

ANAESTHESIA FOR OPHTHALMIC SURGERY - Part 1 : Regional Techniques

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Ophthalmic surgery can be performed under either regional or general anaesthesia. This article describes regional anaesthesia. In the next issue general anaesthesia will be discussed.

Anatomy: Some basic knowledge of the anatomy of the orbit and its contents is necessary for the successful performance of regional anaesthesia for ophthalmic surgery. If possible carefully examine the orbit in a skull whilst reading this article. This will make understanding the techniques described easier.

Each orbit is in the shape of an irregular pyramid with its base at the front of the skull and its axis pointing posteromedially towards the apex. At the apex is the optic foramen, transmitting the optic nerve and accompanying vessels and the superior and inferior orbital fissures transmitting the other nerves and the vessels.

The depth of the orbit measured from the rear surface of the eyeball to the apex is about 25 mm (range 12-35 mm). The axial length (AL) of the globe (eyeball) is the distance from the corneal surface to the retina and is often measured preoperatively. An axial length of 26mm or more denotes a large eye, indicating that great caution is necessary as globes longer than this are easier to perforate during regional anaesthesia.

The angle between the lateral walls of the two orbits is approximately 90° (and the angle between the lateral and medial walls of each orbit is nearly 45° (see figure 1). Thus the medial walls of the orbit are almost parallel to the sagittal plane. (The sagittal plane passes directly from front to back of the body). The orbit contains the globe, orbital fat, extraocular muscles, nerves, blood vessels and part of the lacrimal apparatus.

The Globe (eyeball, see figure 1 & 2): is situated in the anterior part of the orbital cavity closer to the

roof than the floor and nearer the lateral than the medial wall. The sclera is the fibrous layer of the eyeball completely surrounding the globe except the cornea. It is relatively tough but can be pierced easily by needles. The optic nerve penetrates the sclera posteriorly 1 or 2 mm medial to, and above, the posterior pole. The central retinal artery and vein accompany the optic nerve. The cone refers to the cone shaped structure formed by the extraocular muscles of the eye.

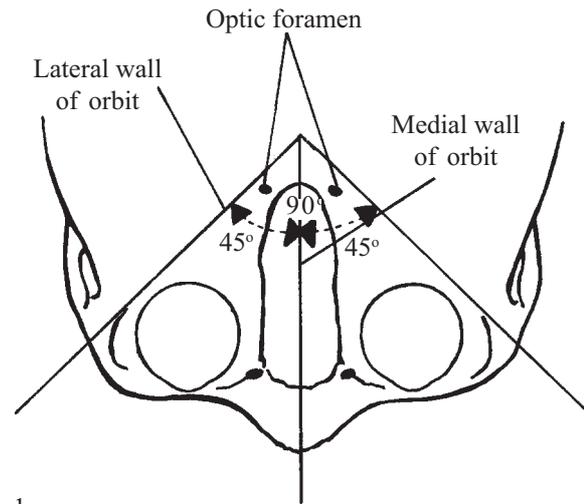


Fig. 1.

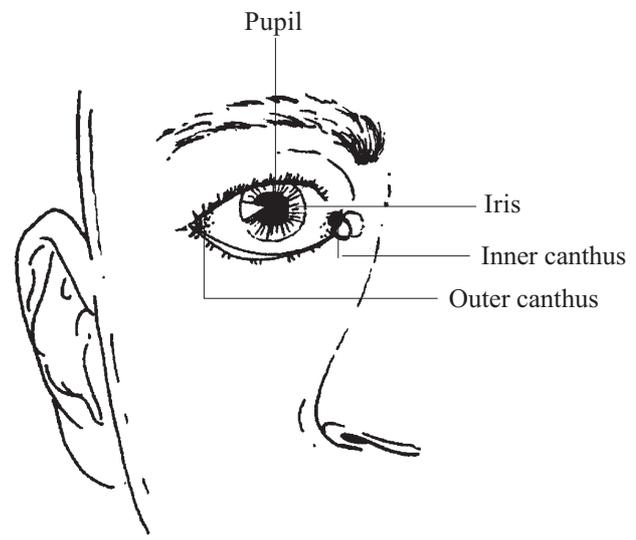


Fig. 2.

The orbital fat is divided into central (retrobulbar, intracone) and peripheral (peribulbar, pericone) compartments by the cone of the recti muscles. The central space contains the optic, oculomotor, abducent and nasociliary nerves. The peripheral space contains the trochlear, lacrimal, frontal and infraorbital nerves. All the motor and sensory nerves can be blocked by an injection into the orbital fat.

