Review Article

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Anesthesia Considerations for Ophthalmic Surgeries

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Abstract

There are special concerns in ophthalmic surgeries, as most of these patients are elderly patients with multiple systemic diseases, pediatric patients, often premature with congenital syndromes, some of them may have limited access to airway, there are concerns regarding oculo cardiac reflex, intraocular pressure and anesthetic interaction and systemic effects of ophthalmic medications.

Keywords: Anesthesia; Ophthalmic Surgeries; Oculocardiac Reflex.

Open Eye Surgical Procedures

- Cataract extraction
- Corneal laceration repair
- Corneal transplant (penetrating keratoplasty)
- Peripheral iridectomy
- Removal of foreign body
- Ruptured globe repair
- Secondary intraocular lens implantation
- Trabeculectomy (and other filtering procedures)
- Vitrectomy (anterior and posterior)
- Wound leak repair

Preoperative Considerations

Anesthesiologist must have detailed knowledge of ocular anatomy, physiology, and pharmacology. Ophthalmic drugs may significantly alter the reaction to anesthesia and that, concomitantly, anesthetic drugs and maneuvers may dramatically influence intraocular dynamics. Patients undergoing ophthalmic surgery may represent extremes of age and coexisting medical diseases (e.g., DM, CAD, essential HTN, chronic lung disease), but they are likely to be in the elderly age group

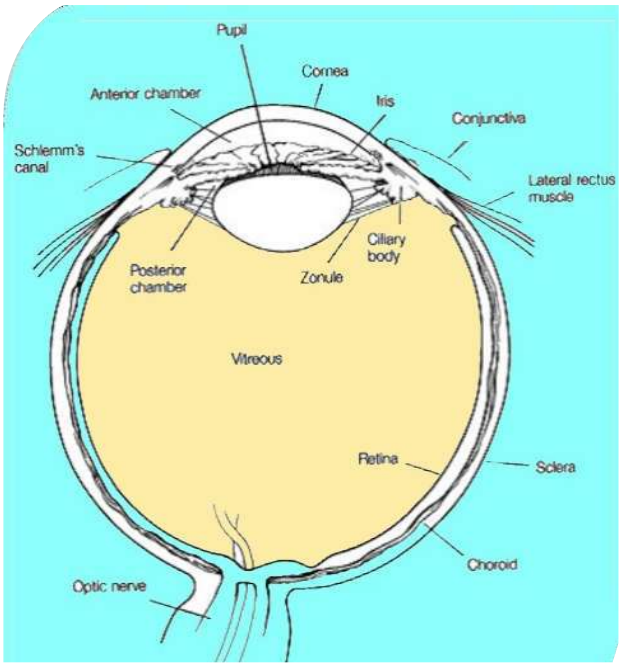

Fig. 1: Anatomy of eye ball

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Ocular Anatomy (Fig. 1)

Salient subdivisions of ocular anatomy include orbit, the eye itself, extraocular muscles, eyelids, lacrimal system. The orbit is a bony box, or pyramidal cavity, housing the eyeball and its associated structures in the skull. The walls of the orbit are composed of the following bones: frontal, zygomatic, greater wing of the sphenoid, maxilla, palatine, lacrimal, and ethmoid.

