CHAPTER 4

ANAESTHESIA OF THE EYE AND PREPARING THE PATIENT FOR SURGERY

It is essential that a patient is given a satisfactory anaesthetic and is correctly prepared for intraocular surgery.

These preparations are almost as important as the operation itself. A badly anaesthetized or badly prepared patient is likely to cause serious problems during the operation and have an increased risk of post-operative infection. Anaesthesia and preparations for extraocular surgery are very much simpler.

Anaesthesia aims to produce a pain-free surgical field. When operating on the eye it is also necessary to paralyse the extraocular muscles and the orbicularis oculi muscle which closes the eyelids.

Anaesthesia can be produced in 2 ways, general anaesthesia (GA) in which the patient is unconscious, or local anaesthesia (LA) in which only certain nerves are blocked and the patient remains conscious. Even in ideal circumstances where first-class general anaesthesia is readily available, many surgeons will operate under LA by choice. Most eye surgery can be done under LA, especially if GA facilities are not ideal.

The main point of this chapter

For intraocular surgery a careful preoperative preparation and a good local anaesthetic block are just as important as the operation itself.

The advantages of local anaesthesia

1. Safety

Nowadays both GA and LA should be safe. However complications do occur even in the best of hands, but these complications are less common and less serious with LA than GA. Many eye patients are elderly and may have chronic respiratory or cardio-vascular disease. These may deteriorate with GA. After GA there is always a risk of post-operative confusion especially in the elderly, and coughing and vomiting may cause complications after an intraocular operation. After GA there is also a slight risk of post-operative chest infection or deep vein thrombosis developing.

2. Speed

LA is quicker than GA because less time is required to give the anaesthetic. In particular a patient after LA can go straight out of the operating room, but after GA the patient must be carefully nursed by skilled staff until full consciousness has returned.

3. Cost

The cost of the equipment and anaesthetic agents is obviously much less with LA. There is also saving because the services of an anaesthetist and anaesthetic nurse or technician are not required.

However in certain situations GA is either necessary or desirable. These are:

- *Children.* Young children must be given a GA, and in older children GA is preferable for all except very minor procedures.
- *Penetrating eye injuries.* LA is difficult to give effectively. There is often orbital haemorrhage, and there is a risk of raising the pressure in the eye and expelling some of the ocular contents after LA. When a patient with a penetrating injury or an open eye is given a GA, it is usually recommended that Suxamethonium Chloride (Scoline) is not used as a paralysing agent. There is some evidence that it causes contractions of the extraocular muscles and may lead to extrusion of ocular contents.
- *Major surgery or long operations such as exenteration or retinal detachment surgery.* GA is obviously preferable for these sorts of operations. It may be difficult to achieve a satisfactory LA if the orbit is very inflamed, for instance for an evisceration on a patient with endophthalmitis.
- *Confused or demented* patients are better operated upon under GA.

Local anaesthesia can be achieved in 3 ways:-

1. Topical drops.
2. Local infiltration.
3. Nerve block.

Topical drops

If local anaesthetic drops are applied to the conjunctival sac they will anaesthetise the conjunctiva and corneal surface. This is all that is required for minor surgical and diagnostic procedures like removing corneal foreign bodies or checking intraocular pressures.

Various agents are available:

Amethocaine 1%
Oxybuprocaine 0.4%
Proxymetacaine 0.5%
Lignocaine 4%
Cocaine 4%

(Cocaine is not available in many countries because it is a drug of addiction. However it is very useful for certain operations because it also causes vasoconstriction and so limits bleeding at operation.)

The anaesthesia will last for about 15 minutes. The effect of topical drops can be increased if a small swab is soaked in the local anaesthetic agent and left for a minute on the conjunctiva. In this way sub-conjunctival or sub-Tenon's injections can be given painlessly.

Local infiltration

If local anaesthetic is injected into the tissues it will produce anaesthesia in the region where it is injected. This is the usual method of anaesthesia for surgery to the eyelids or conjunctiva. Lignocaine 1% to 2% is the most popular agent.

It is recommended that dilute adrenaline (1 in 100,000) should be used in the local anaesthetic solution. (Adrenaline is called epinephrine by medical staff trained in the U.S.A.) If the lignocaine solution is being made up in a local pharmacy or operating room this means adding 1 mg of adrenaline (or a 1 ml. Ampoule of 1/1000 adrenaline) to 100 cc of lignocaine solution. The eyelids and conjunctiva are vascular tissues. The adrenaline constricts the blood vessels and lessens bleeding at surgery. It also prolongs the action of the local anaesthetic and slows its absorption time, so that the risk of systemic side effects is lessened.

