Chapter

42 Strabismus Surgery

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A three-year-old child with Trisomy 21 presents for right strabismus repair. Past medical history is significant for a ventricular septal defect (VSD) and a persistent inward deviation of the right eye that the parents report is constant over the last year. She is not currently on any medications and the parents report no allergies.

What Is Strabismus? What Is Amblyopia?

Strabismus is the misalignment or deviation of the eyes. The prevalence in children ranges from 2% to 7%. This misalignment can be associated with diplopia, decreased vision, and headaches. Neonatal strabismus usually resolves by three months of age. Strabismus found in school age children is considered aberrant and usually warrants an evaluation. A general understanding of the more common diagnosis will facilitate this discussion. *Esotropia* is the inward deviation of the nonfixed eye. *Exotropia* is the outward deviation of the non-fixed eye. *Hypertropia* is an upward vertical deviation of the non-fixed eye while *hypotropia* is defined as the downward vertical deviation of the non-fixed eye.

Amblyopia or lazy eye is defined by decreased vision in an eye when it fails to work properly with the brain. It is commonly caused by strabismus and usually treated with patching or through the use of atropine eye drops, which blur vision in the stronger eye forcing a child to predominantly use the weaker eye.

Given the FDA's Concerns with Neurodevelopment, Is It Imperative to Correct Strabismus at This Time or Could This Case Be Considered Elective and Be Performed When the Child Is Older?

While the FDA's concerns on anesthetic neurotoxicity continue to be debated, it is imperative that this child receives treatment in the form of corrective lenses, pharmacologic aids, or surgical correction. Visual maturity usually occurs through age five and this must be weighed when deciding on corrective action. The primary reason for surgically correcting strabismus at an early age is to restore binocular vision to maintain visual acuity, to improve depth perception, and to eliminate double vision. Earlier correction may prevent amblyopia and visual loss given the higher risk children with strabismus pose. This is further supported by evidence that the duration of the misalignment is a major predictor of the outcome.

What Are Considerations Associated with the Preoperative Assessment in Children Presenting for Strabismus Repair?

Strabismus surgery remains quite common in pediatric ophthalmology practice. While most children with strabismus are healthy, the preoperative assessment should attempt to elucidate coexisting syndromes. This can include cerebral palsy, craniofacial syndromes, neurofibromatosis, and hydrocephalus. Outside of that, the risk of postoperative nausea and vomiting should also be discussed.

Syndromes Associated with Strabismus

- Craniosynostosis syndromes: Apert and Crouzon syndromes
- Goldenhar syndrome
- Marfan syndrome/Homocystinuria
- Myotonic dystrophy
- Down syndrome
- Hydrocephalus
- Neurofibromatosis
- Cerebral palsy
- Prematurity

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How Will You Secure the Airway in This Patient?

Several options are available for airway management during strabismus repair, including a supraglottic airway (SGA) or tracheal intubation. When using an SGA, it is most convenient for the surgeon if a flexible shaft is used, that can be secured to the chin. If tracheal intubation is chosen, an oral RAE tube should be used, when available, for the same reasons to facilitate the surgical approach.

How Will You Maintain General Anesthesia?

Inhaled anesthesia with volatile anesthetics, total intravenous anaesthesia (TIVA) with propofol, or a combination of both can be used for strabismus surgery. The use of propofol may decrease the risk of postoperative nausea and vomiting (PONV). Since these surgeries are at a relatively higher risk of OR fires because of the proximity to the airway, a low FIO_2 (<30%) should be maintained. PONV is discussed in detail in Chapter 5.

After Induction, the Surgeon Informs You that She Would Like to Perform a Forced Duction Test and Would Like Paralysis. What Is a Forced Duction Test and What Is Its Purpose? Is Succinylcholine an Appropriate Choice for This Patient?

The forced duction test (FDT) tests ocular muscle range of motion to differentiate between a mechanical or paralytic etiology for the strabismus. Surgeons may request nondepolarizing muscle relaxants to have the muscles completely relaxed, but this seems rare in practice. Use of succinylcholine should be avoided as it may result in erroneous information obtained during the FDT potentialy altering surgical management.