- The optic foramen, located at the orbital apex, transmits the optic nerve and the ophthalmic artery, as well as the sympathetic nerves from the carotid plexus.
- The superior orbital fissure transmits the superior and inferior branches of the oculomotor nerve; the lacrimal, frontal, and nasociliary branches of the trigeminal nerve; and the trochlear and abducens nerves and superior and inferior ophthalmic veins.
- The inferior orbital or sphenomaxillary fissure contains the infraorbital and zygomatic nerves and communication between the inferior ophthalmic vein and the pterygoid plexus.
- The infraorbital foramen, located about 4 mm below the orbital rim in the maxilla, transmits the infraorbital nerve, artery, and vein.
- The lacrimal fossa contains the lacrimal gland in the superior temporal orbit.
- The supraorbital notch, located at the junction of the medial one-third and temporal two-thirds of the superior orbital rim, transmits the supraorbital nerve, artery, and vein.
- The supraorbital notch, the infraorbital foramen, and the lacrimal fossa are clinically palpable and function as major landmarks for administration of regional anesthesia.
- The coat of the eye is composed of three layers: sclera, uveal tract and retina.
- The fibrous outer layer, or sclera, is protective
- The uveal tract, or middle layer of the globe, is vascular and in direct apposition to the sclera.
- A potential space, known as the suprachoroidal space, separates the sclera from the uveal tract. This may become filled with blood during an expulsive or suprachoroidal hemorrhage, often associated with surgical disaster. The iris, ciliary body, and choroid compose the uveal tract.
- Ciliary body produces aqueous humor
- Choroid supplies nutrition to the outer part of the retina.
- The **retina** is a neurosensory membrane composed of 10 layers that convert light impulses into neural impulses. These neural impulses are then carried through the optic nerve to the brain.
- Located in the center of the globe is the vitreous cavity, filled with a gelatinous substance known as vitreous humor. It is adherent to the most anterior 3 mm of the retina, as well as to large blood vessels and the optic nerve. The vitreous humor may pull on the retina, causing retinal tears and retinal detachment.
- 6 extraocular muscles move the eye within the orbit to various positions.
- The lacrimal gland provides most of the tear film, which serves to maintain a moist anterior surface on the globe
- Blood supply to the eye and orbit is by means of branches of both the internal and external carotid arteries. Venous drainage of the orbit is accomplished through the multiple anastomoses of the superior and inferior ophthalmic veins. Venous drainage of the eye is achieved mainly through the central retinal vein. All these veins empty directly into the cavernous sinus.
- The sensory and motor innervations of the eye and its adnexa are done by multiple cranial nerves supplying branches to various ocular structures.
- A branch of the oculomotor nerve supplies a motor root to the ciliary ganglion, which in turn supplies the sphincter of the pupil and the ciliary muscle.
- The trochlear nerve supplies the superior oblique muscle. The abducens nerve supplies the lateral rectus muscle. The trigeminal nerve constitutes the most complex ocular and adnexal innervation. The zygomatic branch of the facial nerve eventually divides into an upper branch, supplying the frontalis and the upper lid orbicularis, whereas the lower branch supplies the orbicularis of the lower lid.

Ocular Physiology

The formation and drainage of aqueous humor and their influence on intraocular pressure (IOP) in both normal and glaucomatous eyes are among the most important functions, especially from the anesthesiologist's perspective. Two-thirds of the aqueous humor is formed in the posterior chamber by the ciliary body in an active secretory process involving both the carbonic anhydrase and the cytochrome oxidase. The remaining third is formed

by passive filtration of aqueous humor from the vessels on the anterior surface of the iris.

IOP normally varies between 10 and 21.7 mm Hg and is considered abnormal above 22 mm Hg. During anesthesia, a rise in IOP can produce permanent visual loss. If the IOP is already elevated, a further increase can trigger acute glaucoma. If penetration of the globe occurs when the IOP is excessively high, rupture of a blood vessel with subsequent hemorrhage may transpire. IOP becomes atmospheric once the eye cavity has been entered, and any sudden rise in pressure may lead to prolapse of the iris and lens, and loss of vitreous. Thus, proper control of IOP is critical.

Factors Influencing IOP

- External pressure on the eye by the contraction of the orbicularis oculi muscle and the tone of the extraocular muscles, venous congestion of orbital veins (as may occur with vomiting and coughing), and conditions such as orbital tumor.
- Scleral rigidity
- Changes in intraocular contents that are semisolid (lens, vitreous, or intraocular tumor) or fluid (blood and aqueous humor). The major control of intraocular tension is exerted by the fluid content, especially the aqueous humor.