Nerve blocks

With this technique the anaesthetic agent is injected close to the main trunk of a nerve or its branches so that its sensory or motor function is blocked. This is the usual way of giving LA for intraocular surgery. With a nerve block a relatively small injection can achieve a large effect. However a stronger solution of anaesthetic may be necessary and lignocaine 2% is the usual agent. Also the surgeon must know the anatomy of the nerves to place the injection correctly.

Preparing a patient for an extraocular operation is very straightforward. The tissues are infiltrated with local anaesthetic and adrenaline. The area is cleaned and the surgical drapes applied. For intraocular surgery much more preparation is necessary. This will be discussed under the following headings:

Preoperative assessment of the patient's general health.
Preoperative assessment of the eye.
Cleaning and preparing the face and eye.
Treatment to the pupil.
Sedation.
Local anaesthesia.

1. Preoperative Assessment of the Patient's General Health

It may not be possible to carry out a full medical examination, but the patient's heart and lungs should be examined to make sure there are no signs of heart failure, breathing difficulties, or uncontrolled coughing. The blood pressure should be measured to check for ***hypertension***, and the urine tested for sugar to exclude ***diabetes***.

Patients in rural areas may not be able to receive long-term treatment for heart failure, chronic cough, hypertension or diabetes, but if possible these disorders should receive some treatment before surgery. The patient must be able to lie still and fairly flat for the duration of the surgery. Coughing and breathlessness can cause serious complications in the middle of an eye operation. Severe hypertension has an increased risk of expulsive haemorrhage during intraocular surgery, and diabetes has an increased risk of post-operative infection.

2. Preoperative Assessment of the Eye

The eyelid, lacrimal apparatus and conjunctiva protect the eye and should be free from infection. If they are themselves diseased there is a serious risk of post-operative infection or irritation to the eye. In particular look for the following conditions:-

Entropion or Trichiasis. The inturned eyelashes will constantly irritate the eye postoperatively, and entropion should be corrected before doing any intraocular surgery. In cases of mild trichiasis where just a few eyelashes are turning in, it is reasonable to epilate the offending eyelashes, carry out the intraocular operation, and treat the eyelashes later.

Mucopurulent conjunctivitis. If there is a mucopurulent or sticky discharge from the conjunctiva it means there is a bacterial infection of the conjunctiva. There is a great risk of this infection spreading into the eye during intraocular surgery. The conjunctivitis must be treated with intensive local antibiotics, until the eye appears free from inflammation and infection. Chloramphenicol drops every two hours and ointment at night is an effective local antibiotic, but there are many others that can be used. Bacterial conjunctivitis may occur in an otherwise healthy eye, but usually there is a reason for it. Examine the eye carefully for entropion, ectropion, facial palsy, blepharitis or dacryocystitis. If any of these conditions are present the conjunctivitis will not resolve until they are corrected.

Septic spots. Make sure the patient has no septic spots on the face or scalp.

Many patients having intraocular surgery may have other abnormalities such as a pterygium, conjunctival or corneal scarring. These conditions are not a contraindication to surgery, although they might make it a little harder to perform.

3. Cleaning and Preparing the Face and Eye

The importance of keeping pathogenic bacteria from the eye and conjunctiva is obvious. It is not possible to clean the eye with strong disinfectants because they would irritate the conjunctiva and corneal epithelium. Fortunately the healthy eye has various mechanisms which prevent pathogenic bacteria surviving in the conjunctival sac. The production and drainage of tears and the act of blinking will

wash away any bacteria that may land on the eye, and the tears contain lysozyme, an enzyme which inactivates many bacteria.

A standard regime for cleaning and preparing the patient's face and eye should be as follows:

- Wash the face and hair the evening before the operation, and then wash the face thoroughly with a medicated soap or 1% aqueous Cetrimide on the morning of the operation.
- Many surgeons recommend trimming the eyelashes carefully some time before the operation. This will lessen the risk of instruments or an intraocular lens touching the eyelashes and becoming contaminated during the operation. Even better is to use sterile cellophane drapes which stick to the skin and cover the eyelids and lashes. These can be bought as sterile units or made as described on page 44. Their use obviously makes cutting the eyelashes unnecessary.
- Topical antibiotics. The healthy eye usually remains free of bacteria, but there is some evidence that the very slight risk of post-operative infection is lessened by the routine use of pre-operative topical antibiotics. It is usual to apply antibiotic drops to the eye shortly before intraocular surgery, and many surgeons like to apply antibiotic ointment the night before the operation as well.
- Preoperative skin preparation. This is usually done after the local anaesthetic nerve block has been given and before applying the sterile drapes at the beginning of the operation. The eyelids, eyebrows, cheek and side of the nose should be prepared. Various solutions can be used. They should be effective in killing bacteria and yet be non-irritant to the eye, therefore they must be water-based and contain no alcohol. Beware! Many general surgical skin preparations contain alcohol. The following can be recommended:
  i. Aqueous solutions of organic iodine compounds such as 10% povidone-iodine. (This is certainly the most popular skin preparation at present)
  ii. Aqueous solutions of Cetrimide and/or Chlorhexidine such as 1% "Savlon".

