Open Eye Injury with Full Stomach

S Gupta, A Mehta

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Abstract

With the advent of modern era trauma has increased tremendously with injury to the eyes being no exception. The perforating injury of eye has become challenge for anesthesiologists and surgeons for its management. These patients are considered as full stomach. Precautions have to be taken to prevent rise in intraocular pressure (IOP) on one hand and complications of full stomach on the other hand. The maneuvers like laryngoscopy, endotracheal intubation, bucking, coughing and use of the drugs like succinylcholine, ketamine etc cause tremendous increase in IOP thus causing expulsion of eye contents and loss of vision. Aspiration of stomach contents can cause lung injury and pneumonia. There should be balance between the loss of eye sight and loss of life. For the safe outcome the induction of anesthesia, endotracheal intubation, maintenance and extubation should be very smooth. The role of succinylcholine is debatable and controversial. High doze of induction agents like thiopental, propofol, midazolam and non-depolarizing muscle relaxants; anti-emetics and anti-cough agents form the bases of the management.

INTRODUCTION

With the advent and progress of technology of modern era the incidence of trauma has increased tremendously. All the treatment and management of such cases come under the domain of emergency care. EMERGENCY is defined as an event that has to be dealt with immediately, usually within first hour after presentation. With the advancement of life style, trauma as such and trauma of the eye are becoming the leading cause of concern for urgent surgical intervention. Traumatic injuries of eye can be blunt or penetrating ("open eye"). The incidence is highest in young adult males and children. Trauma is often associated with industrial and motor vehicle accidents[1]. Eye protections in work place and car safety belts have lowered the incidences of eye trauma in many countries.

TIMING OF SURGERY

The degree of urgency depends on the size of the laceration, risk of loss of ocular contents, how dirty the wound is and the risk of infection [1]. There should be balance between the problems of emergency and full stomach. On one side is danger of loss of vision due to rise in IOP while on the other side is the aspiration pneumonitis problem [2, 3]. Penetrating injuries may need to be dealt with more urgently due to the risk of infection and endophthalmitis. Decision making needs to be made on the merit of the individual case. If the patient has an open eye injury there is also the risk of vitreous loss and retinal detachment. In many open injuries surgeons are willing to delay the operation until a patient is adequately fasted prior to anesthesia. This is especially the case where there is severe damage to the eye and surgery is not going to improve sight. Open eye injuries in which the eye is still largely intact and vision prognosis is good needs to be dealt with priority.

Ideally all the patients should be fasted before undergoing general anesthesia to minimize the risks of aspiration. It is essential to liaise with surgeon to establish the degree of injury. Most cases involving blunt trauma can usually be delayed to allow for patient fasting [4, 5].

FASTING REGIME

In the uncomplicated patients six hour fasting is good enough. It is now common practice to allow the patients to drink clear fluids (water, non fizzy fruit drinks) up to two to four hours prior to the time of surgery[6, 7]. In the patients who have had trauma or received opoids, gastric emptying time may be delayed up to 24 hours. The most important time interval is that which falls between the last meal and the time of the injury. If trauma occurs soon after a large meal, the patient still has a full stomach after the standard 6 hour fast. Alcohol also delays the gastric emptying. If surgery is necessary in a patient with full stomach then principles of rapid sequence Induction may be followed [1].

INTRAOCULAR PRESSURE (IOP)

PHYSIOLOGY AND MEASUREMENT

IOP is mainly determined by the production of aqueous humor from plasma within capillary network of the eye's cilliary body in posterior chamber dependant on the choroidal blood volume (CBV) and its drainage through trabecular meshwork in the anterior chamber, Fontana's spaces and Schlemm's canal into episcleral venous system [8]. The volume of the aqueous humor is 250 micro liters. The rate of production is 2.50 micro liters per minute [9]. IOP is measured with a tonometer. IOP measurement is influenced by corneal thickness and rigidity [10, 11].