Requirement of Ophthalmic Surgery

- Safety
- Akinesia
- Profound analgesia
- Minimal bleeding
- Avoidance or obtunding of oculocardiac reflex
- Control of intraocular pressure
- Awareness of drug interactions

Table 1: Systemic effects of ocular drugs

Drug	Mechanism of Action	Effect
Acetylcholine	Cholinergic agonist (miosis)	Bronchospasm, bradycardia, hypotension
Acetazolamide	Carbonic anhydrase inhibitor (decreases IOP)	Diuresis, hypokalemic metabolic acidosis
Atropine	Anticholinergic (mydriasis)	Central anticholinergic syndrome
Cyclopentolate	Anticholinergic (mydriasis)	Disorientation, psychosis, convulsions
Echothiophate	Cholinesterase inhibitor (miosis, decreases IOP)	Prolongation of succinylcholine and mivacurium paralysis, bronchospasm
Epinephrine	Sympathetic agonist (mydriasis, decreases IOP)	Hypertension, bradycardia, tachycardia, headache
Phenylephrine	Adrenergic agonist (mydriasis, vasoconstriction)	Hypertension, tachycardia, dysrythmias
Scopolamine	Anticholinergic (mydriasis, vasoconstriction)	Central anticholinergic syndrome
Timolol	Adrenergic blocking agent (decreases IOP)	Bradycardia, asthma, congestive heart failure

- Smooth emergence
- Ocular drugs (Table 1) {not without systemic side effects}

Choice of Anaesthesia for Ophthalmic Surgery

A. General Anaesthesia

The choice between general and local anesthesia should be made jointly by the patient, anesthesiologist, and surgeon. G.A is indicated in children and uncooperative patients, as even small head movements can prove disastrous during microsurgery.

1. Premedication

- Apprehensive
- Pediatric patients often have associated congenital disorders (eg, rubella syndrome, Goldenhar's syndrome, Down syndrome).
- Adult patients are usually elderly, with myriad systemic illnesses (eg, HTN, DM, CAD). These factors must all be considered when selecting premedication.

2. Induction

- Choice of induction technique for eye surgery usually depends more on the patient's other medical problems than on the patient's eye disease or the type of surgery contemplated. Exception- ruptured globe.
- The key to inducing anesthesia in a patient with an open eye injury is controlling IOP with a smooth induction.
- Coughing during intubation must be avoided by achieving a deep level of anesthesia and profound paralysis.

- The IOP response to laryngoscopy and E.T intubation can be somewhat blunted by prior administration of intravenous lidocaine (1.5 mg/kg) or an opioid (eg, remifentanil 0.5–1 microg/kg or alfentanil 20 micro g/kg).
- A non depolarising muscle relaxant is used instead of succinyl choline (depolarizing agent) because of the latter's influence on i.o.p.
- Most patients with open globe injuries have full stomachs and require a rapid-sequence induction technique

3. Monitoring and Maintenance

- Close monitoring of pulse oximetry and the capnograph very important for all ophthalmological procedures as anesthetist is positioned away from the patient.
- Watch for kinking of the ET tube, breathing-circuit disconnections, and unintentional extubation.
- Kinking and obstruction can be minimized by using a reinforced or preformed right-angle ET tube.
- Constantly scrutinizing the electrocardiograph and making sure the pulse tone is audible as oculocardiac cardiac reflex can occur.
- In contrast to most other types of pediatric surgery, infant body temperature often rises during ophthalmic surgery because of head-to-toe draping and insignificant body-surface exposure. End-tidal CO2 analysis helps differentiate this from malignant hyperthermia.
- The lack of cardiovascular stimulation inherent in most eye procedures combined with the need for adequate anesthetic depth can result in hypotension in elderly individuals.
- This problem is usually avoided by ensuring adequate intravenous hydration, administering small doses of ephedrine (2–5 mg), or establishing intraoperative paralysis with non depolarizing muscle relaxants. The latter allows maintenance of a lighter level of anesthesia.
- Emesis caused by vagal stimulation is a common postoperative problem. The Valsalva effect and the increase in CVP that accompany vomiting can be detrimental to the surgical result and increase the risk of aspiration.
- Intraoperative administration of intravenous metoclopramide (10 mg in adults) or a 5-HT3 antagonist (eg, ondansetron 4 mg in adults) decreases the incidence of PONV.
- Antiemetics should generally be given to patients receiving opioids and those with a history of PONV. Dexamethasone (4 mg in adults) should also be considered for patients with a strong history of PONV.