Usually the skin preparation is applied on a swab held in a sponge-holding forceps. Start at the nose and loop outwards around the eyelids, ending with the surface of the eyelids and lashes. Some surgeons deliberately allow some of the povidone-iodine solution to go into the conjunctival sac. It should not be left there too long before being washed out, because the strength recommended for applying direct to the conjunctiva is 5%. Clean the area twice and then use a third sterile dry swab to dry the skin. As soon as the skin has been prepared, the drapes are applied and a speculum inserted to hold open the eyelids. At this stage some surgeons like to leave a few drops of 5% povidone-iodine in the conjunctival sac for about half a minute. Finally the conjunctival sac should be irrigated with sterile saline to wash away any debris, mucus or residual skin preparation present.

4. Treatment to the Pupil

For cataract surgery the pupil must be dilated with mydriatic drops. There are two types of mydriatics.

Parasympathetic blocking agents will paralyse the iris sphincter muscle. Cyclopentolate 1% or tropicamide 1% are the drugs of choice. Cyclopentolate acts for about one day and tropicamide for a few hours and they both start working within a few minutes. Homatropine may also be used as an alternative. Atropine 1% causes mydriasis for up to a week and acts rather slowly so is not usually recommended.

Sympathetic stimulating agents cause the iris dilator muscle to contract. They also constrict the conjunctival blood vessels which helps to limit bleeding during the operation. Phenylephrine 10% is the drug most commonly used. (A weaker strength of 2.5% is recommended for young children and adults with hypertension.) Adrenaline 1% and cocaine 4% are also effective, but are not such powerful mydriatics.

The usual dose is to give one drop each of a parasympathetic blocking drug and a sympathetic stimulating drug one hour or half an hour an hour before the operation, and repeat this just before surgery if the pupil is not fully dilated. Don't start putting dilating drops in the eye more than one hour before surgery because their effect will start to wear off. Further drops will then not be so effective.

During extracapsular extraction the manipulations inside the eye may make the pupil start to constrict. *It is very important to maintain pupil dilatation throughout the whole operation, and there are several ways of achieving this.*

- by the use of topical prostaglandin inhibitors preoperatively.(Diclofenac, ketorolac and flurbiprofen are all available as eye drops although they may not be marketed in some areas).These drugs will not dilate the pupil, but help to counteract the pupil constriction or miosis which often occurs during the operation.
- a very small amount of adrenaline added to the intra-ocular infusion bottle (0.5mg added to 500ml of infusion) is even more effective and should be used routinely for all extracapsular cataract extractions.
- the infusion bottle should not be too cold as this can provoke pupil constriction.

For operations on the iris or for glaucoma, mydriatics should not be given and many surgeons prefer the pupil to be constricted with Pilocarpine drops. Many glaucoma cases will already be receiving Pilocarpine. The only exception is an iridectomy for pupil block glaucoma in which case mydriatics should be used.

5. Sedation

Any patient having intraocular surgery under local anaesthetic will be frightened and anxious. By far the best way to relieve fear and anxiety is to spend a little time reassuring the patient and explaining the purpose of the operation and the effect of the local anaesthetic injection. *Reassurance and explanation is much more valuable than any amount of tablets or injections.* Usually the patient will not need any further sedation and will relax and lie still for the operation. However some sedation given

after this reassurance and explanation may be helpful for anxious patients. It is most important not to over-sedate patients. Too much sedation is much worse than none at all. The patient, especially if they are frail may fall asleep or become confused and restless and will then not co-operate during the operation. The most popular sedative drugs are the Benzodiazepines. Diazepam (Valium) is most commonly used, the oral dose being 5 mg for a frail person and 10 mg for a robust person one or two hours before the operation. There are many other alternative sedatives. Some surgeons like to give multivitamin tablets at the same time, as it helps to prevent poor wound healing in patients who may be malnourished or deficient in vitamins.

