

PAEDIATRIC ANAESTHESIA FOR DAY SURGERY

ANAESTHESIA TUTORIAL OF THE WEEK 203

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QUESTIONS

Before continuing, try to answer the following questions. The answers can be found at the end of the article.

1. Regarding anaesthetic technique for children in paediatric day care, which of the following statements are true:
 - a. Premedication should never be used
 - b. Midazolam in the dose of 0.5-0.75mg/kg PO acts within 10-30 minutes.
 - c. Opioids provide optimal analgesia.
 - d. Intravenous fluids are not indicated
 - e. Clonidine may be used as premedication.

2. The following procedures are suitable for day case surgery
 - a. Strabismus correction
 - b. Tooth extraction
 - c. Adenotonsillectomy
 - d. Appendicectomy
 - e. Herniotomy

3. Regarding fasting instructions for elective surgery, which of the following statements are true:
 - a. The gastric emptying of an infant fed with breast milk is longer than for an infant fed with formula milk
 - b. Solid food can be taken up to 4 hours before surgery.
 - c. Clear fluid can be taken up to 2 hours prior to elective surgery.
 - d. Children are best starved from midnight before surgery.

4. Postoperative control of nausea and vomiting is an important component of paediatric day care surgery. Which of the following statements are true:
 - a. Ondansetron 0.1mg/kg IV/PO is the drug of first choice
 - b. There have been no harmful side effects reported with the use of dexamethasone as an antiemetic.
 - c. Adequate hydration reduces postoperative nausea and vomiting
 - e. A combination of two drugs can be more effective than just one.

INTRODUCTION

The development of day surgery began in the United Kingdom during the 1950s and 1960s in response to expert concern for the wellbeing of the child in hospital. In recent years, day surgery has become increasingly popular as it is more cost effective, is less disruptive to the family, and may reduce the risk of nosocomial infection. The European Charter of Children's rights states that "children should be admitted to hospital only if the care they require cannot be equally well provided at home or on a day basis". In the UK there is a drive from the Department of Health to perform 75% of elective surgery in the day case setting. Many common paediatric operations are well suited to day surgery, and the scope of procedures carried out as day stay procedures has increased accordingly.

Day surgery may be provided for a variety of surgical specialities, including ENT, orthopaedic, dental, and ophthalmic and paediatric general surgery. Children have special requirements; they differ from adults anatomically, physiologically and emotionally. The anaesthetic equipment differs and doses of fluids and drugs need to be calculated precisely. Whenever children undergo anaesthesia, their particular needs must be recognised, they should be looked after by appropriately trained staff, and where possible, managed in separate facilities designed and furnished with the needs of children in mind.

For many children, attendance for day surgery may be their first and only experience of a hospital environment. Impressions will be remembered and may colour the way the child reacts to subsequent hospital admissions, as well as their attitudes to healthcare in adult life. Discharge of the child on the day of surgery shifts the burden of care to the parents who need to be well informed and supported so that they provide optimal care for the child when the child returns home.

FACILITIES FOR DAY SURGERY

One of the key aspects of providing high quality paediatric day case management is location of the service. Ideally children should be nursed in customized and specifically designed paediatric day care units. However if children must be cared for on an adult unit, a separate area must be organised for them and their parents/carers. Suitable equipment, toys games and a play area should be provided to reduce anxiety and speed recovery.

Purpose built children's day unit

This is the ideal model, if there is sufficient paediatric workload in the hospital. The environment should be child-safe and child-friendly. The design of the patient areas should ensure that preoperative and postoperative patients are separated.

Children in adult day units

These units should have dedicated children's days or sessions according to demand. The unit can be made child friendly for these sessions and appropriately trained children's nurses can be brought in to ensure best quality care

Children's day cases through in-patient facilities

Although this model ensures appropriate nursing and support personnel are available and the environment is optimal for children, it has many disadvantages. Healthy children are mixed with acutely ill inpatients, which may lead to the day case children being neglected in favour of the in-patients as the ward staff are often more focused on management of the sicker patients. If this model is to be used successfully a separate part of the inpatient ward should be dedicated for day case use, with nursing staff assigned to this area with no other responsibilities.

