Anaesthesia for paediatric eye surgery

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Abstract

Local anaesthesia is often the technique of choice for ophthalmic procedures performed on adults; however, general anaesthesia is usually required for procedures on children. The majority of paediatric patients are fit and healthy but there is a minority in whom the presenting eye complaint is related to a congenital disorder, which may have significant bearing on the conduct of anaesthesia.

Management of the airway and presentation of a quiescent eye for surgery are key considerations, while control of the oculocardiac reflex and intraocular pressure (IOP) are important both intraoperatively and postoperatively. IOP is affected by almost all aspects of general anaesthesia and should be considered when choosing an anaesthetic technique. Ocular surgery is emetogenic and without prophylaxis is associated with a high incidence of postoperative nausea and vomiting which should be addressed to prevent problematic increase in intraocular pressure. Most procedures are associated with mild to moderate postoperative pain and can usually be managed with simple analgesia. Pain, but also the use of opioid analgesia, is a risk factor for postoperative nausea and vomiting. Examination under anaesthesia, intraocular surgery, correction of squint and emergency ophthalmic surgery each presents its own challenge and all are discussed.

Keywords Anaesthesia; intraocular pressure; oculocardiac reflex; ophthalmic; paediatric

Royal College of Anaesthetists CPD Matrix: 1A02, 2D02, 3A12

Learning objectives

After reading this article, you should be able to:

- describe the congenital conditions and associated anaesthetic considerations encountered in paediatric ophthalmic surgery
- classify the anaesthetic factors that affect intraocular pressure (IOP) and discuss the management of these factors
- describe the oculocardiac reflex, its management and associations
- demonstrate the management of postoperative nausea and vomiting following anaesthesia for paediatric ophthalmic surgery
- describe a sensible anaesthetic technique for the following procedures: (i) examination of the eye under anaesthesia including measurement of IOP; (ii) intraocular surgery; (iii) strabismus surgery
- discuss the potential anaesthetic techniques for emergency ophthalmic surgery in the paediatric population

Local anaesthesia is often the technique of choice for ophthalmic procedures performed on adults; it is usually well tolerated, effective, and avoids the risks of general anaesthesia. With the exception of certain mature teenagers, local anaesthesia alone is rarely tolerated by children.

As a result of the need for specialized equipment, ophthalmic surgery is usually performed in specialized eye theatres which can be situated in an isolated location, distant to the main theatre complex. It is important to ensure that staff are appropriately trained and familiar with paediatric patients and that appropriate paediatric equipment is available.

The majority of paediatric patients are fit, healthy, American Society of Anesthesiologists (ASA) I or II, have a very low risk associated with general anaesthesia, and can be managed as day cases. There is a minority in whom the presenting eye complaint is related to a congenital disorder which may have significant bearing on the conduct of anaesthesia (Table 1).

Pre-medication

A number of children having anaesthesia for eye surgery have multiple planned procedures and/or learning difficulties. Mild sedative premedication (e.g. midazolam or clonidine) should be considered for patients likely to find general anaesthesia distressing. Anticholinergic premedication used to be considered standard practice for any procedure during which bradycardia is likely (see oculocardiac reflex). However, it is now rarely used.

Intraoperative considerations

Induction of anaesthesia

Both intravenous and inhalational induction may be suitable and the anaesthetist may make their own assessment based on the patient in question. If inhalational induction is used, nitrous oxide should be avoided. Nitrous may increase the risk of nausea and vomiting, diffuse into the intraocular gas bubbles used in retinal detachment surgery and increase intra-ocular pressure, or even diffuse out of those same bubbles once established and risk recurrence of detachment.

Airway

Unless the patient has associated comorbidities (Table 1) they are unlikely to present with an airway that is difficult to manage. However, limited access to the airway intraoperatively necessitates careful choice of airway device. Endotracheal intubation provides secure airway access and, with paralysis, allows easy ventilation (controlling CO_2 and ensuring no movement during intraocular surgery) but is associated with coughing on emergence (with raised venous and IOPs). A small dose of lidocaine (e.g. 1 mg/kg IV) may avoid the raised IOP encountered on extubation but is seldom required.