The patient must lie still during the operation and in particular must not move their head. The best way to keep the head still is to use a special pillow of foam rubber with a large hole in the middle of it to fit the head. (see fig. 2.2, page 19) Alternatively two small foam pillows or sand bags can be placed on either side of the head. Patients must keep their arms and hands by their sides throughout the operation. The best and most pleasant way to ensure this is to have someone hold the patient's hands, this also provides comfort and reassurance. If no one is available then the patient's hands should be gently tucked under their buttocks as they are lying flat. Some people restrain the patient's hands with a strap tied gently around their wrists but this may alarm and frighten them more. If such a restraint is used, the patients must be told why they are being "strapped down".

6. Local Anaesthesia

The LA injections have the four following aims:

1. Anaesthesia of the eye.
2. Paralysis of the extraocular muscles.
3. Paralysis of the orbicularis oculi muscle.
4. To block the patient's vision.

1. Anaesthesia of the eye so that no pain is felt.

The sensory fibres from the eye pass in the ophthalmic branch of the trigeminal nerve (the 5th. cranial nerve). The cornea, iris and sclera are extremely sensitive to pain, while the conjunctiva is less sensitive.

2. Paralysis of the extraocular muscles so that the eye does not move during surgery (akinesia).

The extraocular muscles are supplied by the oculomotor (3rd), trochlear (4th) and abducens (6th) cranial nerves. A moving eye makes surgery very difficult. In addition the pull of the muscles on the sclera once the eye has been opened will increase the intraocular pressure and make prolapse of the contents much more likely.

3. Paralysis of the orbicularis oculi muscle which closes the eyelids.

This muscle is supplied by the facial nerve (the 7th cranial nerve). If the patient is squeezing his eye shut during the operation surgical exposure will be difficult. There is also a serious risk that once the eye has been opened the pressure of the

eyelids trying to close will force out the ocular contents. This is a very serious complication.

4. To block the vision by anaesthetising the optic nerve (2nd cranial nerve).
In this way the patient is not upset by the bright operating theatre light.

These four aims may be achieved by two nerve blocks, the **facial** and **retrobulbar** block, or alternatively two separate injections into the orbit called the **peribulbar** block may be given. Recently a **sub-Tenon's** block using a blunt cannula has been described.

(Nowadays many experienced surgeons do not routinely give a facial block, as the patient will not squeeze their eyelids if they are not feeling any pain. With the use of modern phako-emulsification equipment, cataracts can be removed through a very small watertight incision. So some expert surgeons are happy to perform phakoemulsification without even paralysing the extraocular muscles. They recommend just applying local anaesthetic drops to anaesthetise the conjunctiva and the cornea. The anaesthesia can be supplemented by instilling lignocaine directly into the anterior chamber during the operation. (This must be free of all preservatives and isotonic.) However, good nerve blocks make the operation very much easier, and for an inexperienced surgeon or in a difficult case a good block is essential.)

Lignocaine 2% is the most popular agent for nerve blocks. It has a rapid onset of action and will usually last for an hour. An alternative is **Bupivacaine** (Marcain) 0.5% or 0.75%. It is more expensive, its onset of action is not so rapid but it lasts for up to 3 hours or longer. Some surgeons use a 50/50 mixture of Lignocaine and Bupivacaine to try to get the advantages of each.

Adrenaline (Epinephrine) 1:100,000 should always be added to the facial block and most people add it to the peribulbar block. Its addition slows the absorption time so that the anaesthetic lasts longer and the risks of the systemic toxic side-effects from rapid absorption of local anaesthetic are less. Many people also add adrenaline to the retrobulbar injection, but there is in theory a possible risk of causing vasoconstriction in the retinal or choroidal arteries. However these arteries are probably not very sensitive to adrenaline.

(In some countries 5% lignocaine is available. This produces an excellent nerve block but because of its strength can have complications. It should always be used with dilute adrenaline to delay its absorption and the maximum overall dose is 5 ml–2.5 ml for the facial block and 2.5 ml for the retrobulbar block).

Hyaluronidase (Hyalase) in a strength of approximately 25 to 50 units/ml may be added to the retrobulbar or peribulbar injections only. (One ampoule of hyalase containing 1500 units is usually added to a 20 ml or 50 ml bottle of 2% lignocaine. Once it has been diluted the hyalase becomes ineffective after a few days). The hyaluronidase helps the local anaesthetic to spread through the tissues, and so increases the effectiveness of the nerve block, especially with a retrobulbar injection where so many nerves need to be blocked by a single injection. Adding hyaluronidase means that a smaller amount of injection has a better effect. It is expensive and is unavailable in many countries.

