A REVIEW OF ANAESTHESIA IN OPHTHALMOLOGY

E Y Yap, W K Chan, R F T Fan

ABSTRACT

In this article, we review the methods of anaesthesia commonly used in ophthalmology in Singapore. These include topical, local, regional and general anaesthesia. Topical and local anaesthesia is adequate for most outpatient procedures. The most common form of regional anaesthesia in Singapore is still retrobulbar anaesthesia. General anaesthesia is used in children and when more extensive procedures are performed.

Keywords: *anaesthesia in ophthalmology, topical anaesthesia, local anaesthesia, regional anaesthesia, general anaesthesia*

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INTRODUCTION

For thousands of years, surgery has been performed on the eye with little or no anaesthesia. It was not until an ophthalmologist by the name of Carl Koller[1] who discovered cocaine hydrochloride as a topical anaesthetic that some types of eye surgery could be performed without pain. Since then, other types of anaesthesia have been used to facilitate ophthalmic surgery including regional anaesthesia and general anaesthesia.

In this article, we review the types of anaesthesia used in ophthalmology.

ANATOMY OF THE EYE

In order to understand the use of various types of anaesthesia in ophthalmology, it is first necessary to understand the nerve supply of the eye and its adnexa.

The nerve supply of the eye, as in any other region of the body, can be divided into either motor or sensory. The motor nerves comprise the 3rd, 4th and 6th cranial nerves which are responsible for ocular motility and the 7th cranial nerve for movement of the frontalis and the orbicularis oculi. The 3rd cranial nerve (oculomotor) innervates the medial, inferior and superior recti and also the inferior oblique. The 4th cranial nerve (trochlear) innervates the superior oblique. The 6th cranial nerve (abducens) innervates the lateral rectus. The facial nerve can be divided into the upper zygomatic branch which supplies the frontalis muscle and orbicularis oculi of the upper lid and a lower zygomatic branch supplying the orbicularis oculi of the lower lid.

The sensory nerve supply is more complicated though one may simplify to the extent that the 5th cranial nerve is the sole sensory supply of the eye and its adnexa. To be more precise, the first two divisions of the trigeminal nerve are responsible for the sensory supply of the eye and its adnexa. The ophthalmic division can be subdivided into the frontal, lacrimal and nasociliary nerves. The maxillary division gives off the infraorbital nerve.

The eye and the orbit can be thought of as a pyramid shaped cavity the base of which faces anteriorly and the apex faces posterio-medially. The globe in turn is attached by six extraocular muscles to the orbit. Four of these are the recti muscles which stretch from their attachments on the superior, medial, inferior and lateral aspects of the globe to the orbital apex forming what is commonly known as the muscle cone. This muscle cone houses the optic nerve, ophthalmic artery, oculomotor nerve, nasociliary nerve, abducens nerve and superior ophthalmic vein. The lacrimal, frontal and trochlear nerves are outside the muscle cone.

Ocular procedures elicit either pain or discomfort. Some form of anaesthesia is therefore necessary. This can be in the form of topical anaesthesia, local anaesthesia, regional anaesthesia or general anaesthesia.

TOPICAL ANAESTHESIA

The topical anaesthetic in general use in our clinic is proparacaine hydrochloride 0.5%. It is rapidly acting (within 20 seconds) and lasts for 15 to 20 minutes. It is used during:

1) eye examination to relieve any discomfort
2) tonometry
3) gonioscopy
4) removal of corneal and conjunctival foreign body
5) contact lens fundoscopy
6) laser procedures
7) and lastly, to augment the anaesthetic effect of local anaesthesia.

Contraindications to topical drops are hypersensitivity to proparacaine and the presence of a penetrating injury to the eye. Proparacaine drops should never be prescribed to patients for pain relief because it produces an anaesthetic cornea which is prone to injury and infection.

