Plastic Surgery

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The anesthetic management of plastic surgical procedures in the pediatric population is often challenging because of the variety of congenital syndromes that require cosmetic repair. These syndromes are associated with altered airway anatomy, as well as complex coexisting medical conditions. This chapter reviews anesthetic management of the more commonly performed plastic surgery procedures—cleft lip and palate, and craniosynostosis repair. In addition, considerations for subcutaneous administration of epinephrine are reviewed.

CLEFT LIP REPAIR

A cleft lip is a unilateral or bilateral split of the upper lip between the mouth and nose (Fig. 34-1). It can range from a slight notch to a complete separation of one or both sides of the lip extending up and into the nose, and is often accompanied by a cleft palate. The overall incidence of cleft lip is approximately 1 in 800 live births; Asians are most commonly affected and African-Americans least commonly affected. While the majority of cleft lips are not associated with any predisposing factors, a history of maternal smoking or phenytoin use increases the risk. Associated congenital defects such as congenital heart disease occur in approximately 10% of affected children, and these are often combined as one of the velocardiofacial syndromes. Feeding difficulties in the newborn period may lead to poor growth and anemia. Surgical repair is usually performed within the first several months of life; some centers are correcting these lesions in the neonatal period. Older children may return for subsequent cosmetic repairs of the lip or nasal tip.

If the infant is otherwise healthy, there are no unique preoperative considerations. A hemoglobin level is indicated if the infant has exhibited poor growth, or to satisfy institutional requirements for routine preoperative testing in the first year of life. A mask induction of general anesthesia is most often performed, followed by endotracheal intubation with an oral RAE endotracheal tube (Fig. 34-2). The patient’s eyes are protected using a petroleum-based lubricant, which is covered by a transparent adhesive covering to preserve visible surgical landmarks. The OR table is turned 90 degrees away from the anesthesiologist to facilitate the surgical repair from the head or side of the table. A small amount (usually <1 mL) of local anesthetic with epinephrine is injected into the surgical field to control hemostasis at the incision site. Blood and fluid losses are minimal. Therefore, maintenance and preoperative deficit fluid replacement is sufficient. Small amounts of opioid may be administered intraoperatively or held until the infant demonstrates signs of postoperative pain. Rectal administration of acetaminophen may also be helpful. Soft arm restraints are often used to keep the infant from handling the repair postoperatively.

Many pediatric anesthesiologists advocate regional anesthesia for cleft lip repair. Bilateral infraorbital blocks with a long-acting local anesthetic can provide up to 18 hours of pain relief and decrease the frequency of postoperative administration of opioids.

CLEFT PALATE REPAIR

A cleft palate occurs when the roof of the mouth (i.e., hard and/or soft palate) has not joined completely during fetal development. A cleft palate can range from a
small bifid uvula to a complete separation of both the soft and hard palate. The incidence of cleft palate is approximately the same as that of cleft lip, with a similar racial distribution. Associated congenital defects occur in up to 50% of infants born with a cleft palate. Cleft palate can exist as a component of the Pierre-Robin sequence (cleft palate, glossoptosis, and micrognathia). Early concerns in the newborn period relate to feeding difficulties and airway compromise. Mild forms of this disease are managed adequately by prone positioning. Severe forms, however, manifest as life-threatening upper-airway obstruction in the newborn period, necessitating placement of an oral or nasal airway, or tracheostomy (see Chapter 18).

Surgical correction of cleft palate is usually performed by 12 months of age. Older children may present for subsequent procedures such as correction of velopharyngeal incompetence, or repair of bony palatal defects with a bone graft. If a child is born with both cleft lip and cleft palate, the lip repair is performed first because the repaired lip helps to decrease the width of the palatal defect.

Preoperative considerations for children presenting for cleft palate repair are focused on delineation of coexisting medical problems and assessment of airway patency. Infants older than 6 months of age and without airway compromise are candidates for anxiolytic premedication. Unless intravenous access is previously established, inhalational induction of general anesthesia is performed. Upper-airway obstruction during this phase is common and is almost always relieved by placement of an oral airway device to prevent the tongue from becoming lodged in the cleft. Endotracheal intubation may be complicated by the presence of micrognathia or unintentional placement of the laryngoscope blade into the cleft during laryngoscopy. Some pediatric anesthesiologists prefer to place gauze material into the cleft prior to laryngoscopy attempts. An oral RAE tube is inserted and the OR table turned 90 degrees to facilitate surgical repair from behind the head of the infant.

The cleft palate is exposed by placement of a mouth-opening device (usually a Dingman mouth gag) and extending the child’s head and neck, in a similar position as that for a tonsillectomy. Bilateral breath sounds should be reconfirmed after these maneuvers because they may cause caudal movement of the endotracheal tube and a right main bronchial placement. A small amount of local anesthetic with epinephrine is injected into the palate. Blood and fluid losses are minimal but somewhat greater than for cleft lip repair, and may not always be readily apparent. A throat pack is often helpful to prevent the passage of blood into the larynx or esophagus.

