



Anesthesia for Ophthalmologic Procedures in Pediatric Patients

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Disclosures



No relevant financial relationships.

Learning Objectives:

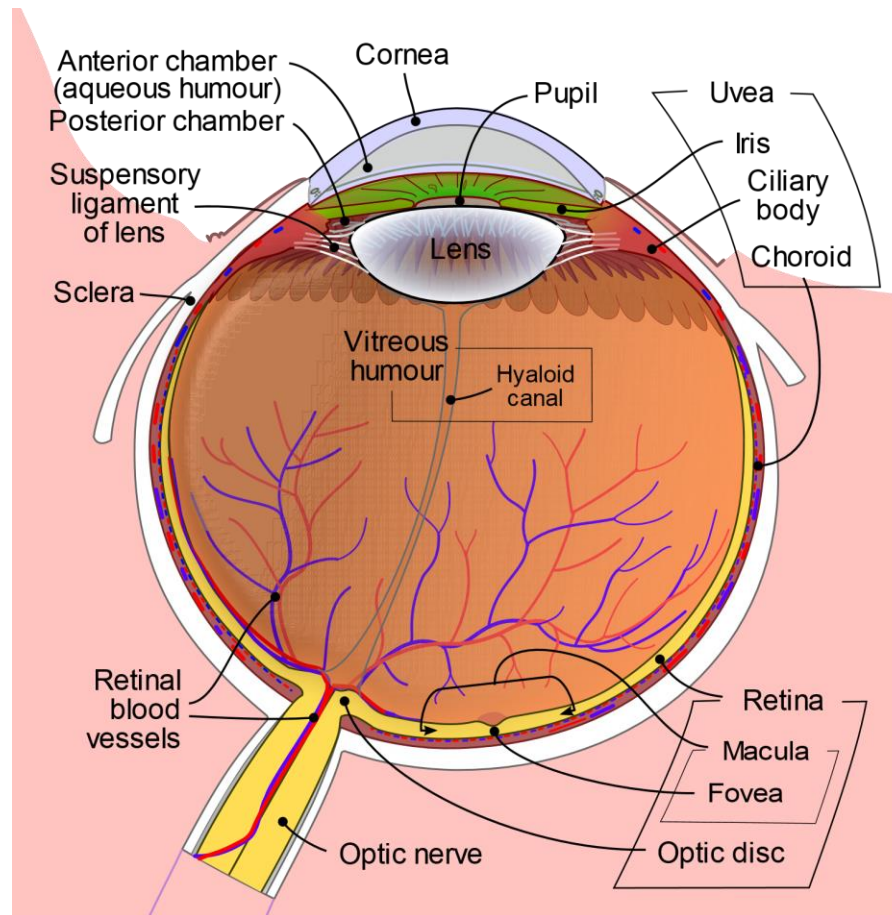


- Review ophthalmologic physiology relevant to anesthetic management.
- Identify commonly used ophthalmologic medications and their side effects.
- Recognize the effect of surgical urgency on anesthetic management.
- Recognize the perioperative issues specific to common pediatric ophthalmologic procedures.



Ophthalmologic Physiology

Anatomy of the Eye



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Intraocular Pressure (IOP)



- **Normal:** 12-15 mmHg; **Elevated:** >20 mmHg
- Elevated IOP may lead to extrusion of contents if the globe is ruptured
- Factors increasing IOP
 - Increased central venous pressure
 - Systemic hypertension
 - Hypercarbia
 - Drugs (succinylcholine, ketamine)

Succinylcholine and IOP



- Increases IOP 6 to 10 mmHg
 - Effect begins 1 min after administration
 - Duration of effect: 10 min
- Mechanisms
 - Cycloplegia
 - Tonic contraction of extraocular muscles
 - Increased choroidal blood volume
 - Relaxation of orbital muscles

Consider rocuronium 1.2 mg/kg as an alternative to succinylcholine

Oculocardiac Reflex



- Triggered by pressure on globe or traction on extraocular muscles.
 - *Afferent Pathway*: cranial nerve V (ophthalmic branch)
 - *Efferent Pathway*: cranial nerve X
- May result in dysrhythmias
 - Sinus or junctional bradycardia
 - Atrioventricular block
 - Ventricular ectopy
 - Asystole