4. Extubation & Emergence

- Coughing while on the endotracheal tube can be prevented by extubating the patient during a moderately deep level of anesthesia.
- As the end of the surgical procedure approaches, muscle relaxation is reversed and spontaneous respirations return. Anesthetic agents may be continued during suction of the airway. Nitrous oxide is then discontinued, and intravenous lidocaine (1.5 mg/kg) can be given to blunt cough reflexes temporarily. Extubation proceeds 1–2 min after the lidocaine and during spontaneous respiration of 100% oxygen.
- Proper airway control is crucial until the patient's cough and swallowing reflexes return
- Scleral buckling procedures, enucleation, and ruptured-globe repair are the most painful operations. Small doses of intravenous narcotics (eg, 15–25 mg of meperidine for an adult) are usually sufficient. Severe pain may signal intraocular hypertension, corneal abrasion, or other surgical complications.

B. Regional Anesthesia

Equipment and personnel required to treat the complications of local anesthesia and to induce GA must be readily available.

1. Retrobulbar Block

- LA is injected behind the eye into the cone formed by the extraocular muscles.
- A blunt-tipped 25-G needle penetrates the lower lid at the junction of the middle and lateral one-third of the orbit (usually 0.5 cm medial to the lateral canthus).
- The patient is instructed to stare supranasally as the needle is advanced 3.5 cm toward the apex of the muscle cone. After aspiration to preclude intravascular injection, 2–5 mL of local anesthetic is injected and the needle is removed.
- Choice of local anesthetic varies, but lidocaine 2% and bupivacaine 0.75% are most common.
- Addition of epinephrine (1:200,000 or 1:400,000) may reduce bleeding and prolongs the anesthesia.

- Hyaluronidase, a hydrolyzer of connective tissue polysaccharides, is frequently added (3–7 U/mL) to enhance the retrobulbar spread of the local anesthetic.
- A successful retrobulbar block is accompanied by anesthesia, akinesia, and abolishment of the oculocephalic reflex (ie a blocked eye does not move during head turning).

Complications

- Globe perforation
- Retrobulbar hematoma
- Optic nerve atrophy
- Frank convulsions
- Oculocardiac reflex
- Acute neurogenic pulmonary edema
- Trigeminal nerve block
- Respiratory arrest

Retrobulbar injection is usually not performed in patients with bleeding disorders (because of the risk of retrobulbar hemorrhage), extreme myopia (the longer globe increases the risk of perforation) and open eye injury (the pressure from injecting fluid behind the eye may cause extrusion of intraocular contents through the wound).

2. Peribulbar Block

- Needle does not penetrate the cone formed by the extraocular muscles.
- Patient supine and looking directly ahead.
- After topical anesthesia of the conjunctiva, one or two transconjunctival injections are given.
- Eyelid is retracted; an inferotemporal injection is given halfway between the lateral canthus and the lateral limbus.
- The needle is advanced under the globe parallel to the orbital floor and when it passes the equator of the eye it is directed slightly medial (20°) and cephalad (10°).
- 5 ml of anesthetic is injected. To ensure akinesia, a second 5-mL injection may be given through the conjunctiva on the nasal side, medial to the caruncle and directed straight back parallel to the medial orbital wall pointing slightly cephalad (20°).
  - *Advantages*: less risk of penetration into optic nerve and artery, less pain on injection.
  - *Disadvantages*: include slower onset and increased likelihood of ecchymosis.

