SUMMARY

Pediatric patients, especially the neonates, presenting for surgery are the most daunting and challenging patients facing the anesthesiologist. This is because there are many obvious differences between adults and children that affect anesthetic management. Apart from the obvious differences of size, communication skills, and issues involving parents, there are multiple differences in the physiology, psychology, anatomy, and pharmacology of children. The most characteristic and significant feature of childhood is development. Not only does the child's responsiveness to other people undergo recognized patterns of psychological development that require appropriate responses from the anesthesiologist, but virtually every organ system undergoes distinct, well-described development that is relevant to the anesthetic management in pediatric patients. The key to understanding pediatric anesthesiology is to understand the dynamic processes that occur at the various developmental stages of childhood. The sense for this dynamic must be acquired by all who wish to anesthetize pediatric patients. The mind set required is not that of understanding anesthesia that is appropriate for adult physiology and adapting this anesthetic approach to children, but rather to flexibly approach the child as he/she grows from fetus to adult. A specific anesthetic plan appropriate to developmental stages must be designed for each child. In addition, familiarity with techniques and equipment specifically designed to provide anesthesia in children is essential. Finally, specific knowledge regarding the surgical procedures is necessary.

The preoperative visit and preparation of the child for surgery are more important than the choice of premedication. The need for premedication must be individualized according to the underlying medical condition, the length of surgery, the desired induction of anesthesia, and the psychologic makeup of the child and family. Premedications may be administered orally, intramuscularly, intravenously, rectally, sublingually, or nasally. Although most of these routes are effective and reliable, each has drawbacks as well. Secretions may contribute to respiratory obstruction in small airways and premedication with an antisialagogue may be required. If analgesia is required preoperatively; an opioid premedication may be prescribed. Fentanyl is the most commonly used narcotic in infants and children.

The method of inducing anesthesia is determined by a number of factors: the medical condition, the surgical procedure, the level of anxiety of the child, the ability to cooperate, the presence or absence of a full

stomach, and others. There are many ways to induce anesthesia in infants and children. The method chosen should be quick, safe, and entail as little fuss as possible. In general, anesthetists should use the technique they are familiar with. Anesthesia may be induced by inhalation, IV, IM, or rectal administration of drugs.

Mask inductions are usually used in infants younger than 10 to 12 months because this age group readily separates from the parents. Successful, psychologically atraumatic induction by mask in the older pediatric patient requires that the patient understand and cooperate. The commonly used inhalational agents include: halothane, enflurane, isoflurane, sevoflurane, and desflurane.

Induction of anesthesia with drugs given IV is the most reliable and rapid technique. An intravenous induction may be preferable when induction by mask is contraindicated (*e.g.*, in the presence of reflux esophagitis or a full stomach). The main disadvantage is that starting an intravenous line can be painful and threatening for the child. Also, IV induction is associated with decreased oxygen saturation in a significant of children. Propofol, thiopental, methohexital, and ketamine have been used for anesthetic induction in pediatric patients.

Many medications, such as methohexital, ketamine or midazolam, are administered intramuscularly for induction of anesthesia. The main advantage of this route of administration is its reliability; the main disadvantage is that it is painful.

Many different medications may be administered rectally for induction of anesthesia (methohexital, thiopental, ketamine, midazolam). The main advantage of this approach is that the child falls asleep in the parents' arms or, as is the case with midazolam, separates atraumatically form the parents.

The anatomy of the infant may cause difficulties in tracheal intubation. The tube should be small enough to allow a leak during the application of positive pressure, otherwise pressure on the soft tissues of the glottis or cricoid may lead to oedema following extubation.

Anesthesia is maintained in pediatric patients with the same agents as in adults and with concentrations of volatile anesthetics, which cause the fewest physiologic changes and still offer adequate surgical conditions (usually in the range of 1.1 to 1.4 MAC). Non-depolarizing muscle relaxants are usually required for optimal surgical conditions.

Children require the same clinical and basic instrumental monitoring. Pulse oximetry, temperature monitoring and capnography should be routine.

Neonates and infants have higher total water content than do adults. This difference affects fluid therapy and clinical pharmacology. Fluid therapy is divided into three portions: deficit, maintenance, and third-space/ blood replacement.

Hypothermia is a serious problem, so meticulous attention to thermoregulation is essential to the anesthetic management in pediatric patients.

At the end of surgery, volatile agents should be withdrawn and if the child has received neuromuscular blockade, the blockade should have antagonized or reversed at the end of the procedure, even if the patient has recovered clinically as any increase in the work of breathing may cause fatigue and respiratory failure.

Most infants can be extubated awake (*i.e.*, stage 1 or lighter), except after intraocular surgery, where a cough on the tracheal tube, as they pass through stage 2, should be avoided. In this case, and in older children, extubation may be done in stage 3 plane 1, and the child left (with extra O_2) to awaken very quietly under close supervision in the postoperative recovery room.

During recovery from anesthesia, pediatric patients are particularly vulnerable to two postanesthetic complications: laryngospasm and postintubation croup.

When adequate ventilaion has been re-established after recovery from anesthesia, the child should be nursed in the lateral position and the airway, cardiovascular system and temperature closely monitored in an adequately equipped recovery area. Oxygen should be administered during transfer from the operating room, and until the child awakens in the recovery area. The patient should be awake before return to the ward.

Postoperative pain has been an area of neglect in pediatric surgery, largely through anxiety concerning the respiratory depression associated with opioid agent and the perceived requirement for intramuscular injections. A considerable amount of recent work has demonstrated that techniques, such as patient-controlled analgesia (PCA) can be used in children from the age of 5 years. Below that age, nurse-controlled analgesia

is feasible. Alternations are subcutaneous and i.v. infusions of opioids. Safe dosage regimens have been established, but the need for trained nurses and adequate monitoring must be stressed.

Medical and surgical diseases that affect pediatric patients are too numerous and are often of greatest concern, especially in the neonates, in whom incomplete adaptation to the extrauterine environment may further complicate perioperative management. However, the basic anesthetic management is the same for all patients. An understanding of the basic differences in physiology, pharmacologic and pharmacodynamic response, and the underlying pathology of the surgical problem is essential for development of a safe anesthesia plan. Most of the complications that arise are attributable to a lack of understanding of these special considerations prior to induction of anesthesia.

CONCLUSION

"*Children are not just little adults.*" However, most principles of adult anesthesia are also applicable in pediatric patients. A thorough understanding of the differences is crucial to the skilled administration of anesthesia to this challenging group of patients—the smaller they are, the less margin of reserve is present. The smile on the face of a child who is comfortable in her mother's arms in the postanesthesia care unit is one of the greatest rewards any practitioner can receive.