Treatment of Dysrhythmias



- Stop surgical stimulation
- Verify adequate oxygenation/ventilation
- Vagolytic agents
 - Atropine 20 mcg/kg IV
 - Glycopyrrolate 10-20 mcg/kg IV
 - Epinephrine 1-10 mcg/kg IV
- Refractory cases may require local anesthetic infiltration of ocular muscles



Ophthalmologic Medications and Syndromes

Commonly Used Ophthalmologic Medications



Drug	Indication	Side Effect Profile
Cholinergic Agonists Carbachol Pilocarpine	Induce miosis Glaucoma	Corneal edema, retinal detachment
Cholinesterase Inhibitors Physostigmine Echothiophate	Glaucoma	Retinal detachment, miosis
Muscarinic Antagonists Atropine Scopolamine Homatropine Cyclopentolate Tropicamide	Cycloplegic retinoscopy	Photosensitivity, blurred vision, increased heart rate, dry mouth

Commonly Used Medications (continued)



Drug	Indication	Side Effect Profile
Sympathomimetic Agents Dipivefrin Epinephrine Phenylephrine Apraclonidine Brimonidine	Glaucoma Glaucoma Mydriasis Glaucoma Glaucoma	Photosensitivity, hypersensitivity
Alpha and Beta-Adrenergic Antagonists Dapiprazole (alpha) Betaxolol (beta 1) Carteolol (beta) Levobunolol (beta) Metipranolol (beta) Timolol (beta)	Reverse mydriasis Glaucoma Glaucoma Glaucoma Glaucoma Glaucoma	Conjunctival hyperemia Decreased heart rate and blood pressure, bronchospasm



Associated Systemic Disorders



Systemic Disorder	Ophthalmologic Condition
Prematurity	Retinopathy of prematurity, congenital cataracts, glaucoma, strabismus
Trisomy 21 (Down syndrome)	Neonatal cataracts, strabismus, glaucoma, nasolacrimal duct obstruction, nystagmus
Alport syndrome	Cataracts, retinal detachment, keratoconus
Connective tissue disorders <i>Marfan syndrome</i> <i>Homocysteinuria</i> <i>Ehlers-Danlos syndrome</i>	Retinal detachment, lens dislocation, glaucoma, cataracts, optic atrophy, intraocular hemorrhages
Craniofacial syndromes <i>Apert syndrome</i> <i>Crouzon syndrome</i>	Severe proptosis, multiple other ocular disorders



Ophthalmologic Procedures

Common Ophthalmologic Procedures in Children



- Emergent and penetrating globe injury
- Examination under anesthesia
- Cataract excision
- Strabismus repair
- Glaucoma surgery
- Treatment for retinopathy of prematurity

Emergent Procedures

Example - Ruptured Globe



May need to proceed with surgery despite not being NPO

- Modified rapid sequence IV induction with Propofol* and rocuronium; intubation with cuffed ETT to secure airway
- If no IV, gentle inhalational induction; proceed with second practitioner available to place IV as quickly as possible to facilitate securing airway

*Consider thiopental 5 mg/kg or methohexital 1-2.5 mg/kg if Propofol unavailable.

Exam Under Anesthesia (EUA)



- Common Indications:
 - General eye exam
 - Fundoscopy
 - IOP measurement
- General anesthesia needed when child uncooperative or too young to follow commands
- Preoperative evaluation for associated conditions or syndromes

Exam Under Anesthesia



Anesthetic technique

- Simple/short duration exam: consider mask general anesthetic
 - Inhalational induction
 - +/- IV access
 - Intermittent deepening of anesthetic as needed
- Longer/more involved exams: consider LMA
 - Inhalational induction
 - IV access established
 - LMA placement

Exam Under Anesthesia



IOP measurements – special considerations

- Important to have accurate measurement for assessing glaucoma/treatment
- “Safer” to have falsely elevated measure as falsely low measure could delay treatment

IOP Measurement



- Consider effects of induction agents on IOP to limit effects on the measurement
- Allow measurement of IOP as soon as child stops moving
- Ensure face mask does not compress eyes
- If airway device planned, measure IOP prior to airway manipulation