3. Sub-Tenon Block

- Tenon's fascia surrounds the globe and extraocular muscles.
- Local anesthetic injected beneath it diffuses into the retrobulbar space.
- Complications with the sub-Tenon blocks are significantly less than with retrobulbar and peribulbar techniques, but rare reports of globe perforation, hemorrhage, cellulitis, permanent visual loss, and local anesthetic spread into CSF exist.

4. Facial Nerve Block

- A facial nerve block prevents squinting of the eyelids during surgery and allows placement of a lid speculum.
- Several techniques: van Lint, Atkinson, and O'Brien.
- The major complication of these blocks is subcutaneous hemorrhage.

Complications of Needle Based Ophthalmic Anesthesia

a. Stimulation of oculocardiac reflex arc
b. Superficial hemorrhage '! circumorbital hematoma
c. Retrobulbar hemorrhage ± retinal perfusion compromise '! loss of vision
d. Globe penetration ± intraocular injection '! retinal detachment, loss of vision
e. Trauma to optic nerve or orbital cranial nerves '! loss of vision
f. Optic nerve sheath injection '! orbital epidural anesthesia
g. Extraocular muscle injury, leading to postoperative strabismus, diplopia
h. Intra-arterial injection, producing immediate convulsions
i. Central retinal artery occlusion
j. Inadvertent brainstem anesthesia '! contralateral amaurosis, neurocardiopulmonary compromise

5. Topical Anesthesia

- Less traumatic local anesthetic technique mainly used for anterior chamber (eg, cataract) and glaucoma surgeries.
- After topical instillation of anesthetic drops, 0.5% proparacaine (also known as proxymetacaine

chlorhydrate), repeated at 5-min intervals for five applications, an anesthetic gel (lidocaine chlorhydrate plus 2% methylcellulose) is applied with a cotton swab to the inferior and superior conjunctival sacs.

- Ophthalmic 0.5% tetracaine may also be used.
- Use of topical anesthesia is not appropriate for posterior chamber surgery.

6. Intravenous Sedation

- Small dose of propofol (30–100 mg slowly) or a short-acting barbiturate (eg, 10–20mg of methohexital or 25–75 mg of thiopental) to produce a brief state of unconsciousness during the regional block.
- Small bolus of an opioid (remifentanil 0.1–0.5μg/kg or alfentanil 375–500μg) allows a brief period of intense analgesia.
- Some anesthesiologists limit doses to provide only minimal relaxation and amnesia. Midazolam (1–2 mg) with or without fentanyl (12.5–25μg) or sufentanil (2.5–5μg) is a common regimen.
- Doses vary considerably among patients and should be administered in small increments.
- Concomitant use of more than one type of drug (benzodiazepine, hypnotic, and opioid) potentiates the effects of other agents; doses must be reduced accordingly.
- An antiemetic should probably be administered if an opioid is used.
- Regardless of the technique employed, ventilation and oxygenation must be carefully monitored, and equipment to provide positive-pressure ventilation must be immediately available.

Oculocardiac Reflex

- Originally described in 1908 by Aschner.
- Consists of a trigeminal afferent and a vagal efferent pathway.
- Most commonly seen in pediatric patients undergoing strabismus surgery. But can occur in all age groups and during a variety of ocular procedures, including cataract extraction, enucleation, and retinal detachment repair.
- In awake patients, the oculocardiac reflex may be associated with somnolence and nausea.
- Traction on extraocular muscles or pressure on the eyeball can elicit a wide variety of cardiac dysrhythmias ranging from bradycardia and ventricular ectopy to sinus arrest or ventricular fibrillation.
- Anticholinergic medication is often helpful in preventing the oculocardiac reflex. I.V atropine or glycopyrrolate immediately prior to surgery is more effective than I.M premedication. Anticholinergic medications can be hazardous in elderly patients, who often have some degree of CAD.
- RETROBULBAR blockade or deep inhalational anesthesia may also be of value, but these procedures impose risks of their own. Retrobulbar blockade can, in fact, elicit the oculocardiac reflex. The need for any routine prophylaxis is controversial.