SELECTION CRITERIA

Day surgery is particularly appropriate for children, provided the operation is not complex or prolonged and the child is healthy with no significant co-existing medical illness. Exclusion criteria for day care surgery include patient-related factors, surgical, anaesthetic, and social factors.

Exclusion criteria for paediatric day care:

Patient related factors

- Term baby less than one month in age
- Preterm or ex-preterm baby <60wks post conception age
- Poorly controlled systemic disease e.g. asthma
- Inborn errors of metabolism, diabetes mellitus
- Complex cardiac disease, or cardiac disease requiring investigation.
- Sickle cell disease (not trait)
- Active infection (especially of respiratory tract)

Anaesthetic and surgical factors

- Inexperienced surgeon or anaesthetist
- Prolonged procedure
- Opening of a body cavity
- High risk of perioperative haemorrhage/fluid loss
- Postoperative pain unlikely to be relieved by oral analgesics
- Difficult airway (including obstructive sleep apnoea)
- Malignant hyperpyrexia susceptibility
- Sibling of a victim of sudden infant death syndrome

Social factors

- Parent unable or unwilling to care for the child at home postoperatively
- Poor housing conditions
- No telephone
- Excessive journey time from home to the hospital (>1 hour)
- Inadequate postoperative transport arrangement

Examples of procedures suitable for paediatric day surgery

General surgery

- Herniotomy (inguinal, umbilical, epigastric)
- Upper and lower gastrointestinal tract endoscopy +/- biopsy
- Lymph node excision/biopsy

Urology

- Cystoscopy
- Orchidopexy
- Preputial adhesions and circumcision
- Minor hypospadias

ENT

- Myringotomy +/- grommets
- Nasal fracture reduction
- Adenotonsillectomy **

Dental

- Extractions

Ophthalmology

- Examination under anaesthesia
- Lacrimal duct probing
- Strabismus correction

Plastic surgery

- Otoplasty
- Excision skin lesions
- Scar revision

Orthopaedics

- Change of plaster
- Removal of metalwork
- Arthroscopy

Medical

- Imaging techniques, e.g. CT, MRI
- Interventional radiology/cardiology
- Bone marrow sampling, lumbar puncture +/- intrathecal medication

Day case adenotonsillectomy

This is a controversial area of day case practice. In 1985 the Royal College of Surgeons of England published guidelines for day surgery in which they concluded that adenotonsillar surgery was unsuitable for day care surgery due to the risk of haemorrhage. However attitudes have changed in recent years with increasing reports in the UK literature testifying to the safety of day case adenoidectomy and tonsillectomy. Scrupulous patient selection is essential to the success of a day case adenotonsillectomy programme. The following criteria should be used:

- Well child
- No concurrent respiratory tract infections
- No obstructive sleep apnoea

A strict anaesthetic protocol improves outcomes (see below).

PERSONNEL

A multidisciplinary team is required to provide high-quality day care. All staff should be trained in the developmental, psychological and communication aspects of care. Clinical staff should be able to recognise a sick child quickly and start emergency treatment if required, including paediatric resuscitation. Staff should have the appropriate child protection training.

Surgeons and anaesthetists

Children should be anaesthetised by consultants who have regular and relevant paediatric practice sufficient to maintain core competencies. In the UK, non-consultant anaesthetists may anaesthetise children provided there is a nominated supervising consultant anaesthetist. The anaesthetist must be assisted by staff (operating department practitioner/anaesthetic nurses) that have relevant paediatric training and skills.

Nursing staff

All nursing staff should be experienced in day-case management and in addition a proportion of the nursing establishment should be trained paediatric nurses.

Play specialists

Most UK children's hospitals employ play specialists. By establishing a rapport through normal play, the play specialists can prepare the child for their perioperative experience.