LOCAL ANAESTHESIA

Local injections of lignocaine (1.5% or 2%) or marcaine (bupivacaine) with or without adrenaline 1:1000 are commonly used in minor surgical procedures such as:

1) pterygium excision
2) incision and drainage of styes and chalazions
3) oculoplastic procedures on the lids
4) retinal cryopexy
5) cyclocryotherapy

It is important to ensure that one does not give an intravascular injection to avoid systemic complications.

REGIONAL ANAESTHESIA

Regional anaesthesia is commonly used during cataract and glaucoma surgery and less commonly in vitreo-retinal surgery. It is especially useful in patients who cannot withstand the stress of general anaesthesia.

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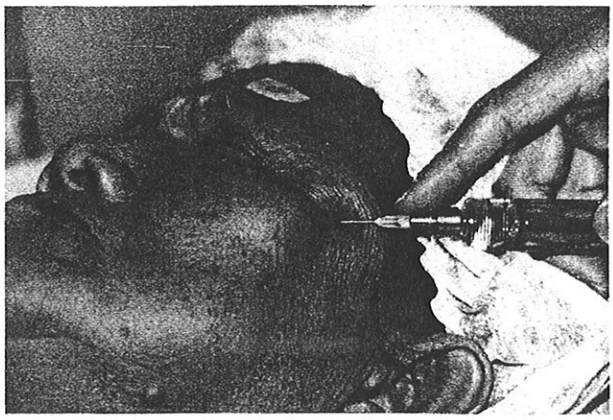
Fig 1 (a & b) - Van Lint's method

(1a)



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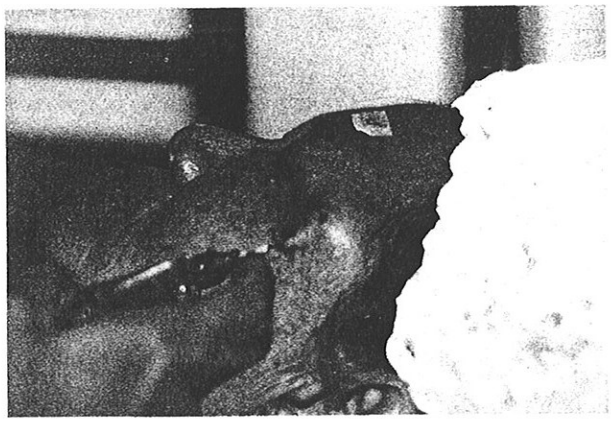

Fig 2 - O'Brien's method

Fig 3 - Retrobulbar anaesthesia

The purpose of regional anaesthesia is two-fold. Firstly, it achieves akinesia of the lid and ocular muscles. Secondly, it produces analgesia of the eye.

The anaesthetic used in regional anaesthesia is either lignocaine hydrochloride or marcaine with or without adrenaline 1:1000 and hyaluronidase[2]. Adrenaline prevents too rapid vascular absorption of the anaesthetic. Hyaluronidase facilitates tissue penetration of the anaesthetic agent.

In regional anaesthesia, in order to achieve akinesia of the lids, the methods of Van Lint[3], Atkinson[4-6], O'Brien[7] or Nadbath[8] are used. To achieve akinesia as well as analgesia of the globe, we use techniques like retrobulbar anaesthesia and peribulbar anaesthesia. We commonly use a combination of Van Lint, O'Brien and retrobulbar anaesthesia.

Van Lint in 1914 advocated the injection of anaesthesia into the deep orbicularis muscles. With reference to Fig 1(a & b), the point of entry of the needle is one centimetre behind the intersection of a line extending temporally from the lower orbital rim and a line extending inferiorly from the temporal orbital rim. The needle is first directed horizontally across the lower lid. The anaesthetic is injected as the needle is withdrawn. Without totally withdrawing the needle, it is then directed along the lateral orbital rim superiorly to its full length. Again, the anaesthetic is injected as the needle is withdrawn. This method blocks the branches of the facial nerve to the orbicularis. A disadvantage of the Van Lint block is that the lower lid is swollen from the injection. There may even be a haematoma.

