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Clinical challenges in paediatric ambulatory patients

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Clinical challenges for the child undergoing ambulatory surgery was the topic discussed on the morning of Friday, May 2, 1997, at the Society for Ambulatory Anaesthesia Annual Meeting. The first talk, entitled 'Managing the Child with Congenital Heart Disease' was presented by Ronald S. Litman, DO, Assistant Professor of Anaesthesiology and Paediatrics and Chief of Paediatric Anaesthesia at the University of Rochester Medical Center, Rochester, New York. Congenital heart disease affects between two and eight children per 1000 at birth. When a child with congenital heart disease comes for ambulatory surgery, the lesion is either uncorrected, palliated, or corrected. Children with uncorrected lesions either have a lesion that will not cause hemodynamic compromise or may be awaiting surgery for correction. An example of a child who has undergone palliative surgery is a child who has had a Blalock–Taussig shunt for tetralogy of Fallot. Children with corrected lesions may present no cardiac concerns although other non-cardiac anomalies may affect anaesthetic management. Some cardiac lesions, for example, are associated with shorter tracheas so that after intubation, it is especially important that breath sounds be auscultated to ensure that both sides of the lung are being ventilated. Concerning preoperative laboratory tests, no specific laboratory test is indicated in children with heart disease. In these children, as with most children undergoing ambulatory surgery, the most commonly ordered blood test is hematocrit. Preoperative hematocrits $>65\%$ are problematic and should be discussed with the patient's cardiologist.

Information that can be gleaned from the preoperative interview includes a determination of exercise intolerance. In an infant, strength of feeding may be a means to determine exercise intolerance. The child's cardiologist or even parent can provide important clinical information about the nature of the child's complex lesion. A mild upper respiratory tract infection may cause greater cardiac stress, so surgery is usually cancelled when the child has such an infection. It is important to ask parents about the child's previous anaesthetics and their management and to check the patient's chart for this information.

Dehydration must be avoided. With chronic hypoxia, patients may have polycythemia, and dehydration with polycythemia may be problematic. For perioperative fasting, normal NPO rules should apply.

If the child is sedated preoperatively, there is less crying. Because sedation decreases oxygen consumption, it may be important if oxygen consumption is a concern. An excessive amount of sedation should be avoided though, because of possible hypotension or respiratory depression. Oral midazolam seems to be particularly advantageous in children with congenital heart disease, but oxygen saturation should be measured to avoid desaturation.

Intraoperative monitors may not be accurate in patients with congenital heart disease, particularly in patients with a right to left shunt in whom ventilation and perfusion are mismatched. The difference between end-tidal and arterial carbon dioxide is greater in patients who are cyanotic. Such a difference is present even in normal patients, although the difference is greater in patients with congenital heart disease. The practitioner should use the end-tidal CO_2 as a means to detect a trend and should not rely on absolute numbers.

Pulse oximeters may also be problematic in patients with congenital heart disease, particularly when the oxygen saturation is less than 70%. When saturation decreases further in patients with chronically low oxygen saturation, the pulse oximeter may not reflect the decrease. A precordial stethoscope may then be useful for monitoring.

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Concerning anaesthetic agents, there is no good proof that one agent is better than another. In patients with right to left shunts, inhalation agents may cause a greater shunt fraction cyanosis. Ketamine has been thought to be particularly useful in patients with right to left shunts because it preserves systemic vascular resistance. Propofol has recently been used and seems to be a better drug because of its shorter duration of action.

Regional anaesthesia is generally safe for children with congenital heart disease. Patients with coarctation of the aorta may have tortuous arteries, so that regional anaesthesia is probably not optimal because the needle used to insert the local anaesthetic may hit such an artery. In patients with right to left shunts the action of local anaesthetics may be prolonged: local anaesthetics are metabolized in the lungs and because of the shunt, anaesthetics may take longer to reach the lungs. In patients with high hematocrits ($>60\%$) coagulopathy may be present. If regional anaesthesia is anticipated, the practitioner should make sure that clotting function is normal.

Postoperatively, hypoventilation of the child should be avoided. Oxygen is recommended on transport of the patient to postoperative care. These patients may be more prone to develop post extubation croup. The clinician should be prepared for that problem in the post anaesthesia care unit.