The choice of anesthetic agent for maintenance of general anesthesia is unimportant. Most pediatric anesthesiologists will administer a moderate amount of opioid intraoperatively while recognizing that airway obstruction may occur following tracheal extubation at the completion of the procedure. Prior to tracheal extubation, the oropharynx should be gently suctioned to remove...
retained blood and secretions while taking care not to disrupt the delicate suture lines. Many surgeons will place a loop suture through the anterior portion of the tongue which can be pulled anteriorly if the tongue is causing postoperative upper-airway obstruction. This suture is then usually removed within several hours after the procedure when the child has demonstrated the ability to maintain airway patency without assistance.

The primary postoperative concerns following cleft palate repair are airway assessment and pain control. Prone or lateral positioning is often helpful to alleviate obstruction by the tongue. If indicated, small doses of morphine are administered while monitoring upper-airway patency. Placement of a nasal or oral airway is relatively contraindicated (unless absolutely necessary) because of possibly disrupting the surgical repair. A nasal airway is also relatively contraindicated in any future anesthetic if a posterior pharyngeal flap was used to repair the cleft.

**CRANIOSYNOSTOSIS REPAIR**

**Types of Craniosynostosis**

At birth, the skull consists of distinct cranial bones separated by malleable strips of connective tissue that are known as “sutures” (see Fig. 2-5). During the first 2 years of life, the sutures serve as growth sites for the deposition of additional cranial bone with eventual formation of the adult-like skull. *Primary* craniosynostosis, which occurs in approximately 1 in 2000 live births, results when one these sutures closes prematurely, thus restricting growth of the adjacent cranial bones in a perpendicular direction. The remaining cranial bones that are adjacent to normal sutures continue to grow unchecked, producing a misshapen head that may affect facial anatomy, as well as brain structure and function. *Secondary* craniosynostosis results from the normal progression of brain growth and expansion. Most forms of craniosynostosis are diagnosed in the first several months of life, after the completion of normal cranial molding that is attributed to the birth process.

A large number of craniosynostosis syndromes are possible, depending on the specific bones involved, and the underlying genetic syndrome. In most infants with craniosynostosis that involves only a single suture, the primary concern is cosmetic: surgery will prevent a permanent craniofacial deformity. More severe forms of craniosynostosis, especially when seen as part of a genetic syndrome, are associated with increased intracranial pressure, neurologic deficits, and ophthalmologic problems. Surgical correction of craniosynostosis is usually performed as early as 3-6 months of age to prevent permanent craniofacial deformities and secondary brain abnormalities.

*Scaphocephaly* (dolichocephaly) is the most common type of craniosynostosis (50%) and results from premature closure of the sagittal suture. The cranial bones continue to grow in an anteroposterior direction and produce an elongated skull with frontal bossing and occipital protrusion (Fig. 34-3). Although the transverse dimension of the head is narrow, head volume is normal; therefore, increased intracranial pressure and neurologic deficits are not usually observed.

A number of surgical procedures have been developed to correct scaphocephaly, the simplest of which is a strip craniectomy, in which the fused sagittal suture is removed and the remainder of the skull is allowed to remodel itself through normal growth. More often, however, complete reconstruction of the infant skull is required to achieve satisfactory cosmetic results.

![Prematurely fused sagittal suture](image)

**Figure 34-3** A, Premature fusion of the sagittal suture produces scaphocephaly. B, The result is a misshaped head that is narrow and long.
The frontal, parietal, and occipital bones are excised and then trimmed, reshaped, relocated, and affixed with biodegradable plates and screws with the objective of restoring a normal biparietal diameter and reducing the severity of frontal bossing and occipital protrusion.

*Plagiocephaly* (18%) results from a unilateral synostosis of a coronal suture, producing a unilateral “tilting” forehead and orbital anomalies. *Brachycephaly* (9%) results from a bilateral coronal synostosis and causes a broadened skull and midface hypoplasia. Brachycephaly occurs in Apert’s and Crouzon’s syndromes. Brachycephaly is associated with a higher incidence of neurologic complications, including increased intracranial pressure, optic atrophy, and mental retardation. These deformities are corrected surgically by advancement of the frontal bone and orbital segments of the skull.

*Trigonocephaly* (9%) is the result of premature closure of the metopic suture, resulting in a triangular-shaped head and hypotelorism, with an increased risk for associated anomalies of the forebrain. It is often accompanied by additional congenital deformities including cleft palate and urinary tract anomalies. Trigonocephaly is surgically corrected by incision, reconstruction, and replacement of the frontal bone.