SIGNIFICANCE

The success of any procedure lies in understanding the physiological rise and the implications of anaesthetic drugs in IOP [3, 4, 9]. It is important for anesthesiologist to control IOP. A rise in IOP will impair the operating conditions and may cause an expulsion of intraocular contents with permanent damage to the eye. On the other hand a mild reduction in IOP will improve the operating condition for the surgeon. Normal IOP as that between 10 mmHg to 20 mm Hg [5, 8] . The average value of IOP being 15 mm Hg with fluctuations of about 0.25 mm Hg. IOP also varies with a number of other factors such as heart rate, respiration, exercise [12], fluid intake, systemic medication, topical drugs, Alcohol and caffeine consumption may increase IOP[13]. An important quantitative relationship is provided below:

IOP = F / C + PV

F = aqueous fluid formation rate,

C = outflow rate,

PV = episcleral venous pressure

FACTORS INCREASING IOP

1.Raised arterial pressure

Intraocular pressure (IOP) is normally regulated by changes in the volume of the aqueous humour[14]. Choroidal blood volume (CBV) is dependent upon the arterial blood pressure and is auto regulated over a range of perfusion pressure to keep IOP with in normal limits. Any rise in blood pressure reflects the rise in IOP may be transient but is sufficient to cause detrimental effect on the open eye injury. On the other hand hypotension (systolic below 90) may reduce IOP as CBV decreases.

2. External pressure e.g. face mask; While keeping the face mask for delivering oxygen or inhalational anaesthesia gentleness is required.

3. Raised venous pressure e.g. by coughing, straining, vomiting and twisted neck veins.

4. Hypoxia and hypercarbia which cause vasodilatation of blood vessels of intraocular blood vessels.

5. Suxamethonium (Succinylcholine): The precise mechanism is unknown but may be due to contraction of extra ocular muscles during the fasciculation or dilatation of blood vessels. The effect is maximum at 2 to 4 minutes and returning to normal within 7 minutes. On balance there is no case report of ocular damage with succinylcholine use or evidence that succinylcholine avoiding techniques are any better or safe.[1]

6. Ketamine: Although early documentation blames ketamine for raising IOP but if given after premedication with diazepam and meperidine does not affect IOP, and intramuscular ketamine may even lower IOP in children [3].

7. Laryngoscopy and endotracheal intubation raise IOP. An increase in IOP during induction may cause expulsion of intraocular contents and the permanent damage to the eye [15]. But insertion of laryngeal mask airway after propofol induction has been shown to have minimal effects on IOP [16]

8. Ryle tube insertion causes multi factorial rise in IOP.

FACTORS LOWERING IOP

When the globe has been penetrated the IOP is reduced to atmospheric pressure.

1. Reduced venous pressure: Head up tilt lowers venous pressure and thereby IOP.

2. Lowering arterial pressure: Keeping the systolic pressure < 90mm of Hg is beneficial for lowering IOP.

3. Hypocarbia acts by constricting the choroid vessels and thereby lower IOP.

4. Induction agents (except ketamine): CNS depressants generally lower IOP. Thiopental significantly decreases IOP by its central depressive effect on the diencephalic control of IOP. Althesin and etomidate also lower IOP. The effects of propofol are similar to that of thiopental [16].Major tranquilizers, including intravenous doses of midazolam (0.03 mg/kg), lower the IOP.

5. Inhalational agents cause fall in IOP is proportional to the inspired concentration.

6. Non depolarizing muscle relaxants.

7. Reduction in aqueous humor volume: Agents like acetazolamide which reduces IOP by inhibiting the production of aqueous humour.