Concerning specific lesions, an atrial septal defect may be associated with postoperative arrhythmias. Patients with ventricular septal defects may have pulmonary hypertension. After repair, a right bundle branch block is common and patients may also have myocardial dysfunction; arrhythmias; tricuspid and mitral and/or pulmonary insufficiency. Patients who have undergone a patent ductus arteriosus repair usually have no permanent sequelae. For all of these lesions, prophylactic antibiotics should be considered to prevent sub acute bacterial endocarditis, particularly in surgical procedures that are likely to result in bacteremia. Patients who have a Blalock shunt should be kept well hydrated so that the shunt does not clot.

Pain management for the child was the next topic of discussion given by Hernando DeSoto, MD, Chief of Paediatric Anaesthesia and Clinical Associate Professor of Anaesthesia at the University of Florida College of Medicine, Jacksonville, Florida.

The tendency in the management of postoperative pain in children is to undermedicate patients. The primary reason for undermedication is that a fixed dose is given based on weight. Another reason is that pain medications are ordered 'as needed'. PRN (as needed) may be acceptable for adult pain medication, but it is difficult for a 6 month old to state that he or she is in pain. Older children hate intramuscular injections and so may avoid asking for pain medication. There is also an exaggerated concern about side effects. For children, as is the case frequently for adults, determination of the presence of pain is delegated to inexperienced personnel. Finally, there is the mistaken belief that children do not experience pain.

Pain assessment in children is not necessarily more difficult than in adults, but it is different. For neonates behavioral cues for pain are facial grimacing (eyebrows furrowed and eyes tightly closed), crying and an increase in motor activity. A cry of pain is higher in pitch and more urgent in character than normal crying. Motor activity in the presence of pain consists of arching of the back and withdrawing. The physiologic parameters associated with pain are non-specific. If a procedure is painful for an adult or older child, the procedure will also be painful for a young child. Sometimes when scales for pain are used, the child will point to what he likes to feel rather than what he is actually feeling. Many tools are available to help children qualify the amount of their pain. These include facial expressions, the oucher scale, color scales, and various linear analog scales.

Acetaminophen is the most common drug used for mild analgesia. In the past, children have been undermedicated with this drug. Doses of 10 mg/kg are too conservative. Doses rectally of 35 and up to 45 mg/kg have been reported without adverse effects. Orally, the dose of 15–20 mg/kg every 4 h is useful. The drug takes approximately 3 h before a maximal effect is seen. Therefore, it is best given even preoperatively rather than at the end of a surgical procedure.

Ketoralac is a useful, non-steroidal, anti-inflammatory drug for the control of pain. It can be given both intravenously and orally. When given in combination with opiates, opiate requirement is less. Non-steroidal anti-inflammatory drugs and acetaminophen work together and act at different sites. The toxicity of the two drugs is not additive. The main concern with the use of non-steroidal anti-inflammatory drugs is their effect on platelet function. In patients undergoing tonsillectomy, for example, the drugs may be problematic. Ketorolac should be avoided in patients with a coagulopathy, neuropathy, gastropathy, or hypovolemia or in those undergoing high-risk surgery.

Clonidine, which reduces postoperative pain, is a drug that has had limited use in adults and even less use in children. There is the potential for bradycardia when clonidine is used.

Narcotics, which may be necessary to control intense pain, can contribute to postoperative drowsiness, respiratory depression, and nausea and vomiting. Remifentanil has recently been introduced into anaesthesia practice, and it may be useful for children. Because of its rapid offset though, it may not be therapeutic in patients who will have pain postoperatively. In addition, because delivery by infusion is nec-

essary, it should not be used for short cases where the complexity and expense associated with its delivery are not warranted.

Regional anaesthesia is a method to help control pain, and one that should not be ignored in patients undergoing ambulatory surgery. The caudal block is probably the most popular form of regional anaesthesia in children but is most useful for operations below the umbilicus. Bupivacaine is the local anaesthetic most commonly used. For lower extremity surgery, a dose of 0.5–0.75 ml/kg of a 0.125% bupivacaine solution is satisfactory. For operations in the inguinal region, a higher dose, i.e. 0.75–1 ml/kg, is necessary. Penile blocks are very effective for circumcision or hypospadias repair. A ring block around the base of the penis or a dorsal nerve block at the 10:30 and 13:30 h positions at the base of the penis can be performed. Another type of penile block involves the application of a local anaesthetic cream at the incision site after surgical closure. In neonates, an epinephrine-free solution of local anaesthesia (either 0.25% bupivacaine 1–3 ml or lidocaine 1%) should be used.