Administrative staff

Good clerical assistance is essential if the day unit is to function efficiently.

PREOPERATIVE ASSESSMENT

Explanation of procedures

Ideally the family should attend a pre-assessment visit to allow for a thorough explanation of the perioperative sequence of events to the parent and child. Preparation of the parent is crucial in reducing parental anxiety. Parents should be encouraged to ask questions about any concerns they may have. It has been shown that children with anxious parents are more likely to display signs of perioperative anxiety themselves. Explanation may be given through the use of videos, booklets (http://www.rcoa.ac.uk/docs/PI_ycgadt-single.pdf, http://www.rcoa.ac.uk/docs/PI_ycga.pdf) and written instructions as well as face-to-face. This is an ideal opportunity to discuss post operative pain management and recovery care. Telephone preassessment may be used as an alternative where travel to the hospital is difficult.

Instructions

Written instructions should be used where possible. Particular emphasis should be given to perioperative fasting and instructions regarding regular medication. There is much controversy as to suitable fasting limits for breast and formula milk, resulting in a lack of uniformity between institutions. There is some evidence that human milk and whey-based formula empties from the stomach faster than cows-milk (casein) based formula. It is postulated that this is due to the higher protein content of casein formulas.

Guidelines vary between institutions, but the table below shows fasting guidelines for elective surgery used in our institution.

Fasting instructions for children before surgery

No solids/milk including formula for 6 hours preoperatively
No breast milk for 4 hours preoperatively

Free clear fluids up to 2 hours preoperatively

Consent

According to UK General Medical Council guidelines, consent for surgery is a process that should start in the outpatient clinic and then verified with a written consent form on admission. Anaesthetic consent (usually verbal) is usually obtained on admission, although this may be taken at a preadmission clinic. Consent should be obtained from the parent and the child if the child is old enough to understand; in the UK, children over the age of 16 years are able to sign their own consent form.

Preoperative investigations

Routine preoperative investigations of children prior to day surgery are unjustified on clinical and economic grounds unless clinically indicated, and will cause unnecessary stress to the child. A full blood count and sickle test may be justified in at risk populations.

PREOPERATIVE CARE

On the day of admission the child and family should be welcomed to the unit and introduced to the nurse caring for them. They should be assessed clinically to ensure that they are fit for surgery.

The Child with a Cold

The child with a cold poses a particular dilemma. Colds are common - children have 6-8 upper respiratory tract infections (URTIs) per year, but URTIs are associated with an increased incidence of complications under anaesthesia, such as coughing breath holding, desaturation, bronchospasm and laryngospasm. How should a decision be made to proceed?

There have been a few case reports of deaths in children undergoing anaesthesia associated with an URTI - thought to be due to undiagnosed myocarditis. As a general rule, it is sensible to examine all children before anaesthesia, particularly the child with a cold. Beware a child who has had a prolonged or unusual illness, is pyrexial, listless and unwell, who is breathless and who has a relative tachycardia. Oxygen saturation is a very useful to discriminate between an URTI and a lower respiratory tract infection. Check the oxygen saturation in all children with an URTI!

Risk factors for complications of an URTI in a child undergoing anaesthesia include:

- Use of a tracheal tube,
- Prematurity
- Asthma
- Parental smoking
- Copious secretions
- Nasal congestion
- Surgery on the airway.

Epidemiological studies looking at the complications of URTI in children have generally excluded those children who are significantly unwell (pyrexia 38°C, systemically unwell) and children <1 year of age (who are at increased risk of airway complications due to their age)

The following approach may be used for the child with an uncomplicated URTI:

- Urgent surgery – proceed
- Elective surgery:
- Severe symptoms ('unwell') - postpone 4 weeks
- Mild/recent URTI
 - <1 year of age – postpone
 - >1 year – consider risk/benefit ratio

The anaesthesia technique in a child with an URTI should include minimal airway instrumentation if possible, gentle suction to clear secretions, adequate hydration and humidification of the airway to avoid sputum plugging, 'smooth' anaesthesia induction and emergence. Anticholinergics should be considered.