8. Reduction in vitreous volume: Mannitol which exerts its effect as an osmotic diuretic.

9. Drugs: certain drugs like Acetazolamide can be used to reduce an acutely raised IOP[14]

Also premedication with dexmedetomidine, an alpha-2 agonist, could attenuate increase in the IOP after succinylcholine and intubation along with haemodynamic fluctuations[17]

ANESTHETIC MANAGEMENT OF PENETRATING EYE INJURY

CHOICE OF A LOCAL OR GENERAL ANESTHETIC TECHNIQUE

The choice of technique will depend upon factors including whether the patient is able to lie flat, still and protect his or her own airway safely for the duration of the procedure and the advantage of general anaesthesia in full stomach cases. Thus the children, uncooperative or intoxicated patients usually are the better candidates for general anesthesia. Local anaesthesia has its own problems as spread of the local anaesthetic is poor in patients with eye and orbital infections. Also injection of local anaesthetics using peribulbar and retrobulbar techniques is associated with increase in IOP which may lead to vitreous loss. Ocular compression after the block is also not an option if the patient has an open eye injury. In some patients it may be possible to operate on small eye injuries using topical anaesthesia, sub-tenon block, or a careful peribulbar or retrobulbar block.[18,19]

DOES THE PATIENT HAVE OTHER MEDICAL PROBLEM?

In principle any other associated problems must be taken care. Eye trauma requiring surgery may also be associated with other injuries that may or may not need surgery. Life threatening problems should be dealt before sight threatening problems. Patients with other disease process such as diabetes or ischemic heart disease should be optimized prior to surgery if the time allows.

Planning / general guidelines

Stress has already been laid down on the factors on which the outcome of the patient depends.

If the repair is carried out as an emergency procedure the patient must be considered to have a full stomach and requires a rapid-sequence induction. If possible, early administration of an H2 receptor antagonist such as metoclopramide (0.15 mg/ kg IV) will decrease the gastric volume and provide some protection [20]. Use of anti-cholinergic is useful for preventing the oculocardiac reflex.

During pre-oxygenation care must be taken not to exert pressure on the eye by the face mask [1]. Pre-oxygenation for 3 to 4 minutes with the patient holding the mask himself can build confidence and relieve anxiety. Meanwhile intravenous line is set up.

Before rapid- sequence intubation, several precautions must be taken to blunt the pressor, IOP response to laryngoscopy and tracheal intubation. When the globe has been penetrated the IOP is reduced to surrounding atmospheric ambient pressure. Any attempt which causes increase in IOP may cause expulsion of the eye contents, may it be vomiting, Ryle tube insertion, placemeant of oxygen mask, laryngoscopy, intubation, bucking, coughing, raised arterial or venous pressure.

Intravenous administration of lidocaine (1.5 mg/ kg) and remifentanil (0.7microgram / kg) 3 to 5 minutes before induction may help to attenuate the increase in IOP after tracheal intubation. A beta adrenergic receptor blocking drug such as labetalol (0.05mg to 0.10 / kg) may also be useful in blocking the cardiovascular response to tracheal intubation, especially in patients with angina or hypertension [20]. Most recently a technique has been developed where a strong analgesics like fentanyl (2-3 microgram/ kg) or remifentanil (0.7 microgram/kg) are administered followed by vecuronium (0.15mg/kg). Other non-depolarizing muscle relaxants e.g. rocuronium, mivacurium can also be used in sufficient and equipotent doses. This is followed by propofol (2-5mg/kg) or sodium thiopental (6mg/kg) over 20 to30 seconds. As soon as muscle weakness is perceived, cricoid pressure (Sellick's maneuver) is applied then immediately endotracheal intubation is performed within 30 seconds .Thus intubation is performed by taking total 90 seconds only [21]. Abbott [22] has documented that he was able to do it within 60 seconds. An attemptation of intubation too early with incomplete relaxation for performing laryngoscopy may stimulate coughing or bucking and cause sudden and significant rise in IOP.