Management of OCR

1. Immediate notification of the surgeon and temporary cessation of surgical stimulation until heart rate increases.
2. Confirmation of adequate ventilation, oxygenation, and depth of anesthesia.
3. Administration of intravenous atropine (10 mcg/kg) if the conduction disturbance persists.
4. In recalcitrant episodes, infiltration of the rectus muscles with local anesthetic.
5. The reflex eventually fatigues itself with repeated traction on the extraocular muscles.

Anaesthesia Management in Specific Situations of Eye

General Considerations

- Proper control of IOP is crucial for intraocular procedures as glaucoma drainage surgery, open sky vitrectomy, penetrating keratoplasty (corneal transplantation), and traditional intracapsular cataract extraction.
- Before scleral incision (when IOP becomes equal to atmospheric pressure), a low-normal IOP is essential because abrupt decompression of a hypertensive eye could result in iris or lens prolapse, vitreous loss, or expulsive choroidal hemorrhage.
- If GA is selected, most of the inhalation drugs may be given after i.v induction with a barbiturate

or propofol, neuromuscular blocking drug, and topical laryngeal lidocaine.

- Because complete akinesia is essential for delicate intraocular surgery, nondepolarizing drugs are administered, followed by neuromuscular function monitoring to ensure a 90 to 95% twitch suppression level during surgery.
- Proper control of IOP is critical, so controlled ventilation of the lungs is used, along with $ETCO_2$ monitoring to ensure avoidance of hypercarbia.
- At the completion of surgery, any residual neuromuscular blockade is reversed.
- On resumption of spontaneous ventilation, the patient's trachea is extubated (often in the lateral position) with the patient still deeply anesthetized and after IVadmnistartion of lidocaine to prevent coughing.
- Atropine and neostigmine may be safely used to reverse n.m blockade, even in patients with glaucoma because this combination of drugs, in conventional doses, has minimal effects on pupil size and IOP.

1. "Open-Eye, Full-Stomach" (Penetrating Eye Injury)

- Attention should be given to the exclusion of other injuries, such as skull and orbital fractures, intracranial trauma associated with subdural hematoma formation, and the possibility of thoracic or abdominal bleeding.
- The time of last oral intake before or after the injury should be established as accurately as possible. The patient must be considered to have a full stomach if the injury occurred within 8 h after the last meal, even if the patient did not eat for several hours after the injury: gastric emptying is delayed by the pain and anxiety that follow trauma.
- Preoperative prophylaxis against aspiration may involve administering H_2 receptor antagonists to elevate gastric fluid pH and to reduce gastric acid production. Metoclopramide may be given to induce peristalsis and enhance gastric emptying.
- Regional anesthesia should be avoided because of the potential to extrude intraocular contents via pressure generated by local anesthetics (to prevent further damage to the eye by avoiding increases in intraocular pressure).

Many of the common strategies used to achieve these objectives are in direct conflict with one another.

a. Strategies to Prevent Rise in Intraocular Pressure

- Avoid direct pressure on the globe
- Patch eye with Fox shield
- No retrobulbar or peribulbar injections
- Careful face mask technique
- Avoid increases in central venous pressure
- Prevent coughing during induction and intubation
- Ensure a deep level of anesthesia and relaxation prior to laryngoscopy
- Avoid head-down positions
- Extubate deeply asleep
- Avoid pharmacological agents that increase IOP (Succinylcholine Ketamine)

b. Strategies to prevent aspiration pneumonia

- Regional anesthesia with minimal sedation
- Premedication
- Metoclopramide,
- H2-receptor antagonists
- Nonparticulate antacids
- Evacuation of gastric contents
- Nasogastric tube
- Rapid-sequence induction
- Cricoid pressure
- A rapid-acting induction agent
- Avoidance of positive-pressure ventilation
- Intubation as soon as possible
- Extubation awake