Incidental heart murmurs

The identification of an incidental heart murmur may also cause concern in a child presenting for day surgery. When should the murmur be investigated, and when should elective surgery be postponed?

An innocent murmur is typically, soft, early systolic and there are no abnormal symptoms or signs. The murmur varies in intensity with position – usually quieter when the child is standing upright. Children who are anaemic may have a flow murmur associated with increased cardiac output. It is reasonable to proceed with surgery in this situation, but the child should be investigated later (cannot exclude e.g. mild pulmonary stenosis)

The child should be investigated prior to surgery in the following situations:

- Child < 1 year old
- Pathological murmur
 - All diastolic, pansystolic, late systolic, loud or continuous murmurs
- Any abnormal symptoms or signs
 - Failure to thrive
 - Recurrent chest infections
 - Syncope, chest pain
 - Cyanosis, desaturation
 - Hypertension
 - Palpable heave/thrill
 - Radio-femoral delay
- Abnormal ecg or chest X-ray

Psychological preparation

Children and parents require careful psychological preparation for what is often a stressful event for the whole family. Preparation should begin at the initial preoperative assessment. Parents should be given the opportunity to ask questions and allay anxieties. Separation of child from parent should be minimised; parents should be encouraged to accompany their child during anaesthetic induction.

Sedative premedication

Good psychological preparation combined with parental presence at anaesthetic induction minimises the need for premedication, although selected children may benefit from sedation. These include children who have had a previous traumatic experience, or an unduly anxious child. Younger children undergoing inhalational induction may also benefit.

- Opioids are suboptimal as premedication as they can increase postoperative nausea and vomiting (PONV)
- Midazolam is commonly used. A dose of 0.5-0.75mg /kg acts within 10-30mins so that the child is calm and cooperative. Postoperative recovery is not delayed, although midazolam may be associated with nightmares in some children postoperatively.
- Ketamine has been suggested as an alternative pre-med in children. In low doses ketamine has hypnotic, analgesic and amnesic effects. Ketamine may be associated with emergence phenomenon in some children. The dose of ketamine for premedication is 5mg/kg PO.
- Clonidine 1mcg/kg is useful as premedication. It should be given one hour pre-operatively.

Topical local anaesthetics

Local anaesthetic skin preparations (EMLA, Ametop) allow intravenous access in a relatively pain free manner. For best results the preparations have to be applied 60-90 minutes preoperatively to be effective. Lidocaine 4% w/w Cream is a new advanced topical anaesthetic, which may have a faster onset of action

MONITORING AND EMERGENCY EQUIPMENT

The full range of paediatric anaesthetic equipment, monitoring devices, and disposable items for general and regional anaesthesia is required. For example, the following devices should be available for children of all ages and sizes

- Airway management equipment - facemasks, tracheal tubes, LMAs, oral airways
- Pulse oximeter with paediatric probe
- End-tidal CO₂ monitoring
- ECG
- Paediatric blood pressure cuffs
- Intravenous cannulae (25G, 22G)
- Temperature probe
- Resuscitation drugs and equipment, including a defibrillator.
- Anaesthetic machines should incorporate ventilators that permit the use of pressure-controlled ventilation and PEEP in children of all sizes.

ANAESTHETIC MANAGEMENT

Induction of anaesthesia

For the majority of children the most daunting experience of day surgery is the visit to the anaesthetic room with its unfamiliar people and apparatus. Nursing staff should accompany parents to the theatre to support those who wish to be with their child in the anaesthetic room.

The choice of anaesthetic technique is aimed to provide a smooth, atraumatic induction.