Use of succinylcholine as muscle relaxant although theoretically is contraindicated and controversial [5] but no

published report has come so far causing further eye damage. In rapid sequence induction, Libonati and coworkers [23, 24] did not encountered aspiration of gastric contents or extrusion of eye contents. Other worker Bourke[25] used succinylcholine successfully and carefully without encountering much problem. However, the significance of lack of reported cases is strengthened by an argument based on biologic plausibility. When an open globe injury has occurred, it is often associated with crying. Valsalva maneuver, forceful blinking and rubbing the eyes, all of which create a much larger rise in IOP than associated with the use of succinylcholine [3, 26, 27.] Thus increase in IOP produced by succinylcholine may be tempered by sedatives[28] and the induction agents in setting of rapid sequence induction for the repair of acute injuries and may prevent more devastating eye injury by profoundly paralyzing the muscles of chest and avoiding coughing. Advocating the evidence based practice and controversies regarding use of succinylcholine, ultimately majority have agreed to modify the technique of rapid-sequence induction with presently available faster acting dose dependent non depolarizing blocking agents for providing good relaxation [5, 29]. In practice the risk is minimized by the prior administration of the induction agents which reduce IOP, e.g. small dose of non depolarizing muscle relaxant, diazepam, lignocaine, acetazolamide, and self taming dose of succinylcholine. The anaesthesiologist must however weigh the risk to the eye against the risk of aspiration of gastric contents [2, 3, 4, 5].

The muscular relaxation must be monitored with train of four to prevent accidental coughing caused by carinal stimulation[20]. A little head up tilt is helpful in further lowering the IOP.

If intubation seems easy and uneventful then a large doze of non-depolarizing relaxants may be substituted for succinylcholine and a modified rapid-sequence induction performed. Care must be taken to allow the time for full muscle paralysis to occur before laryngoscopy.

During the procedure adequate depth of anaesthesia should be maintained to avoid any movement of the patient [30.]

A good monitoring of vital parameters should be done. Patient should be maintained with controlled ventilation during the procedure aiming for low to normal end-tidal carbon dioxide.

At the end of the procedure once airway protective reflexes have returned and the patient starts breathing spontaneously, the patient should be extubated on their side. To avoid coughing and smooth emergence from anaesthesia lidocaine (1.5mg/kg IV) or remifentanil (0.5microgram/kg) should be administered 5 minutes before the awakening. Application of lidocaine spray or gel may be helpful but with the risk of numbness of vocal cords and some chances of aspiration.

Post operative nausea, vomiting and pain should be kept to a minimum as they can cause increase in IOP. Prescribe analgesics and an anti-emetic.

SPECIAL CARE FOR ANAESTHESIA IN CHILDREN

Special care is needed in the children having open eye injury. The management of the children the following aspects is to be considered: [31, 32]

* The open eye injury in a child may also be associated with head injury. In such cases administration of narcotics should be avoided. Topical instillation of local anaesthesia (Amethocaine 0.5 to 1 % or cocaine 2 to 4 %) for conjunctiva and cornea may be helpful for relieving the pain for some time but it has to be replaced by other suitable agents as mentioned above. In fact rather than pain other factors such as crying, rubbing of the eyes, anxiety are the causes of concern. The patient should be nicely sedated [33, 34].

* Analgesic along with anti-emetic should be given [1]. The value of anti-emetics is more important if narcotic analgesics are considered. Various trials have been worked out to control nausea and vomiting [34, 35, 36, 37,38].

* Regional anaesthesia is not possible and suitable however local anaesthetic eye drops as topical analgesia may be helpful in relieving the pain and reducing the anxiety [39]. Although topical analgesia is of some value for facilitation for ocular examination in adults but its usefulness is limited in children. Benzocaine 4%, cocaine 4%, proparacaine 0.5%, tetracaine hydrochloride 0.5%, bupivacaine 0.5%, lidocaine 2%, may be used for such purpose.

* At the same time awake endotracheal intubation may cause serious and deleterious effects up to the expulsion of the eye contents by sudden and tremendous increase in the IOP.

* The intravenous access should be made gently by topical application of anaesthetic cream or gentle induction of anaesthesia by mask (with 7 to 8 % of sevoflurane) with good pre-oxygenation for a period of time without disturbing the patient, positive pressure must be avoided.