The other method that we commonly employ either alone or in conjunction with Van Lint's method is O'Brien's method. O'Brien advocated a nerve block of all the branches of the facial nerve. The injection is made in front of the tragus of the ear thereby affecting the branches of the facial nerve as they pass over the condyloid of the mandible. This is an intraparotid injection as the facial nerve traverses the substance of the parotid gland. (Fig 2).

In order to achieve akinesia and analgesia of the eye, we either use the technique of retrobulbar anaesthesia or peribulbar anaesthesia.

In retrobulbar anaesthesia, with the patient lying supine and the eye directed upwards and inwards, a $1\frac{1}{2}$ inch 26 gauge needle is introduced through the lower lid at the junction of the medial $\frac{2}{3}$ and lateral $\frac{1}{3}$ of the lower orbital rim. The needle is directed beneath the globe in the direction of the occiput. Two gives are felt as the needle penetrates firstly the orbital septum and secondly, the muscle cone. Two millilitres of the anaesthetic solution is then injected paralysing the 2nd, 3rd and 6th cranial nerve as well as the nasociliary branch of the 5th cranial nerve (Fig 3).

Retrobulbar anaesthesia is not without its complications. These can be either local or systemic. Local complications include injury to orbital vessels giving rise to a retrobulbar haemorrhage, scleral perforation with resultant intraocular injection of lignocaine[9], optic nerve injury[10] and conjunctival chemosis when a subconjunctival injection is made inadvertently. Systemic complications may result in cardio-respiratory

arrest and death. These result from injection into the brainstem[11], lignocaine toxicity due to intravascular injection and systemic allergy to lignocaine. To avoid complications to the optic nerve, some ophthalmologists ask patients to look straight up at the ceiling. This is to avoid tauting the optic nerve and presenting it directly to the needle.

Peribulbar anaesthesia is the alternative to retrobulbar anaesthesia in regional anaesthesia. It is favoured by some ophthalmologists because it avoids entering the muscle cone with its attendant risks as outlined above whilst achieving the same effect of analgesia and akinesia of the eye. However, it is slower in onset compared to retrobulbar anaesthesia and a larger volume of anaesthetic is required. A separate facial nerve block either by the method of O'Brien or Van Lint is not required. Murdoch[12] reports that peribulbar anaesthesia gives less pain, more reliable ocular akinesia and orbicularis oculi paralysis and a lower operative complication rate.

Regional anaesthesia (using lignocaine) lasts approximately an hour and a half. Patients undergoing regional anaesthesia are premedicated with valium and phenergan if they are inpatients. If they are day surgery cases, they are not premedicated. Regional anaesthesia is a good form of anaesthesia in ocular surgery as we do not expose patients to the risks of general anaesthesia.

With regional anaesthesia, the practice of day surgery is possible as there are less after effects compared with general anaesthesia. Furthermore, patients undergoing day surgery in our department are not premedicated which means they go home fully alert. Day surgery offers several advantages. Firstly, patients are not hospitalised. Secondly, there is less risk of nocosomial infections. Thirdly, their lifestyle is not disrupted. Fourthly, it allows early mobilisation which decreases the risk of deep vein thrombosis. Lastly, early mobilisation of the elderly reduces the risk of bronchopneumonia. Day surgery does not have a higher rate of complications compared to inpatient surgery.

GENERAL ANAESTHESIA

The last form of anaesthesia that is employed in eye surgery is general anaesthesia. General anaesthesia is used if we operate on children, mentally defectives, deaf patients, psychiatric patients, nervous and anxious patients, patients who request for general anaesthesia and procedures like corneal grafts, repair of penetrating injuries, squint operations, oculoplastic work, vitreo-retinal work and any other procedures that may be prolonged.

Of interest to ophthalmologists is the type of anaesthesia used in children when measuring intraocular pressure. In general, anaesthetic agents lower intraocular pressure[13]. Central nervous system depressants, narcotics, major tranquilizers, hypnotics and volatile anaesthetics may reduce intraocular pressure. Exceptions to this general statement are ketamine hydrochloride and succinylcholine which may cause a transient elevation in intraocular pressure. This should be borne in mind when performing examination under anaesthesia (EUA) in children.