Inhalational induction

This route is preferred in children who are needle phobic, young children or in those with difficult intravenous access. Neonates should lie on the operating table (trolley); anaesthesia is induced via an anaesthetic mask attached to a T-piece, or similar, low resistance anaesthetic circuit. Older children can either sit on a parents lap, or lie on the operating table and usually accept a gas induction with gentle encouragement. Halothane used to be a popular induction agent but sevoflurane is now preferred due to its rapid onset, pleasant smell and non-irritating properties.

Intravenous induction

The main problems with intravenous induction are pain on insertion of the cannula, a natural aversion of children to "needles" and difficult intravenous access. The choice of intravenous agent for day care is between sodium thiopentone and propofol. Induction with propofol is generally preferred as it is relatively smooth and can profoundly obtund upper airway reflexes facilitating early insertion of a laryngeal mask airway (LMA). One drawback is that it can cause pain on injection that can be minimised by adding small dose of lidocaine to the propofol.

Maintenance

Maintenance of anaesthesia with oxygen, air/nitrous oxide and a volatile agent is satisfactory for the majority of paediatric day case procedures. Maintenance with propofol may be preferred in children with a history of PONV, or those undergoing surgery that is high risk for PONV.

Fluid therapy

The goal is to correct preoperative deficits and to replace intraoperative losses. PONV is reduced if the child is well hydrated intraoperatively.

A simple approach is to give 10-20ml/kg Hartmann's solution and monitor clinically. Postoperatively it is safer for the child to manage their own fluid requirements via the oral route. Intravenous fluids should not be used routinely in the postoperative period.

ANALGESIA

Pain control is essential for the success of children's day surgery. A multimodal approach using local anaesthesia, paracetamol and NSAIDs can help in achieving this.

Non steroidal anti-inflammatory drugs and paracetamol

This forms the mainstay of postoperative pain relief. The advantage over opioid analgesics includes a lack of respiratory depression and sedation. They do not cause nausea or vomiting. Use of NSAIDs is not recommended below six months of age due to the possibility of immature renal function and hepatic metabolism. Most commonly used agents are:

- Diclofenac (1mg/kg, PO/PR 8 hourly prn)
- Ibuprofen (5-10mg/kg PO 6-8 hourly).
- Paracetamol (10-15mg/kg PO/PR/IV, maximum 60mg/kg/day <3 months, 90 mg/kg/day in older children).

Opioids

Opioids are not ideal for paediatric day case surgery as they may produce ventilatory depression, excessive sedation and PONV. Opioids are required during and after surgery for some procedures such as adenotonsillectomy. Shorter acting opioids are ideal - fentanyl (1-2mcg/kg) is commonly used. Longer acting opioids (morphine / pethidine) may be required if postoperative pain is unexpectedly severe.

Local anaesthetic techniques

The route of administration of local anaesthetic will depend on the skill and experience of the anaesthetist and type of surgery.

Topical

Lidocaine gel can be used topically after circumcision. Topical local anaesthetic eye drops can be used to provide analgesia following ophthalmic surgery

Infiltration

Surgical wound infiltration with bupivacaine 0.25% 2mg/kg can be used to provide analgesia following skin biopsies, muscle biopsies and virtually all procedures where other regional blocks are either inappropriate or contraindicated. It is simple to perform and very effective.

Peripheral nerve blocks

Ilioinguinal/Iliohypogastric nerve block, penile block, TAP block and caudal block can provide effective postoperative analgesia. (Tutorials on this website can be referred to for this)

POSTOPERATIVE NAUSEA AND VOMITING

The successful management of PONV is an important component in the care of children after surgery. PONV may cause discomfort and distress, delay recovery and prolong hospitalisation. A multimodal management approach is useful:

- Avoid emetogenic anaesthesia techniques (e.g. morphine IV)
- Perioperative intravenous hydration
- Adequate pain control
- Multiple different antiemetic medications (double or triple combination antiemetic therapy acting at different neuroreceptor sites)

Some of the commonly used antiemetics include:

- Ondansetron 0.1mg/kg IV (maximum 4mg)
- Dexamethasone 0.1mg/kg IV (maximum 4mg)
- Cyclizine 0.5-1 mg/kg IV (maximum 50mg).