* The surgery of the patient may be delayed if the patient has eaten something recently. However it has already been emphasized to consider all the eye injury patients have full stomach. The delay of surgery must be balanced with seriousness of the open eye injury. Administration of metoclopramide and H 2 receptor antagonists must be given for early emptying and decreasing the volume of the secretions released by the stomach.

* During the course of surgery while the patient is totally paralyzed, stomach should be decompressed and the endotracheal tube is extubated while awake.

* All the other precautions and care must be taken as it has been discussed for general patients with penetrating eye injury with full stomach.

References

1. Wilson A, Soar J. Anaesthesia for Emergency Eye Surgery. Issue 11 (2000) Article 10: 1-2 pp 1 of 3. http://www.nda.ox.ac.uk/wfsa/html/u11/u1110_01.htm 1/19/2008
2. Donlon JV jr. Anaesthesia for ophthalmic surgery. In Brash P (ed): ASA Refresher Course Lectures, vol 16. Philadelplhia, JB Lippincott, 1988, p 81.
3. Cunningham AJ, Barry P. Intraocular pressure – physiology and implications for anaesthesia management. Can J Anaesth 1985; 33:195-208.
4. Murphy DF:Anesthesia and intraocular pressure. Anesth Analg 1986; 64:520-30.
5. Hall SC, Lerman J: Should succinylcholine be used in the child with an open eye injury and full stomach? Anesth Rev. 1993; 20-98.
6. Splinter WM, Schaefer JD: Unlimited clear fluid ingestion two hours before surgery
7. Anae Inten Care 1990, 18:522-526.
8. Schreiner MS, Treibwasser A, Keon TP: Ingestion of liquids compared with preoperative fasting in pediatric outpatients. Anesthesiology 1990,72:593-597.
9. Shields MD. In textbook of Glaucoma, 4th ed. Baltimore Williams & Wilkins 1998; pp 14, 25, 47- 49.
10. Patil BB, Dowd IC: Ocular physiology. In kumar CM, Dodds C, Fanning GL (eds): Opthalmic anaesthesia. Lisse, Netherlands, swets & Zeitlinger 2002; 23-35.
11. Matthias C. Grieshaber, MD; Andreas Schoetzau, MS; Claudia Zawinka, MD; Josef Flammer, MD; Selim Orgul, MD: Effect of Central Corneal Thickness on Dynamic Contour Tonometry and Goldmann Applanation Tonometry in Primary Open-angle Glaucoma.Arch Ophthalmol 2007; 125:740-744.
12. Tanaka: Corneal Pachymetry. A Prerequisite for Applanation Tonometry in Arch Ophthalmol 1998; 116: 544-545.
13. Geraldo M V; Hildeamo B O; Daniel T de Andrade; Martim B; Robert R, Intraocular Pressure Variation During Weight Lifting. Arch ophthalmol 2006;124:1251-54. http://archopht.ama-assn.org/cgi/content/full/124/9/1251
14. Pardianto G et al. Intraocular pressure measure on normal eyes- Mimbar Ilmiah Oftalmologi Indonesia. 2005; 2: 78-9
15. Harry Murgatroyd and Jane Bembridge: Intraocular pressure. BJA: CEACCP 2008, 8(3), 100-103.
16. Wynands JF,Cromwell DF. Intraocular tension in association with Succinylcholine and endotracheal intubation. Can Anaesth Soc J 1960, 7: 39-43.
17. Deramoudt V,Gaudon M,MalledentY, et al. Effect of propofol on IOP in strabismus surgery in children. Ann Fr Anesth Reanim 1990, 9:1.
18. HA Mowafi, N Aldossary, SA Ismail, J Alqahtani. Effect of dexmedetomidine premedication on the intraocular pressure changes after succinylcholine and intubation. BJA.2008; 100(4):485-9.
19. James Al, Pittman, Gary N, Shuttleworth. Local Anaesthesia for Eye Surgery. 2006;54(2): 77-84