The extraocular muscles: The combined actions of the four rectus and two oblique muscles on each eyeball allow elevation, depression, adduction and abduction. Under normal circumstances unmodified activity of one muscle is rare but testing individual muscle function becomes necessary after local anaesthetic block to identify the unblocked nerve when some movement is still present.

Nerve supply to the eyes: The motor nerve supply to the extraocular muscles is easy to remember using the pseudoformula LR₆(SO₄)₃ - lateral rectus by the sixth (abducent) cranial nerve, superior oblique by the fourth (trochlear) and the remainder by branches of the third (oculomotor) nerve.

The sensory supply is mainly from the ophthalmic division of the 5th (trigeminal) cranial nerve (*table 1*). The lacrimal branch innervates the conjunctiva and the nasociliary branch the cornea, sclera, iris and ciliary body. The second cranial nerve (optic) conveys vision.

the superior cervical ganglion before joining the long and short ciliary nerves.

Injection of local anaesthetic solution into the lateral adipose compartment from an inferotemporal needle insertion normally blocks the nasociliary, lacrimal, frontal, supraorbital and supratrochlear branches of the ophthalmic division of the trigeminal nerve and the infraorbital branch of the maxillary division.

Injection into the medial compartment through a needle placed between the caruncle and the medial canthal angle usually blocks the medial branches of the nasociliary nerve, the long ciliary nerves, the infratrochlear nerve and medial components of the supraorbital and supratrochlear nerves.

Blood vessels: The main arterial supply to the globe and orbital contents is from the ophthalmic artery which is a branch of the internal carotid artery and passes into the orbit through the optic canal inferolateral to the optic nerve and within the

Table 1. Summary of sensory nerve supply

Sclera and cornea	Short ciliary nerves Long ciliary nerves	
Conjunctiva	Superior	Supraorbital nerve Supratrochlear nerve Infratrochlear nerve
	Inferior	Infraorbital nerve
	Lateral	Lacrimal nerve (with contribution from zygomaticofacial nerve)
	Circumcorneal	Long ciliary nerves
Periorbital skin	Supraorbital Supratrochlear Infraorbital Lacrimal	

The parasympathetic supply is from the Edinger Westphal nucleus accompanying the 3rd nerve to synapse with the short ciliary nerves in the ciliary ganglion. The sympathetic fibres are from T1 (the first thoracic sympathetic outflow) and synapse in

meningeal sheath of that nerve. In the elderly and hypertensive patient it is tortuous and vulnerable to needle trauma when it may bleed profusely. Venous drainage is via the superior and inferior ophthalmic veins.

The lacrimal apparatus has orbital and palpebral components. The orbital part lies in the lacrimal fossa on the anterolateral aspect of the orbital roof, and the palpebral part is situated below the levator palpebrae superioris aponeurosis and extends into the upper eyelid secreting tear fluid into the superior conjunctival fornix.

Lacrimal drainage occurs through superior and inferior lacrimal puncta near the medial ends of both lid margins which form entrances to the 10-mm long lacrimal canaliculi medially passing through the lacrimal fascia to enter the lacrimal sac. The nasolacrimal duct connects the inferior end of the lacrimal sac to the inferior meatus of the nose.

The anatomical features of the orbit described above permit the passage of needles into fibro-adipose compartments in the orbit avoiding close contact with the globe, major blood vessels, extraocular muscles and the lacrimal apparatus.

Types of regional anaesthesia for ophthalmic surgery:

- ◆ *Peribulbar block (Pericone block)*
- ◆ *Retrobulbar block (Intracone block)*

The most popular technique for regional anaesthesia in eye surgery is now a peribulbar block. This has largely replaced retrobulbar blocks and general anaesthesia for many types of eye surgery.

Preparations

1. An intravenous cannula is inserted to allow immediate venous access in case of emergency.
2. The conjunctival sac is anaesthetised with amethocaine 1%. Three drops are instilled and this is repeated 3 times at 1 minute intervals.
3. A 10ml syringe is prepared containing 5 ml bupivacaine 0.75% plain plus 5ml lignocaine 2% with 1:200,000 adrenaline. Hyaluronidase 75 units is added to improve diffusion of the anaesthetic mixture within the orbit, giving faster onset and prolonged duration of anaesthesia.
4. A 25 gauge, 2.5 cm disposable needle is attached to the syringe.