Another problem in general anaesthesia is when there is a need to have a soft eye during surgery as for example during cataract surgery and glaucoma surgery. It is helpful if the patient is completely relaxed intraoperatively. Also, there should not be a buildup of carbon dioxide as this increases choroidal volume. This in turn increases intraocular pressure and contributes to the risk of expulsive haemorrhage.

Penetrating injuries should be repaired under general anaesthesia because if a retrobulbar haemorrhage should occur with regional anaesthesia, there is a very real risk of expulsion of intraocular contents. Succinylcholine is also not used in penetrating injuries as it increases intraocular pressure and therefore the risk of expulsion.

In ptosis and squint patients, malignant hyperthermia[14] is more commonly encountered but even then, the incidence is extremely low. A family history of malignant hyperthermia should always be sought. If necessary, a preoperative workup in conjunction with the anaesthetist may be rewarding.

Gases such as sulphur hexaflouride[15] and perflouropropane[15] are sometimes used in vitrectomy and retinal detachment surgery. Anaesthetic gases such as nitrous oxide[15] and even oxygen[15] have an effect on these gases used in intraocular surgery. In order to avoid complications due to the expansion or contraction of these gases, ophthalmologists should request for nitrous oxide to be switched off about ten minutes prior to closing the eye.

When using the services of the anaesthetists in achieving a bloodless field by the use of hypotensive anaesthesia as for example in dacryocystorhinostomy, it is important to remember to ask the anaesthetist to bring the blood pressure up to normal before closing up. This is to ensure adequate haemostasis.

Mention should be made of the oculocardiac reflex[16]. Oculocardiac reflex is the occurrence of cardiac arrhythmias as a result of manipulation of the eye. Any manipulation of the eye especially pulling of the extraocular muscles results in impulses being transmitted via the trigeminal nerve to the brainstem. These impulses are then transmitted to the vagus nerve. Impulses travel via the vagus nerve to the heart where it exerts its effect. Retrobulbar anaesthesia blocks the transmission of impulses along the trigeminal nerve (ie the afferent limb is blocked). In general anaesthesia, atropine is administered intravenously to block the vagus nerve (ie the efferent limb is blocked). With a knowledge of the above, it is important to have constant electrocardiogram monitoring intraoperatively to detect any oculocardiac reflex.

General anaesthesia allows us complete control over patient movement thereby facilitating surgery. We should however remember that in eye surgery, we are dealing mainly with an aged population. These patients are frequently not in the best of health. They may have cardiovascular and pulmonary problems which predispose them to a greater risk under general anaesthesia. General anaesthesia should therefore be utilised cautiously in such patients.

PREOPERATIVE WORKUP AND INTRAOPERATIVE CARE OF PATIENTS UNDERGOING REGIONAL ANAESTHESIA

Diabetics should have their blood sugar levels checked the day before operation. A safe level of blood sugar is important should the need arise to convert the operation from one using regional anaesthesia to general anaesthesia. All diabetic medication should be omitted on the morning of operation and the patient is put on a dextrose and insulin drip.

Hypertensives must have their blood pressures checked preoperatively. An electrocardiogram and chest X-ray are mandatory. Blood electrolytes should be ordered where necessary. Hypertensives should take all their medications on the morning of operation with a sip of water.

Patients with other problems should be worked up accordingly.

In our department, all patients undergoing regional anaesthesia are fully monitored by the anaesthetists. This monitoring includes blood pressure, electrocardiogram and pulse oximeter monitoring. In addition, patients are given 100% oxygen through nasal catheters. This close monitoring is essential as most of our patients are elderly and frail. In the event of collapse through whatever cause, the anaesthetist can institute

immediate resuscitation.

All patients undergoing regional anaesthesia are fasted from midnight of the previous night. This is in case if for some reason or other, regional anaesthesia is not feasible on the table and general anaesthesia is required.

CONCLUSION

We have provided a review of the methods of anaesthesia that we employ in our department and which we have found to be safe and effective over the years.

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