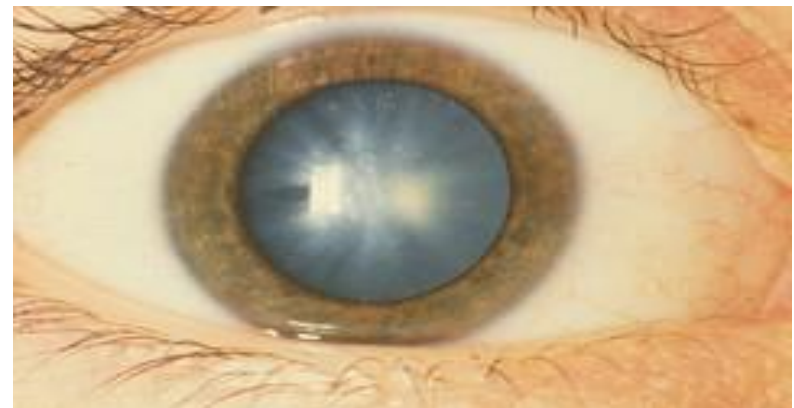
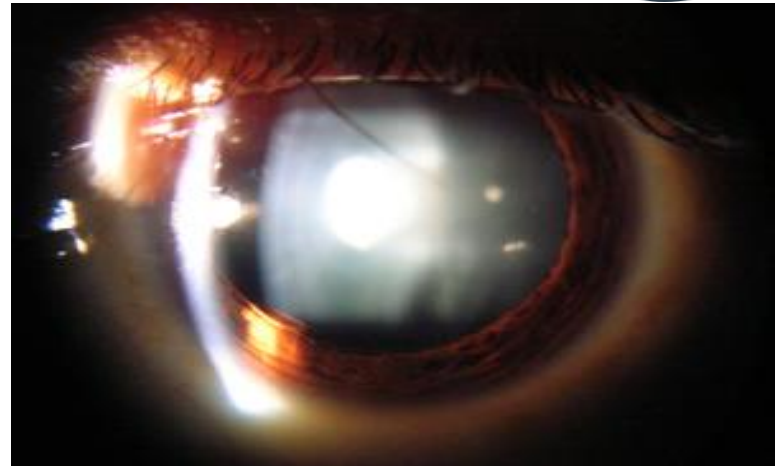
Cataract Surgery



Types of cataracts

- Congenital: Early repair may allow photo-stimulation of retina
- Post traumatic
- Metabolic

Surgery involves corneal incision, removal of opacified patient lens, +/- intraocular lens implant



Cataract Surgery



Preoperative evaluation

- Identify associated conditions/syndromes and anesthetic implications
- Evaluation of child to determine anesthetic technique
 - General anesthesia in the majority of pediatric patients
 - Can consider local anesthetic with sedation in older and more mature teenagers

Syndromes Associated with Cataracts



Condition/Syndrome	Potential Anesthetic Implications
Mucopolysaccharidoses	Difficult airway
Hallerman-Strieff syndrome	Difficult airway
Trisomy 21	Congenital heart disease, atlantoaxial instability, subglottic stenosis, bradycardia with induction
Alport syndrome	Hearing loss, renal disease, myopathy
Homocystinuria	Coronary artery disease, hypercoagulability, renal disease
Marfan Syndrome	Aortic dilation/dissection concern
Fabry disease	Cardiac/renal/pulmonary involvement
Prematurity/congenital cataract	Postoperative apnea, pulmonary disease, patent foramen ovale, patent ductus arteriosus



Cataract Surgery



- Communication with ophthalmologist important
 - Limited access to airway
 - Microscopic surgery requires still operating field
 - LMA or ETT can be used for airway
- Induction/maintenance
 - Elevated IOP usually not a concern
 - Inhalational or IV induction at anesthesiologist's discretion
 - IV access important to treat possible OCR

Cataract Surgery



Emergence/postoperative management

- Prevent acute rises in IOP
 - Consider deep extubation
 - Topical local anesthetic +/- sub-tenon blocks for post-op pain control
 - Pharmacologic PONV prophylaxis
 - Limit opioids to prevent post-op nausea or vomiting (multimodal anesthesia)
- Typically outpatient procedure unless coexisting conditions or prematurity mandate post-operative monitoring

Strabismus



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accessed 7/22/19

Strabismus



- Divergent visual axes of eyes
- Common names: squint or cross eyed
- Often isolated finding but may be related to systemic disease/syndromes
 - Craniofacial syndromes: Crouzon, Apert, Pfeiffer
 - Prematurity
 - Myopathies/cardiomyopathies
 - Central nervous system disorder
 - Fetal alcohol syndrome