5. The patient lies supine and is asked to look directly ahead focussing on a fixed point on the ceiling, so that the eyes are in the neutral position.

Performance of the block

Two transconjunctival peribulbar injections are usually required.

Inferotemporal injection (figs 3 - 5). The lower lid is retracted manually and the the needle is placed half way between the lateral canthus and the lateral limbus. The injection is not painful as it is passing through an already anaesthetised conjunctiva. If there is not enough room for the needle to be positioned correctly then the injection may be made directly through the skin. The needle is advanced in the sagittal plane, parallel to the orbital floor passing under the globe. There is no need to apply pressure to the syringe as it will easily advance without resistance.

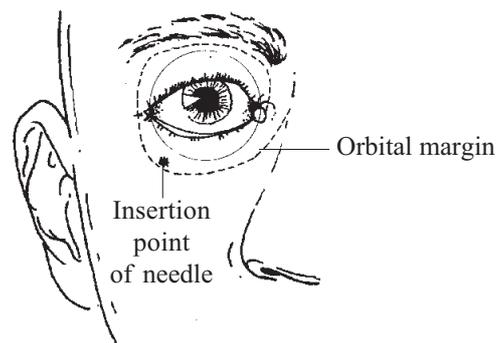


Fig. 3. View from front

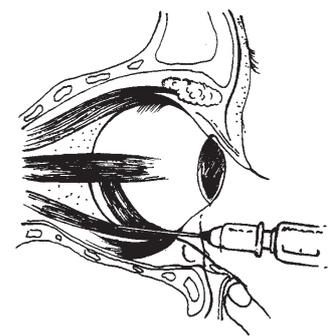


Fig. 4. View from side

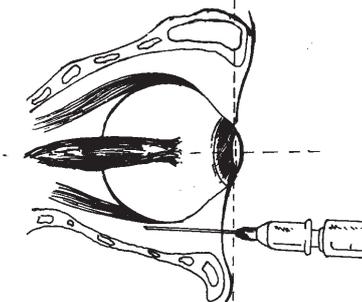


Fig. 5. View from above

When the needle tip is judged to be past the equator of the globe the direction is changed to point slightly medial (20°) and cephalad (10° upwards) to avoid the bony orbital margin. Advance the needle until the hub (which is at 2.5 cm) is at the same depth as the iris. Following negative aspiration 5 ml of the solution is slowly injected. There should not be any resistance while injecting. If resistance is encountered, the tip of the needle may be in one of the extraocular muscles and should be repositioned. During the injection the lower lid may fill with the anaesthetic mixture and there may be some conjunctival oedema.

Within 5 minutes of this injection, some patients will develop adequate anaesthesia and akinesia (lack of movement), but the majority will require another injection.

Nasal injection (figures 6,7). The same needle is inserted 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°) until the hub of the needle is at the same level as the iris. The needle traverses the tough medial canthal ligament and may require firm gentle pressure. This may cause the the eye to be pulled medially briefly. After negative aspiration another 5ml of the anaesthetic mixture is injected.

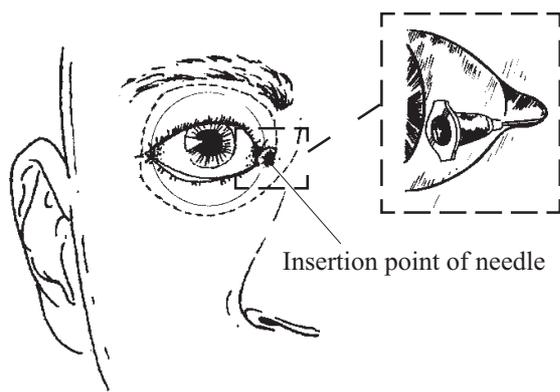


Fig. 6.

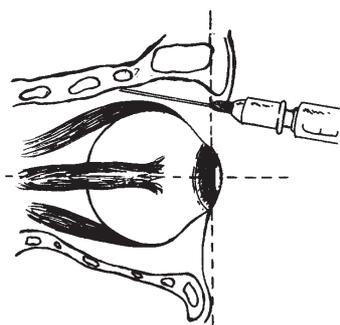


Fig. 7. View from above

The eye is then closed with adhesive tape. A piece of gauze is placed over the lids and pressure applied with a Macintyre oculopressor for 10 minutes at a pressure of 30 mmHg. If no oculopressor is available gently press on the eye with the fingers of one hand. This is to lower intraocular pressure (IOP) by reducing aqueous humour production and increasing its reabsorption.