Anaesthetic management – day surgery adenotonsillectomy

Outcomes after day stay adenotonsillectomy are improved if a standard protocol is used. A useful protocol has been described by Ewah et al (see further reading). Dexamethasone is an effective antiemetic for day case adenotonsillectomy, but there have been recent concerns that dexamethasone increases bleeding after adenotonsillectomy. A pragmatic approach is to use one dose of dexamethasone and restrict to 0.1mg/kg, maximum 4mg.

- Clear fluids until 2hrs preoperatively.
- Propofol induction
- Maintenance with sevoflurane in air and oxygen
- Reinforced LMA in children 3 years and above.
- Spontaneous breathing via a suitable breathing system.
- Routine antiemetics – ondansetron, dexamethasone,
- Routine analgesia - paracetamol, diclofenac, codeine (1mg/kg IM).
- Intravenous infusion with crystalloids 10ml/kg.
- On return to the ward children are given free fluids and food on demand
- Nursing observations for 6 hours postoperatively
- **Postoperative consultant led ward round**
- Nurse led discharge after 6 hours

Discharge medications

- Routine antibiotics
- Ibuprofen 5mg/kg tds for **1 week**
- Soluble paracetamol 15mg/kg qds for **1 week**
- Soluble codeine linctus 0.75-1mg/kg qds for **1 week**.

POSTOPERATIVE CARE

Children should be returned to the ward when they are awake (responding to commands), in control of their airway and warm. Pain and PONV should be under control. Parents should be allowed to sit with the child in the recovery area if this is appropriate and can be facilitated by the PACU, and accompany the ward nurse on the journey back to the ward. Depending on type of surgery, children should be offered fluids and a light diet as soon as possible on return to the ward (when fully conscious/not vomiting), as this tends to make them less distressed.

DISCHARGE FROM HOSPITAL

The medical team must review the child postoperatively and the parents must be given clear verbal and written instructions regarding postoperative care at home. This should include details of wound care, analgesia, diet, mobilisation and resumption of normal activity. It is very important that parents are taught to give pain relief regularly for at least 24-48hrs postoperatively (in cases where local anaesthetic blocks are given, it should be started before block has worn off). This will ensure optimal pain relief and decreases the number of referrals to general practitioners or re-admissions because of analgesia problems. An example of a pain information leaflet for parents can be found at:

http://www.gosh.nhs.uk/gosh_families/information_sheets/pain_day_surgery/pain_day_surgery_families.html

The following criteria must be met before discharge:

- Vital signs and conscious levels should be normal
- Protective airway reflexes fully regained
- No respiratory distress or stridor
- No unexpected intraoperative anaesthetic events
- No bleeding/surgical complications

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- PONV absent/mild
- Pain absent/mild
- Appropriate ambulation
- Written or verbal instructions issued
- Escort home by responsible adult (who is not driving and not looking after other children)

HOSPITAL ADMISSION

A small proportion of children may require inpatient admission and free standing day units should ensure that they have capability to transfer children to inpatient facilities if need arises.

FOLLOW UP

A discharge letter describing treatment received should be posted or faxed to the general practitioner or passed to the patient/parents for immediate delivery.

SUMMARY

- A variety of general surgical, orthopaedic, urological, ENT and radiological procedures can be undertaken as day cases in children.
- Good psychological preparation and close involvement of family is essential
- The full range of paediatric equipment, monitoring devices and resuscitative equipment should always be available
- Anaesthetic technique can be chosen depending on the needs of the child; it is preferable to avoid strong opioids
- A multimodal approach is useful for successful management of pain and control of postoperative nausea and vomiting.
- Adequate analgesia must be provided at home.
- Parents must be provided with verbal and written postoperative instructions about wound care, analgesia, diet, mobilisation and resumption of normal activity.

ANSWERS TO QUESTIONS

1. FTFFT
2. TTTFT
3. FFTF
4. TFTT

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