20. Hamilton RC, Gimbel HV,StruninL. Regional analgesia for 12,000 cataracts extraction and intra ocular lens implantation procedures. Can J Anaesth 1988; 35:615-623.
21. Donolon J V, Doyle J, Feld man MA, Anesthesia for eye, ear, nose & throat surgery. In MILLER R D (ed): Miller anaesth; 6th ed, Philadelphia: (Elsevier living Stone) 2005;2, 2527-56.
22. Bajaj P. The ocular system: Clinical anaesthesia, Paras Medical Publishers 3rd ed. Chap. 14 2006; 602-20.
23. Abbott MA, The control of IOP during the induction of anesthesia for emergency eye surgery. High dose vecuronium. Anaesthesia 1987; 42: 1008-1012.
24. Libonati MM, leahy JJ, Ellison N. The use of succinylcholine in open eye surgery. Anesthesiology 1985; 62:637-40.
25. McGoldrick KE. The open globe: is an alternative to succinylcholine necessary? J Clin Anaesth 1993; 5: 1-4.
26. Bourke DL. Open eye injuries, Anesthesiology 1985; 63 (6): 727-27.
27. Vinik HR. Intra ocular pressure changes during rapid sequence induction and intubation: A comparison of rocuronium, atracurium and succinylcholine. J Clin Anaesth 1999; 11:95-100.
28. Coleman Dj, Troket S. Direct-recorded intraocular pressure variations in a human subject. Arch ophthal 1969, 82: 637-640.
29. Fanning GL. Monitored sedation for ophthalmic surgery. In Kumar CM, Dodds C, Fanning GL. Ophthalmic Anaesthesia. Lisse, Netherlands, Swets & Zeitlinger, 2002; pp 104-5.
30. Claud A. Vachon, David O. Warner, Succinylcholine and the open globe: Tracing and teaching. Anesthesiology 2003; 99: 220-3
31. Edge KR, Nicoll JMW. Retrobulbar hemorrhage after 12,500 retrobulbar blocks. Anesth Analg 1993; 76; 1019-1022.
32. Faith IS. The child with open eye injury. Anesthesiol News. 1988; 3:12.
33. McGoldrick KE. Pediatric ophthalmic surgery: Anesthetic considerations. In McGoldrick KE (ed): Anesthesia for Ophthalmic and Otolaryngologic Surgery. Philadelphia, WB Saunders, 1992; 190
34. Cohen MM , Cameron CB, Duncan pg. Pediatric anesthesia morbidity and mortality in the perioperative period. Anesth Analg. 1990;70:160-167.
35. Kumar MC, Dodd C, Gary L, Fanning. Anaesthesia for Paediatric Ophthalmological surgery. Kumar CM, Dodd C, Fanning(eds):Ophthalmic Anaesthesi. Lisse, Netherlands, Swets & Zeitlinger,2002;127-44.
36. Tramer M, Moore A, McQuay H: Meta-analysis comparison of prophylactic antiematic efficacy for postoperative nausea and vomiting: Propofol anaesthesia vs omitting nitrous oxide vs total iv Anaesthesia with propofol. Br J Anaesth 1997; 78 : 256-59.
37. Busoni P, Crescioli M, Agotino R, sestini G. Vomting and common paediatric surgery. Paediatr Anaesth. 2000;10:

639-643.
38. Fujii Y, Tanaka H, Toyooka H. Granisetron and dexamethasone provides more improved prevention of post operative emesis than granisetron alone in children. Can J Anaesth. 1996;43:1229-1232.
39. Lerman J, Eustis S, Smith DR. Effect of droperidol pretreatment in children undergoing strabismus surgery. Anesthesiology. 1986; 65: 322-325.
40. Fry RA, Post operative pain and vomiting may be decreased by regional local anesthetic block. Reg Anesth. Pain Med. 1999;24: 582-583.

Author Information

Satya Dev Gupta
Prof., Teerthanker Mahavir Medical College and Research Centre

Anjali Mehta
Sr. Resident Anesthesia & Intensive Care, Govt Medical College