Bier blocks are effective in the emergency room for closed reductions. A 3 ml/kg of 0.5% lidocaine solution may be used.

Although anaesthesiologists who care for children, in general, tend to undermedicate them for control of pain, our colleagues who care for them outside of the operating room probably undermedicate them even more. Procedures such as veni-puncture, lumbar puncture, or bone marrow aspiration may be particularly painful and feared by children. Pain control with some of the techniques described or with EMLA cream is advisable.

The next lecture entitled 'Management of the Ambulatory Patient with Sleep Apnea or Bronchospastic Disease' was given by Raafat S. Hannnallah, MD, Professor of Anaesthesiology and Paediatrics at the Children's Hospital National Medical Center, Washington, DC. The current trend in management of ambulatory surgery patients is to take care of patients who are sicker. These include patients with sleep apnea or bronchospastic disease.

Patients with sleep apnea may have obstructive central or a mixed type of apnea. In central apnea, there is decreased CNS output to the inspiratory muscles. With obstructive apnea, although respiratory efforts continue, the upper airway is closed, resulting in no airflow. Despite the cause for apnea, the end result is desaturation. The usual causes for this syndrome in children include adenotonsillar hypertrophy, craniofacial anomalies, obesity, or neuromuscular disease. Frequently patients with adenotonsillar hypertrophy require tonsillectomy and adenectomy. A patient with craniofacial anomalies may have sleep apnea because of the decreased area of his airway. Obstructive sleep apnea should always be suspected in a child scheduled for tonsillectomy and adenoidectomy surgery. These patients may have an elevated hematocrit because of chronic hypoxemia. Patients with coexisting pulmonary disease, e.g. bronchopulmonary dysplasia or asthma, may have a predilection for pulmonary hypertension. Severe forms of the disease may be accompanied by cardiomegaly and some element of cardiac dysfunction.

Intraoperatively, apneic patients may demonstrate complete airway obstruction after induction of anaesthesia. They usually do not have an anatomic obstruction that would interfere with direct visualization of the vocal cords during laryngoscopy. These children probably should not be extubated until they are awake. Patients who are considered high risk have craniofacial anomalies affecting the pharyngeal airways, failure to thrive, hypotonia, corpulmonale, morbid obesity, previous upper airway trauma and are less than 2 or 3 years of age. Postoperatively, these patients may require oxygen, continuous positive airway pressure, or some form of afterload reduction. Extubation may be delayed until surgical swelling subsides and normal pharyngeal muscle tone is restored. Patients such as these obviously are not appropriate for ambulatory surgery. Some physicians think that any apneic child with more than minimal symptoms is not an appropriate candidate for ambulatory surgery.

Patients with bronchospastic disease are noisy breathers. They may have reactive airway disease or asthma. Asthma is probably the most common disease of childhood, and a disease whose incidence is increasing. Although more prevalent among Caucasians, the disease tends to be more intense in African American individuals. Asthma may be classified according to its intensity, from mild asthma by history to active wheezing. Patients with active wheezing either have moderate asthma that is under poor control or are never wheeze free and have severe asthma. Patients with active wheezing because their moderate asthma is poorly controlled should not undergo surgery. Patients with severe asthma are difficult to manage and probably should not, under any circumstance, undergo ambulatory surgery. Patients with upper respiratory tract infections are at an increased risk for wheezing and should probably wait for 1 month before they undergo ambulatory surgery.

Patients with mild asthma are excellent candidates for ambulatory surgery. Patients with moderate asthma who are taking daily medications to control their symptoms should be instructed to continue their medications up to and including the morning of surgery. A beta agonist should be administered in the holding area.

In the management of patients intraoperatively with asthma, endotracheal tubes should be avoided if possible because they are associated with an increased incidence of bronchospasm. If a patient is intubated, the

anaesthesiologist should make sure that there is an adequate depth of anaesthesia. An LMA is preferable to an endotracheal tube.

There is probably no advantage to using one type of anaesthetic over another. If a patient does experience intraoperative bronchospasm, a beta agonist is useful. The criteria for discharge home should be no different than that for other patients. Adequate hydration is important and the patient should not be wheezing.