Assessment of the block is usually judged after an interval of 10 minutes.

The signs of a successful block are:

- ♦ Ptosis (drooping of the upper lid with inability to open the eyes)
- ♦ Either no eye movement or minimal movement in any direction (akinesia)
- ♦ Inability to fully close the eye once opened.

Since the local anaesthetic is placed outside the muscle cone the concentration around the optic nerve may not be sufficient to abolish vision completely. Some light perception will therefore remain; however the patient is not able to see the operation.

If, after 10 minutes the block is inadequate a supplementary injection of 2-5 ml of the anaesthetic mixture may be required. If the residual eye movements are downward and lateral, the supplementary injection is given at the inferotemporal site and if upward and medial, at the nasal site. Pressure is then reapplied for a further 10 minutes.

Care of patient. The patient must be made comfortable in the operating theatre using pillows and pads as required. An assistant should remain with the patient monitoring their condition and giving reassurance. Patients should be asked to remain silent and to squeeze the assistant's hand before any movements are made in order to warn the surgeon. A right angle screen can be used to keep the drapes away from the patient's face and to support an oxygen delivery system. A high flow of oxygen (8l/min) can be used to increase the FiO_2 and prevent CO_2 accumulation. Sedation is rarely required and should be limited to small increments (1mg) of midazolam. Oxygen

saturation, ECG and blood pressure should be monitored throughout. Avoid oversedation of patients who may then wake up and move during the operation.

Retrobulbar block. The conjunctiva is first anaesthetised as described under peribulbar block. A 3 cm needle is inserted half way between the lateral canthus and the lateral limbus in the lower conjunctiva. It is first directed backwards under the globe and then after the equator of the globe has been passed the needle direction is changed upwards and inwards to enter the space behind the globe between the inferior and lateral recti muscles. After aspiration 4 ml of local anaesthetic solution is injected slowly. Retrobulbar block has largely been replaced by peribulbar block because of the higher incidence of complications (see below) and the occasional need for an additional facial nerve block.

Complications of regional blocks for ophthalmic surgery may result either from the agents used or the block technique itself.

Intravascular injection and anaphylaxis can occur, hence resuscitation facilities must always be readily available.

Haemorrhage: Retrobulbar haemorrhage is characterised by a sudden rise of IOP and usually requires postponement of surgery. It is very rare with shallow retrobulbar or peribulbar injections. Subconjunctival haemorrhage is less significant as it will eventually be absorbed. Surgery need not be postponed.

Subconjunctival oedema (chemosis): This is undesirable as it may interfere with suturing. It can be minimised by slowing the rate of injection. It rapidly disappears when gentle pressure is applied to the closed eye.

Penetration or perforation of the globe: This is more likely to occur in myopic eyes which are longer but also thinner than normal. A diagnosis of perforation may be made if there is pain at the time the block is performed, sudden loss of vision, hypotonia, a poor red reflex or vitreous haemorrhage.

Perforation may be avoided by carefully inserting the needle tangentially and by not going “up and in” until the needle tip is clearly past the equator of the globe.

Central spread of local anaesthetic: This is due to either direct injection into the dural cuff which accompanies the optic nerve to the sclera or to retrograde arterial spread. A variety of symptoms may follow including drowsiness, vomiting, contralateral blindness caused by reflux of the drug to the optic chiasma, convulsions, respiratory depression or arrest, neurological deficit, and even cardiac arrest. These symptoms usually appear within about 5min.

Oculocardiac reflex is the bradycardia which may follow traction on the eye. An effective local block ablates the oculocardiac reflex by providing afferent block of the reflex pathway. However the institution of the block and especially rapid distension of the tissues by the solution or by haemorrhage might occasionally provoke it. Careful monitoring is essential for early detection.

Optic nerve atrophy. Optic nerve damage and retinal vascular occlusion may be caused by direct damage to the optic nerve or central retinal artery, injection into the optic nerve sheath or haemorrhage within the nerve sheath. These complications may lead to partial or complete visual loss.

Advantages of local blocks over general anaesthesia:

1. May be performed as day cases
2. Produce good akinesia and anaesthesia
3. Minimal influence on intraocular pressure
4. Require minimum of equipment

Disadvantages:

1. Not suitable for some patients (children, mentally handicapped, deaf, language barrier)
2. Complications as above
3. Depend on the skill of anaesthetist
4. Unsuitable for certain types of surgery (e.g. open eye surgery, dacrycystorhinostomy)