Is There a Malignant Hyperthermia (MH) Risk Associated with Strabismus Repair? What about Masseter Muscle Spasm?

By most accounts, the answer is that no correlation exists between malignant hyperthermia (MH) and patients undergoing strabismus repair. A review of MH susceptibility in over 2,500 patients revealed no association between MH and strabismus. When looking at masseter spasm, children with strabismus have traditionally had a fourfold higher incidence when compared to children without strabismus following a single exposure to succinylcholine. However, given the difficulty in diagnosing masseter muscle spasm and the lack of objective findings associated with this disorder, an association between strabismus and masseter spasm remains difficult.

What Is the Oculocardiac Reflex (OCR)? What Are the Risk Factors Associated with OCR? Please Delineate an Algorithm for Treating OCR? Are There Ways to Prevent OCR from Occurring?

First described in 1908 by Bernard Ashner and Guiseppe Dagnini, the oculocardiac reflex can occur from extraocular and intraocular causes. Traction of the ocular muscles and pressure on or around the globe are readily apparent extraocular causes. Intraocular causes can include ocular trauma, increases in ocular pressure from injections, or an evolving hematoma. The OCR is a trigeminal-vagal nerve reflex arc that results in a significant decrease in the heart rate. The afferent limb travels via the long and short ciliary nerves to the ciliary ganglion and then continues to the gasserian ganglion along the ophthalmological division of the trigeminal nerve. The efferent impulse travels by way of the nucleus of the vagus nerve to the cardiac depressor nerve, which produces the negative inotropic and conduction effects seen with this reflex.

Left untreated, this reflex can manifest in a number of dysrhythmias including junctional bradycardia, atrioventricular block, premature ventricular contractions or asystole. Of note, the OCR is more severe and sustained if the stimulus is abrupt or sustained. The occurrence of the oculocardiac reflex has been quoted to be as high as 90% depending on the anesthetic and the use of anticholinergics.

The OCR usually resolves with removal of the surgical stimulus and this should be the first step in

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treating OCR-induced bradycardia. Ventilatory status should be assessed as apnea can accompany OCR. Depth of anesthesia should also be assessed. If there is hemodynamic instability or the presence of aberrant underlying cardiac rhythms, atropine should be the first line agent administered.

There are some principles that can mitigate the prevalence of OCR. They include:

- Surgeon/anesthesia communication: to coordinate when the surgical stimulus occurs as well as ensuring adequate depth of anesthesia.
- Avoidance of hypercarbia and hypoxia.
- Administration of anticholinergics: this has been shown to statistically decrease the incidence of OCR.

Another possibility is the oculocardiac reflex that presents itself in this surgery is secondary to the pressure on the eyes. The net effect is a vagal response with bradycardia and hypotension. This vagal response occurs by stimulation of the afferent nerves from the V1 portion of the trigeminal nerve which extend to the midbrain with efferent response from the vagal nerve. If it presents the surgeon should be told to halt surgery and pressure on the eyes. Having a syringe of atropine (0.02 mg/kg) and glycopyrrolate on hand will be helpful to treat the vagal response.

What Is Your Plan for Emergence and Extubation?

Most surgeons prefer deep extubation. To perform deep extubation, you will have to have the patient breathing at a steady rate and deep enough either with TIVA or sevoflurane to blunt the response to oral suctioning.

As this surgery has a high risk for nausea, dexamethasone 0.15 mg/kg should be administered after induction. Ondansetron 0.1 mg/kg 30 minutes before the end of the case should always be given.

As mentioned earlier a sub-hypnotic infusion with IV propofol 15–20 mcg/kg/min during the procedure will prove helpful in patients with known PONV.

Other antiemetics that can be used are metoclopramide 0.1 mg/kg (maximum dose of 10 mg) and/or promethazine in patients over 24 months 0.25–1 mg (max dose 25 mg). Suppression of PONV is critical as retching and vomiting result in significant increases in intra-ocular pressure.