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Congenital disorders related to paediatric ophthalmic surgery

Syndrome	Anaesthetic considerations	Ophthalmic disorder
Mucopolysaccharidoses	Difficult mask ventilation and intubation, post-extubation stridor and pulmonary collapse	Cataract, glaucoma, squint
Craniosynostosis disorders • Crouzon's, Apert's and Pfeiffer's syndromes	Upper airway obstruction due to midface hypoplasia and secondary nasal obstruction due to choanal atresia. Tracheal anomalies, such as tracheal cartilaginous sleeve, have been reported in severe cases	
Craniofacial syndromes • Goldenhar, Treacher-Collin, Smith—Lemil—Opitz	Difficult airway and laryngoscopy secondary to retrognathia, decreased mouth opening, decreased neck extension and relative macroglossia	
Hallerman—Streiff syndrome	Mandibular hypoplasia and microstomia results in difficult intubation	
Stickler's syndrome	Midface hypoplasia, retromicrognathia, and cleft palate. The mandibular hypoplasia causes difficulties in mask ventilation and endotracheal intubation	Early retinal detachment, glaucoma
Congenital phakomatoses • Sturge—Weber, neurofibromatosis, von Hippel—Lindau disease	Associated with: seizures, intracranial lesions and phaeochromocytoma	Haemangiomas, ocular melanocytosis, retinal hemangioblastoma
Homocysteineuria	Hypoglycaemia, thromboembolism	Dislocated lenses
Marfan's syndrome	Potential aortic root/valve disorder	

Table 1

If intubation is planned then 'south-facing' (e.g. RAE tubes) or flexible endotracheal tubes avoid interference with the surgical field. Pre-formed south-facing tubes especially should be used with caution in infants and young children as there is a considerable degree of interpersonal anatomical variation which predisposes to endobronchial intubation if the bend is incorrectly located. Alternatively, flexible laryngeal mask airways can be used safely in children at low risk of regurgitating and when combined with paralysis, ventilation and modern volatile agents, allows for a very rapid smooth emergence with minimal coughing.

Intraocular pressure

Normal IOP is 10—20 mmHg. Control of IOP during anaesthesia is important as a sudden rise can lead to loss of intraocular contents or expulsive haemorrhage. Normal regulation of IOP occurs through regulation of the volume of aqueous humour in the anterior chamber. The vitreous humour is a relatively fixed volume. Anaesthetic factors affecting IOP are similar to those affecting intracranial pressure (Table 2).

Oculo-cardiac reflex (OCR)

This is a common phenomenon and particularly potent in children. It can be triggered by a sudden rise in IOP, traction on the extraocular muscles (particularly the medial rectus) or traction on the eyelid. Afferent fibres via the ophthalmic branch of the trigeminal nerve run to a sensory nucleus in the fourth ventricle. Efferent fibres in the vagus nerve generally result in bradycardia but can proceed to asystole if left untreated. Incidence varies but is reported to be as high as 60% during squint surgery. Prophylaxis with vagolytics is protective. Anaesthesia with propofol may increase the risk of bradycardia and those having total intravenous anaesthesia (TIVA) may benefit from prophylactic atropine or glycopyrrolate. It has been suggested that there is an association between the OCR and post-operative nausea and vomiting. There is little evidence for this. Karanovic et al. cast doubt over the association with a study comparing paralysis with rocuronium in one group with no paralysis in the other. There was a significant decrease in incidence of OCR on the rocuronium group but identical incidence of PONV in both groups. It has been proposed that the use of ketamine may blunt the OCR.

Postoperative nausea and vomiting (PONV)

Ocular surgery is emetogenic and without prophylaxis is associated with a high incidence of PONV. The rise in IOP associated with active vomiting is particularly detrimental in these patients. This incidence has been quoted as high as 90% in strabismus surgery and is thought to lie between 50 and 76% for intraocular surgery. Manipulation of the extraocular muscles, increased ocular volume and changes in IOP can all potentiate nausea and vomiting. Reported risk reductions can be seen in Table 3. It should be remembered that PONV secondary to raised IOP is resistant to antiemetics and if vomiting persists despite therapy, the patient should be reviewed by the ophthalmologist.

PONV can be reduced using multi-modal techniques such as ensuring the patient is well hydrated, avoidance of nitrous oxide and opioid analgesia, as well as using one or two prophylactic

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