**Anesthetic Management for Craniosynostosis Repair**

Preoperative assessment of the infant presenting for craniosynostosis repair should include a thorough investigation of all comorbidities, congenital anomalies, and the possibility of increased intracranial pressure. In particular, examination of the facial structure and upper airway may reveal the possibility of a difficult intubation. A complete blood count, coagulation studies, and a type-and-crossmatch should be obtained. A preoperative anxiolytic may be indicated in some infants older than 6 months. These infants are usually admitted from home on the day of surgery.

Most infants with craniosynostosis receive an inhalational induction of general anesthesia. A muscle relaxant is administered in the absence of suspicion of a difficult airway. Direct visualization of the larynx may not be possible in infants with syndromic midface hypoplasia. In these cases, fiberoptic bronchoscopy or a lighted stylet is often required to achieve endotracheal intubation via the nasal or oral route, depending on the site of the surgery and the preferences of the surgeon. The endotracheal tube should be carefully taped (or even sutured) in place so as not to become dislodged during critical portions of the surgical procedure.

Maintenance of general anesthesia can be accomplished with any inhalational agent supplemented with opioids and a neuromuscular blocker. Intraoperative nitrous oxide is avoided because of the risk of venous air embolism (see below). Two large-bore (at least 20-gauge) intravenous catheters and a radial arterial catheter are inserted once the child is anesthetized. The arterial catheter provides continuous assessment of blood pressure and facilitates frequent sampling of blood for hemoglobin and blood gas determinations. In addition, intraoperative examination of the arterial tracing can aid in predicting hypovolemia by noting the presence of respiratory variation as well as a “thinning” of each pulsation. Some centers utilize central venous access for these procedures. A rectal temperature probe is inserted since exposure of the infant and a large amount of administered crystalloid and blood can result in hypothermia. Hypothermia is minimized by using fluid- and blood-warming devices, a forced warm-air blanket over the unexposed portions of the infant, a heating mattress between the infant and the OR table, a heated, humidified breathing circuit, and when necessary, heating the OR environment. An indwelling urinary catheter is inserted and maintained postoperatively.

During the craniotomy portions of the surgical procedure, rapid and significant blood loss in these infants is expected as a result of bleeding from the scalp incisions, osteotomy sites, and the dural venous sinuses. Life-threatening hypovolemia may occur because of the small total blood volume of these infants. All attempts should be made to prepare for this eventuality by keeping pace with blood loss, maintaining a hemoglobin level >7.5 mg/dL, and using large amounts of crystalloid to maintain end-organ perfusion. During a large craniofacial reconstruction over several hours, crystalloid amounts exceeding 125 mL/kg are common. Platelets and fresh frozen plasma administration are often necessary after one blood volume of red blood cells has been lost and replaced. Measures to reduce intraoperative blood loss include infiltration of the scalp with local anesthetic containing epinephrine, and preoperative administration of erythropoietin.

Venous air embolism (VAE) has been reported to occur in up to 83% of infants undergoing craniosynostosis repair because the noncollapsible veins of the skull at the operative site are often above the level of the heart and are exposed to air. VAE is reported to be responsible for life-threatening hemodynamic instability and death intraoperatively. Some centers routinely use a precordial Doppler ultrasonic probe to detect the occurrence of a VAE, and will attempt to aspirate air using an inserted central venous catheter. However, this intervention has not been shown to influence outcome during this complication. Although undocumented, at The Children’s Hospital of Philadelphia it is believed that continuous and vigilant expansion of the intravascular space using ample crystalloid and blood replacement leads to a clinically low incidence of VAE.

Following craniosynostosis repair, virtually all children are awakened and their tracheas extubated in the OR.
All children are routinely admitted to the intensive care unit because of concerns for ongoing blood loss and hemodynamic instability, and for careful monitoring for upper-airway obstruction which may occur as a consequence of the large amount of swelling that occurs in the facial region. Postoperative mechanical ventilation is not often required.

**SUBCUTANEOUS EPINEPHRINE USE IN CHILDREN**

Subcutaneous administration of a local anesthetic containing epinephrine is common in pediatric plastic surgical procedures with the goal of attaining epinephrine-mediated vasoconstriction and minimization of blood loss. In anesthetized patients this poses a potential danger because the ability of epinephrine to induce ventricular dysrhythmias is exacerbated in the presence of an inhalational anesthetic agent. The alkane anesthetic agents (i.e., halothane) are characterized by their propensity to “sensitize” the myocardium to endogenous or exogenously administered catecholamines. The ethers (i.e., isoflurane, sevoflurane, desflurane) do not sensitize the myocardium to the same extent as that for the alkane anesthetics.

The maximum amount of epinephrine that may be safely administered is unknown. However, a retrospective study that examined subcutaneous administration of epinephrine in children in the presence of halothane reported that doses up to 15.7 µg/kg did not cause ventricular arrhythmias. Maintenance of general anesthesia with an agent other than halothane would be expected to carry an even greater margin of safety.

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