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CHAPTER 12.2

Pediatric Ophthalmic Surgery

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Strabismus Surgery

Surgical Considerations

Description: Surgical correction of strabismus is a common procedure in ophthalmic practice, as strabismus occurs in 3–5% of the general population. Strabismus surgery is the most common pediatric eye surgery performed. The goal of this procedure is to correct the ocular misalignment caused by this condition. This can be achieved by several methods: (a) **weakening the muscles** (either by recession, marginal myotomy, or inserting a spacer), (b) **strengthening the muscles**, by shortening their length (resection), moving the muscle's insertion toward the limbus (advancement), or tightening the muscle's fibers (plication or tuck), or (c) by **transposing the muscles**. Surgery can be performed on any of the four recti muscles (medial rectus, lateral rectus, superior rectus, and/or lateral rectus muscle) or the two oblique muscles (superior oblique and inferior oblique).

Often, **forced duction testing (FDT)** is performed during surgery to determine if there is evidence of limited ductions. This helps to differentiate a paretic muscle vs a restriction that may limit motility. The eyes should be immobile during FDT as well as during surgery. If succinylcholine has been used, at least 20 min should pass before performing duction testing, since succinylcholine causes contraction of extraocular muscles. Alternatively, a different muscle relaxant may be used.

Eye position under GA is well documented: the eyes will become more divergent and this tendency is increased in misaligned eyes; therefore, exotropic eyes appear more outwardly deviated and esotropic (inward deviation) eyes actually appear straighter (less esotropic). Hence, it is important that the surgeon have solid measurements preoperatively.

The surgery usually is performed through one of two possible approaches. The **limbal incision** is made at the junction of the cornea and the conjunctiva, with radial relaxing incisions in the quadrants on either side of the muscle. The other is a **fornix or cul-de-sac incision**, which is made 4–8 mm from the limbus in the quadrant adjacent to the muscle on which to operate. This approach is subposterior to tenon's capsule. Comfort and cosmesis immediately postop are superior with the fornix incision.

Variant procedure or approaches: In very cooperative older children, an **adjustable suture** technique may be used. Unlike fixed sutures, the adjustable suture technique allows modification of the position of the muscle. An adjustable suture involves temporarily positioning the muscle, but not finally tying it down until the patient is awake and has been remeasured. After the patient is free of the effects of anesthesia, measurements are retaken, and the muscle is placed in its optimum position, to properly align the eyes, and then securely tied down. This adjustment may be performed the same day of surgery or the following day. **Adjustable strabismus surgery** ideally reduces the frequency of reoperations by eliminating undesirable early postop undercorrections or overcorrections and increases the rate of surgical success.

Although GA is most commonly used, strabismus surgery may be done using a **retrobulbar**, **peribulbar**, **subtenon**, or **subconjunctival block**, or even **topical anesthesia**. Both topical and peribulbar anesthesia have the advantage of providing good akinesia and anesthesia but without the risks associated with a retrobulbar injection (e.g., hemorrhage, optic nerve damage, ocular perforation). When using topical anesthesia, this may be augmented by the use of minimal sedation and/or antianxiety medications.

Usual preop diagnosis: Strabismus

Summary of Procedures

Position

Supine

Incision	Limbal or fornix
Antibiotics	Topical and/or subconjunctival antibiotics at completion of case
Unique considerations	Ask surgeons if they want neuromuscular blockade. If using succinylcholine, would need to wait 20 min before doing FDT. Keep patient under stable anesthesia, so the eyes are immobile and not drifting. Postop vomiting is common after strabismus surgery, with an incidence of 40–88%. Topical tetracaine may aide in diminishing postop pain.
Surgical time	Dependent upon type of surgery and number of muscles; usually 20–90 min.
EBL	Minimal
Mortality	Rare
Morbidity	Failure to achieve desired alignment Infection Hemorrhage Anterior segment ischemia
Postop care	PACU with discharge home within a few hours. Typically no eye patches.
Pain Score	2–4

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Patient Population Characteristics

Age range	Children (most common)
Male:Female	1:1
Incidence	5% of population
Etiology	Generally idiopathic; muscle palsies may be associated with trauma, inflammation, tumors, and/or ischemia; restrictive strabismus may occur with thyroid disease (Graves disease), fibrosis syndromes, or 2° to a scleral buckle or mass. ↑ incidence in premature infants, small-for-gestational-age infants, those with a positive family Hx of strabismus, craniosynostosis syndromes, or associated CNS disease
Associated conditions	