Induction and Maintenance

- Propfol and thiopental have a rapid onset of action and decrease IOP; however, neither prevents the hypertensive response to laryngoscopy and intubation or prevents the increase in i.o.p that accompanies laryngoscopy and intubation.
- Prior administration of fentanyl (1–3μg/kg), remifentanil (0.5–1μg/kg), alfentanil (20 μg/kg), esmolol (0.5–1mg/kg), or lidocaine (1.5mg/kg) attenuates this response with varying degrees of success.

Choice of Muscle Relaxant is Controversial

- Succinyl choline increases intraocular pressure

- Nondepolarizing muscle relaxants do not increase i.o.p. Until the release of rocuronium, however, nondepolarizing agents did not provide a rapid enough onset of action.
- Regardless of the muscle relaxant chosen, intubation should not be attempted until a level of paralysis is achieved that will definitely prevent coughing on the endotracheal tube.
- Attempting to sedate children with rectal suppositories or intra muscular injections often heightens their state of agitation and may worsen the eye injury.
- Although preoperative sedation may increase the risk of aspiration by obtunding airway reflexes, it is often necessary for establishing an intravenous line for a rapid-sequence induction.
- An ideal strategy would be to administer enough sedation painlessly to allow placement of an intravenous line yet maintain a level of consciousness adequate to protect airway reflexes.
- The introduction of new drugs and innovative delivery systems, such as opioid-containing lollipops, may provide some acceptable alternatives.
- Patients at risk for aspiration during induction are also at risk during extubation and emergence. Therefore, extubation must be delayed until the patient is awake and has intact airway reflexes (eg, spontaneous swallowing and coughing on the e.t tube). Deep extubation increases the risk for vomiting and aspiration. Intraoperative administration of antiemetic medication and nasogastric tube suctioning may decrease the incidence of emesis during emergence, but they do not guarantee an empty stomach.

2. Strabismus Surgery

It is one of the most common pediatric ocular surgeries performed. Most patients are healthy, normal children. The incidence is increased in those with CNS dysfunction such as cerebral palsy and meningomyelocele with hydrocephalus. It may be acquired secondary to oculomotor nerve trauma or sensory abnormalities such as cataracts or refractive aberrations. Three problems associated with strabismus are of particular interest to anesthetist:

1. Increased risk of malignant hyperthermia
2. High incidence of PONV
3. Likelihood of an OCR

- Risk of malignant hyperthermia may be lessened by avoiding Succinyl Choline (SCh) & Halothane.
- SCh also increases the extraocular muscle tone & interferes with the forced duction test(which evaluates muscle tone & is helpful in differentiating between a paretic muscle and a restrictive force preventing ocular motion.
- Vecuronium andRocuroniumrender extraocular muscles flaccid thereby minimizing afferent stimulus for nausea, omitting and OCR.
- Anesthesia is commonly maintained with halothane; desflurane; sevoflurane; or isoflurane, nitrous oxide, and oxygen.
- **The LMA** is gaining popularity and can be used provided the patient is not at risk for aspiration. The laryngeal mask can be inserted without the use of muscle relaxants, causes less hemodynamic perturbation, and is associated with less straining and coughing on removal.
- Vomiting is the commonest complication.
  - The administration of droperidol, 75mcg/kg at induction of anesthesia before manipulation of the eye, has been shown to reduce the incidence of vomiting.A lower dose of droperidol, 0.02 mg/kg i.v, administered immediately after anesthetic induction in patients with strabismus may decrease both the incidence and severity of nausea and vomiting.
  - Prophylactic i.v administration of ondansetron also appears to be efficacious.
  - Combination therapy consisting of one or two antiemetics, each with a different mechanism of action, plus a glucocorticoid such as dexamethasone is also gaining popularity.
- A total i.v technique with proprofol has also been associated with a low incidence of emesis after strabismus surgery. Avoiding narcotics may be helpful.
- In addition to the usual practice regarding pediatric mgmt. following measures should be employed to decrease the incidence of nausea & vomiting:

1. Minimal use of opioids for pain mgmt.
2. Decrease or avoid the use of N_2O
3. Administration of 5-HT3 antagonist like ondansetron (0.1 mg/kg i.v) during anesthesia
4. Use of propofol & a potent volatile anesthetic to maintain GA

5. Use of dexamethasone(0.15 mg/kg i.v)
6. Insertion & removal of orogastric tube to decompress the stomach after the induction of anesthesia
7. Gentle surgical manipulation of the eye muscles
8. Maintenance of adequate hydration with i.v crystalloids
9. Placement of lidocaine near the extraocular muscles during surgery to minimize afferent impulses & postoperativeproper control of IOP is crucial for intraocular procedures as glaucoma drainage surgery, open sky vitrectomy, penetrating keratoplasty (corneal transplantation), and traditional intracapsular cataract extraction.
10. Before scleral incision (when IOP becomes equal to atmospheric pressure), a low-normal IOP is essential because abrupt decompression of a hypertensive eye could result in iris or lens prolapse, vitreous loss, or expulsive choroidal hemorrhage
11. Pain on awakening.

3. Retinal Detachment Surgery

- Surgery to repair retinal detachments involves procedures affecting intraocular volume.
- Ophthalmologists sometimes inject a small bubble of gas into the vitreal cavity during surgical reattachment of the retina. The goal is to have a sustained bubble of stable size holding the retina in place. The gases commonly used-sulphur hexafluoride (SF_6) & carbon octofluorine (C_3F_8) which are inert, very soluble in water & poorly diffusible.
- N_2O is 117 times more diffusible than SF_6 & rapidly enters gas bubble. So it should be discontinued at least *20 minutes* before injection of gas into vitreal cavity as intra ocular pressure can rise abruptly.
- N_2O should be avoided in any patient returning for a GA within 3-4 wks. of undergoing intra vitreal gas injection as it may cause re-expansion of the bubble & elevated IOP resulting in retinal artery occlusion & loss of vision.
- These patients are usually managed in the same manner as those having intraocular surgery, except that maintenance of intraoperative skeletal muscle paralysis is not as critical as during intraocular surgery. Hence, inhalational anesthetics need not be accompanied during surgery by non-depolarizing neuromuscular blocking drugs.
- The surgery is basically extraocular but may briefly become intraocular if the surgeon elects to perforate and drain subretinal fluid. Rotation of the globe with traction on the extraocular muscles may elicit the *oculocardiac reflex*.
- It is desirable to have a soft eye while the sclera is being buckled; intravenous administration of acetazolamide or mannitol is common during retinal surgery to lower intra ocular pressure.

Post Operative Eye Pain

It more commonly arises due to corneal abrasion; can also occur due to acute glaucoma attack. During GA, blinking reflex is lost & both basal & reflex tear production decreases which leads to high risk for corneal abrasion. Corneal abrasion pain is characterized by a foreign body sensation in the eye, tearing, conjunctivitis & photophobia. Treatment requires application of antibiotic eye ointment & covering of the eye with a patch for at least 48 hrs. Topical application of anesthetic drops & steroids to the cornea is contraindicated because they retard healing.

Acute glaucoma may manifest as severe, diffuse periorbital pain in a dry pale eye with a dilated pupil in postoperative period. Initial treatment is to decrease intra ocular pressure includes intravenous administration of either 20% mannitol (1 g/kg) over 30 minutes or 500 mg acetazolamide over 5 mins. If pain persists for> 24 hrs, Ophthalmologist consultation should be consulted.

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