Strabismus Repair



- Realigns divergent visual axes of eyes by detaching and reattaching extraocular muscles of the globe
- Forced duction test
 - Performed prior to repair
 - Mechanical restriction to movement of eye assessed by ophthalmologist
 - Differentiates a paretic EOM from muscle restriction impeding movement of eye
- High risk for postoperative nausea and vomiting
- One of most painful ophthalmologic procedures

Strabismus Repair



Induction/Maintenance

- Inhalational or IV induction at discretion of anesthesiologist
- IV access essential for treating PONV, pain and possible OCR
- LMA for airway management
- Pharmacologic PONV prophylaxis
- Limit opioids to prevent PONV
- Multimodal analgesia: acetaminophen, NSAIDS
- Consider propofol-based anesthetic to minimize PONV

Strabismus Repair



Emergence/Postoperative Management

- Pharmacologic PONV prophylaxis prior to emergence
- May consider deep extubation
- May need additional PONV treatment such as scopolamine patch or benzodiazepine (Ativan)
- Typically outpatient procedure
- Discharge from PACU if no significant PONV and able to take POs

PONV Prevention Review



- Limit preoperative dehydration: Give clears until 2 hours prior to surgery
- Avoid nitrous oxide
- Consider intraoperative fluid bolus of 30 ml/kg
- Serotonin 5-HT₃ antagonist (e.g. ondansetron)
- Dexamethasone (0.1 mg/kg up to 10 mg)
- Benzodiazepines
- Scopolamine patch
- Propofol-based anesthetic with minimal volatile agents
- Minimize narcotics: utilize multimodal analgesia

Glaucoma



Medical Management

- Agents may be used as first-line management or as adjunct to surgery
- Therapeutic window for topical medications can vary widely with age
- Most common: beta-blocker +/- carbonic anhydrase inhibitor (CAI)
 - Beta blocker: systemic effects include bronchospasm, bradycardia
 - CAI: topical usually systemically safe; oral therapy may result in metabolic acidosis

Glaucoma Surgery



Goniotomy and Trabeculectomy are most common surgical procedures.

- Eye must remain motionless to avoid extrusion of intraocular contents
 - Avoid coughing on extubation
 - Consider endotracheal intubation and neuromuscular paralysis
- Acetazolamide may be administered IV during procedure to reduce IOP

Retinopathy of Prematurity



- Abnormal blood vessel growth in the retina
- Associated with prematurity, low birth weight, exposure to supplemental oxygen
- Severe disease (Stage 3 or above) may lead to retinal detachment and blindness

ROP Treatments



Cryotherapy or laser therapy

- Neonatal unit versus operating room
- Avoid high FiO_2
- May require opioid administration
- Consequences of extreme prematurity
 - High incidence of bronchopulmonary dysplasia
 - Apneas → may require postoperative ventilation

Conclusions:



- Communication with the ophthalmologist is essential.
- Thorough preoperative assessment for associated conditions and syndromes is vital.
- Oculocardiac reflex: Be vigilant and have anticholinergic medications immediately available.
- During emergent ocular surgery, the risk of aspiration must be weighed against the risk of IOP increases.
- PONV prevention is important.

References:



1. Chapter: Tobin JR and Grey Weaver Jr. R: Ophthalmology, A Practice of Anesthesia for Infants and Children, 6th edition. Edited by Coté CJ, Lerman J, Anderson BJ. Philadelphia, Elsevier, 2019 pp790-803.
2. Dell R, Williams B. Anaesthesia for strabismus surgery: a regional survey. Br J Anaesth 1999; 82: 761-3.
3. James I. Anaesthesia for paediatric eye surgery. Continuing Education in Anaesthesia, Critical Care & Pain 2008; 8: 5-10.
4. University of Michigan Kellogg Eye Center. (2019, July 29). Anatomy of the Eye. Retrieved from <https://www.umkelloggeye.org/conditions-treatments/anatomy-eye>
5. Rodgers A and Cox RG. Anesthetic management for pediatric strabismus surgery: Continuing professional development. Can J Anaesth 2010; 57: 602-17.

References:



6. Papadopoulos M, Edmunds B, Fenerty C, Khaw PT. Childhood glaucoma surgery in the 21st century. *Eye* 2014;28:931-943.
7. James I. Anaesthesia for paediatric eye surgery. *Continuing Education in Anaesthesia Critical Care & Pain* 2008;8:5-10.