■ Anesthetic Considerations

■ Preoperative

In children, strabismus is the most frequent ophthalmic condition requiring surgical repair. Although most patients with this condition are otherwise healthy, there is an increased incidence of strabismus in children with cerebral palsy and other neurological disorders. Although many adult eye surgeries can be performed under regional anesthesia (retrobulbar or peribulbar block), in children GA is almost always required to ensure good surgical conditions. The anesthesiologist should be aware of the potential problems associated with strabismus surgery, including: increased risk of malignant hyperthermia (MH), occurrence of the oculocardiac reflex (OCR), and increased incidence of PONV. Because individuals at risk for MH often have musculoskeletal abnormalities, such as strabismus or ptosis, it is important to obtain a thorough family Hx of anesthetic problems. Avoid the use of succinylcholine since it can induce a tonic contracture of the extraocular muscles, which can interfere with the FDT (see above). The surgeon performs FDT by grasping the eye at the limbus, slightly proptosing the eye, and moving it into each field of gaze in order to determine if the strabismus is a result of paretic or restrictive extraocular muscles. This helps in formulating the surgical plan.

Anesthetic technique: GETA, LMA

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Induction

Following standard pediatric induction (see [p. D-1](#)), a vagolytic dose of atropine (0.02 mg/kg) or glycopyrrolate (0.01 mg/kg) may be given to attenuate oculocardiac and oculorespiratory reflexes. The use of sevoflurane as an inhalation agent, however, significantly decreases the occurrence of these two vagally mediated responses. FDT may be performed by the surgeon at this time, before the use of muscle relaxants. Subsequently, NMB (e.g., rocuronium 0.6 mg/kg) can be used to assist ET intubation. Techniques can include either inhalation agents or TIVA. The use of N₂O may ↑ risk for PONV, despite use of prophylactic antiemetics. If a propofol drip is used, suggested dose ranges are 150–175 mcg/kg/min. Postop analgesia should include fentanyl (1–2 mcg/kg) and acetaminophen (30–40 mg/kg prn × 1). Preferred antiemetic medications include ondansetron (0.1 mg/kg up to 4 mg), metoclopramide (0.1 mg/kg up to 10 mg), or dexamethasone (0.15 mg/kg up to 5 mg); consider “super” hydration with 30 cc/kg of LR solution. Combination therapy with drugs from different antiemetic drug classes is most effective.

In specific cases, the surgeon may request “deep extubation.” This can be accomplished with a high concentration of inhalational anesthetic (e.g., 2% sevoflurane). The ETT is removed, and an oral airway is placed. The patient is then gradually allowed to awaken, taking care to monitor for the development of laryngospasm.

iv: 20–22 ga

NS/LR to replace calculated deficit and maintain requirements.

Standard monitors (see [p. B-1](#)).

Temperature

Supine or supine with shoulder roll.

Oculocardiac reflex (OCR)/
oculorespiratory reflex (ORR)

Traction on extraocular muscles can result in vagally mediated slowing of HR (> 20% of baseline), ± junctional, ventricular, or supraventricular arrhythmias. Additionally, depressed spontaneous ventilation may occur. Both of these complications are significantly decreased with use of sevoflurane or desflurane anesthesia. OCR/ORR tends to fatigue with repeated manipulation. Treatment includes release of tension on extraocular muscles and administration of vagolytic agents (atropine or glycopyrrolate).

Consider MH if the following are noted: unexplained tachycardia; ↑ ETCO₂; muscular rigidity, masseter spasm; ↑ temperature (a late sign). To evaluate, obtain ABGs, CK, and myoglobin. MH produces ↓ PaO₂, ↑ PaCO₂, ↑ K⁺ and acidosis. If MH is suspected, discontinue volatile agents immediately. Stop surgery as soon as possible, hyperventilate patient with 100% O₂ at > 10 L/min. Give dantrolene 2.5 mg/kg iv ASAP. Treat acidosis with bicarbonate (1–2 mEq/kg), and treat hyperkalemia (insulin 0.1 U/kg + 1 ml/kg D50, CaCl 10 mg/kg or Ca gluconate 10–50 mg/kg). Cool the patient and hydrate to maintain urine output. Further doses of Dantrolene may be necessary (up to 30 mg/kg).

Malignant hyperthermia (MH)

Surgical repositioning or removal of surgical drapes may result in accidental extubation. ETT should be firmly secured and anesthesiologist should be attentive to changes in positioning or removal of drapes.

Complications

Accidental extubation

Postoperative

Complications	PONV MH	See above for rescue doses of antiemetics. See above.
Pain management	Continue po acetaminophen (10–12 mg/kg q 4 h) + antiemetics as needed.	Occasional need of opioid analgesics.

Suggested Readings

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