing rapport with the child and can help determine whether the child trusts you and will let you near them!

Upper respiratory tract infection (URTI)

Colds are very common in children, but they may be associated with a 2-10 fold increase in peri-operative respiratory complications such as infection, laryngospasm and wheeze.

Elective surgery should be postponed 2-4 weeks if the child is 'unwell', or if there is any suggestion that the child has a lower respiratory tract infection:

- Fever > 38°C
- General malaise
- Chest signs on auscultation
- Productive cough
- The child is under one year old
- Wheezy child
- Major surgery
- Surgery involving the airway.

Investigations

It is essential that all children are weighed on the day of surgery.

Special investigations are not usually required on the day of surgery. Exceptions include:

- Malaria parasites/full blood count in malaria endemic areas
- Peak expiratory flow rate (for brittle asthmatic children or those with an exacerbation of asthma)
- Blood sugar level (for diabetic children only).

Prescription of premedication if required (see below)

Other Issues

Preparation of environment

Consider a 'child friendly' environment with brightly coloured pictures on the walls and toys (be wary of soft toys for infection control reasons). Devices such as mobile phones with music may provide useful distraction. If possible, allow children to enter the theatres in their own clothes to help maintain normality and dignity.

Premedication

Consider premedication for:

- Anxiolysis
- Analgesia
- Antiemesis
- Antisialagogues
- Antacids
- Topical anaesthesia of suitable veins (using local anaesthetic cream) to reduce the pain associated with cannula placement and to help facilitate an intravenous induction.

There has been a reduction in routine anxiolytic pre-medication over the last decade. Appropriate preparation of the child combined with parental presence at induction is sufficient in the majority of cases. There are still situations where anxiolytics are appropriate:

- Multiple/repeated procedures
- Learning difficulties
- Extreme anxiety
- Uncooperative children.

Anxiolytics should be used with caution if there is a history suggestive of obstructive sleep apnoea due to the increased risk of post-operative apnoea.

Midazolam (0.5mg.kg⁻¹ PO (maximum 20mg), or 0.3mg.kg⁻¹ buccally) is the most commonly used pre-operative anxiolytic. The child is sleepy and cooperative after 15-30 minutes and it has minimal effect on wake-up times. Midazolam tastes bitter, which can be disguised by mixing with a small amount of paracetamol elixir or fruit flavoured drink.

Paracetamol is commonly used PO preoperatively and is preferable to perioperative suppositories as rectal absorption of paracetamol is unpredictable. A small amount of water with tablets or a minimal volume of analgesic elixir does not significantly increase the risk of pulmonary aspiration. NSAIDs such as ibuprofen or diclofenac may also be given.

Induction

The presence of parents at induction has become more common in recent years and reduces peri-operative anxiety in both the parent and child. You will need to prepare the parent with a description of what to expect, their role, and when to leave.

There are certain situations when it may not be appropriate to allow parents to be present at induction:

- Neonates and babies - there is little benefit to children under 6 months in having a parent present.
- Many parents may prefer not to be there for the acute management of a critically ill child.
- The anaesthetist or other staff may find that working under the scrutiny of the parent impairs their ability to treat the child in stressful situations.

EMERGENCY SURGERY

There are additional psychological and physiological issues to consider when preparing children for emergency surgery.

Psychological issues

By their nature, these admissions are unplanned. The child may be quiet and withdrawn due to pain, fear, hypotension or sepsis, with little interest in interacting with their environment (state of passivity). Be alert to a child presenting in this manner - never assume that the child is simply frightened. Immediately examine the child to exclude septic or hypovolaemic shock.

It is important to consider the parent. Parental anxiety can present in a spectrum of behaviour from silence and crying to open aggression. This can often be attenuated by a full explanation of the peri-operative plan.

Physiological issues

All of the conditions outlined in table 2 above can also be present in the acutely ill child and the principles of management are the same. Often patient notes are not immediately available. Balance the need for further investigation of pre-existing disease against the urgency for surgery.

Children presenting for emergency surgery may be critically ill and will require thorough assessment and, if necessary, resuscitation prior to induction. Key aspects of the assessment of the critically ill child are outlined in Table 4.

Inadequate resuscitation of a critically ill child prior to induction can result in severe peri-operative haemodynamic instability. Pre-operative shock may be due to hypovolaemia (e.g. trauma, dehydration, acute abdomen) or sepsis (e.g. abscess, appendicitis). The principles of management of the shocked child should follow the ABC framework, and are discussed further on page 223.

Surgery should only proceed if resuscitation is incomplete for haemostasis in trauma or other resuscitation situations.

Anaesthetic induction and maintenance in emergency situations is difficult – use extreme caution. A rapid sequence induction using judicious (lower than normal) drug doses is usually most appropriate.

More thorough reviews of the management and assessment of the critically ill child, including cardiopulmonary resuscitation, are elsewhere in this *Update* (pages 209, 223, 264).

Fasting

Patients awaiting emergency surgery should be 'nil by mouth' for solids for 6 hours pre-op and clear fluids 2 hours, as for elective surgery. However, a risk-benefit decision may be required depending on surgical urgency (e.g. trauma). Beware the use of pre-operative opioids, which can lead to a significant delay in gastric emptying. Intubation is often prudent in this situation. If in doubt, you should choose intubation over an LMA or facemask to protect the airway. If the child is unable to take oral fluids, consider starting pre-operative IV fluids.

Consent

This should be obtained where possible. Proceed in the child's best interests if emergency life-saving surgery is required and there is no parent or guardian available.

Table 4. Recognition of the critically ill child

	Clinical signs of concern
Airway and breathing: Respiratory rate Respiratory effort Efficacy Effects on other organs	A very sensitive sign. Normal rate varies with age. Tachypnoea may indicate pain, respiratory or circulatory compromise. Recession, grunting, accessory muscle use and gasping are especially concerning. Look for poor expansion or reduced breath sounds on auscultation. Heart rate, skin colour, conscious level will alter if the child is hypoxic.
Circulation: Heart rate Blood pressure Pulse volume Capillary refill Peripheral temperature	May be raised due to shock (septic or hypovolaemic), pain, or anxiety. Bradycardia is a worrying sign and may be pre-terminal. Hypotension is a late sign of shock. Age-normal blood pressure is NOT a good measure of volume status. May be bounding in early septic shock or reduced in severe shock. Five seconds of pressure on the sternum should result in capillary refill in 2-3 seconds. Prolonged refill is a sensitive measure of hypoperfusion. The peripheries may be warm in early septic shock, cold in established shock, or simply cold due to a cool ambient temperature.
Neurological status: Conscious level	Reduced consciousness or lethargy is concerning and may be due to hypovolaemia, sepsis or have a primary neurological cause (e.g. head injury, meningitis).

Investigations

Depending on the pathology, pre-operative blood tests are much more important for emergency surgery. Significant electrolyte imbalance (e.g. pyloric stenosis, bowel obstruction) or anaemia (trauma) may be present. Blood group typing or cross match may also be necessary. Always measure blood sugar concentration in a shocked child.

CONCLUSION

Preparation of children for surgery is essential to ensure a safe perioperative course and pleasant experience for the child. All children should be weighed and examined carefully prior to surgery.

For elective procedures, a pre-assessment visit may be helpful to smooth the preoperative process and avoid cancellations on the day.

Children presenting for emergency surgery may be critically ill and require a thorough physiological assessment to ensure that resuscitation measures are taken prior to induction of anaesthesia.

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