The Child Wakes Up in the Recovery Room a Little Agitated and Vomits Later in Recovery. What Are the Risk Factors in Children for the Development of Postoperative Nausea and Vomiting (PONV)? What Are Risk Factors Specific to Strabismus Surgery that Increase the Risk of Developing PONV?

Vomiting following strabismus surgery remains problematic and usually occurs in two-thirds of patients undergoing strabismus repair, if untreated. Untreated PONV can result in dehydration, delayed discharge, and decreased patient and parental satisfaction. Surgical specific complications including: subconjunctival hemorrhage and surgical wound dehiscence are possible.

Risk factors in the development of pediatric PONV have been identified in Table 42.1. Risk factors specific to strabismus surgery include initiation of an emetic reflex associated with ocular muscle manipulation, the occurrence of OCR during strabismus repair, altered postoperative vision, and the number of repaired muscles.

Describe an Optimum Intraoperative Strategy to Mitigate the Development of PONV? Can the Anesthetic Technique Be Optimized to Limit the Incidence of PONV?

Postoperative nausea is remarkably difficult to diagnose in the pediatric population so this will specifically describe a prophylactic strategy using anti-emetics. Metoclopramide at doses between 0.15 mg/kg and 0.25 mg/kg has been shown to be more effective than placebo in preventing early vomiting up to six hours following strabismus repair. The same study found that droperidol at 0.075 mg/kg was most effective in preventing postoperative vomiting (POV). Given the black box warning issued on the use of droperidol in 2001 secondary to prolonged QT issues, its use as an antiemetic has all but ceased. Ondansetron and droperidol are more effective than metoclopramide in reducing PONV.

The two most common agents used currently in strabismus surgery are dexamethasone and

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Table 42.1 Pediatric PONV risk factors

High-risk surgery • Strabismus • Tonsillectomy • Mastoidectomy
Age ≥ 3 years old
Personal or family history of motion sickness or PONV
Surgery ≥ 45 minutes in duration
Repeated doses of opioid

ondansetron. Dexamethasone has effectiveness starting at a dose of 0.05–0.5 mg/kg. Ondansetron has been shown to be effective from 0.05 to 0.2 mg/kg. Ondansetron has been found to be consistent in reducing the incidence of PONV regardless of when administered in regards to surgical stimulus. High-risk patients such as those undergoing strabismus repair should receive multimodal antiemetic therapy. Dexamethasone and ondansetron in combination are more effective than either drug administered alone in reducing postoperative vomiting (9% vs. 28%).

The use of different anesthetic techniques has been found to impact the potential development of PONV in patients undergoing strabismus repair. While anticholinergic administration decreases the incidence of the OCR, it does little in the face of preventing PONV. Benzodiazepine as a premedication has been shown to reduce PONV. Nitrous oxide use in pediatric strabismus surgery has not been shown to increase PONV risk, although studies in adults have shown benefit with its exclusion. Propofol used as maintenance after induction does reduce postoperative vomiting, but this must be weighed with the finding of increasing the potential of developing OCR in strabismus patients. Aggressive intraoperative fluid therapy at 30 mL/kg has shown decreases in the incidence of PONV.

An optimal analgesic strategy should be pursued as it may further contribute to PONV, emotional distress, and delayed discharge. Opioids should be minimized if possible given their direct contribution to increased PONV. This is difficult, as ophthalmic blocks are not commonly performed in children. Nonsteroidal anti-inflammatories should be part of an analgesic regimen for pediatric patients undergoing strabismus surgery.

What Can You Do for Emergence Delirium in These Patients?

In pediatric anesthesia, emergence delirium is a common event and more likely to occur in children if with pain and those waking up with either one eye shut or both. Alpha adrenergic medications such as clonidine 1–2 mcg/kg or dexmedetomidine 0.25–1 mcg/kg can be used. As pain is one of the likely culprits, a subtenon block performed by the surgeon during the procedure can alleviate much of the pain that the patients can have. An adequate intraoperative dose of opioids will reduce the risk of delirium. Once the patient is awake, propofol or other fast-acting opiates like fentanyl can be used if signs of delirium show up. Emergence delirium is discussed in Chapter 6.

Suggested Reading

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