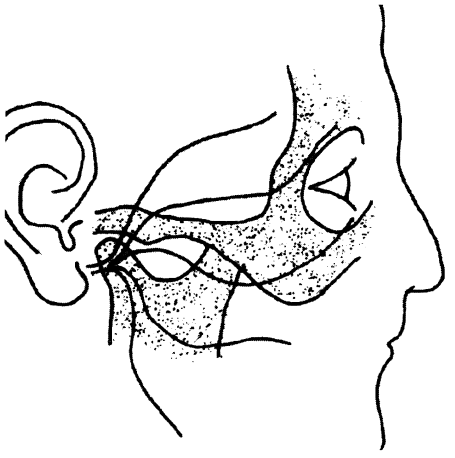


Fig. 4.1 To show the course of the facial nerve

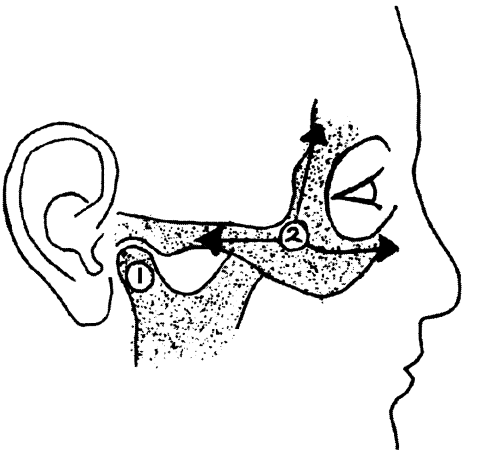


Fig. 4.2 To show the position of the facial nerve block for the O'Brien method (1) and the Van Lint method (2).

The Facial Block

If the surgeon plans to give a retrobulbar and a facial block, it is usual to give the facial block first and the retrobulbar block second. The facial block can be given at the neck of the mandible (the O'Brien method), or at the orbital rim (the Van Lint method). In each case 5 ml of 2% lignocaine with adrenaline are used with a 21G or similar needle.

The O'Brien Method (figs. 4.1 and 4.2):

Principle:

The divisions of the facial nerve are blocked as they pass around the neck of the mandible.

Method:

1. The temporo-mandibular joint and the neck of the mandible are palpated while the patient opens and closes his mouth.
2. The needle is inserted perpendicularly through the skin and is pushed down to the neck of the mandible. The tip should touch the bone. This corresponds to a point about 1 cm anterior and 1 cm below the external meatus of the ear.
3. After withdrawing slightly on the plunger to ensure that the needle is not in a blood vessel, up to 5 ml of anaesthetic is slowly injected as close as possible to the bone.
4. The syringe is removed and the site massaged vigorously.

The Van Lint Method (figs. 4.1 and 4.2):

Principle:

Paralysis of the orbicularis oculi muscle by local infiltration around the orbit.

Method:

1. The needle is inserted through the skin at the lateral margin of the orbit and pushed down to the bone. There is very little subcutaneous tissue here. Try to avoid blunting the tip of the needle on the bone. A bleb is raised using about 1 ml of lignocaine.
2. The needle is then advanced to its full extent in three directions. Firstly along the upper orbital margin, then along the lower orbital margin and finally along the zygomatic arch back towards the ear. The needle must be kept close to the bone so as to be under the orbicularis muscle. This is because the motor nerves enter the muscle on its deep side. The lignocaine is injected as the needle is advanced. A total of 4 ml is distributed equally in the 3 directions.
3. On removal of the needle the area is massaged to aid diffusion of the anaesthetic and help its action.

Complications of the facial nerve block:

The facial block sometimes causes slight pain as it is being injected because the tissues are quite tense there. The commonest complication is a failure to achieve a satisfactory block. Quite often the block is not complete and the patient can still close the eye with difficulty. A complete block is not necessary but the eyelids should not be able to close forcibly.

If after 5-10 minutes the block has not been effective it should be supplemented by using the other method.

There are also some very rare complications of the O'Brien method. These are:-

- Tenderness over the temporo-mandibular joint.
- Permanent weakness of the facial nerve.
- Injection into the branches of the external carotid artery or jugular vein.

The Retrobulbar Block (figs. 4.3 and 4.4)

Principle:

The retrobulbar space lies inside the extraocular muscle cone behind the eye. The 2nd, 3rd, 6th and branches of the 5th cranial nerves are all found in this space and the 4th nerve passes very near. Therefore all the nerves supplying the eye and extraocular muscles are blocked by one injection of local anaesthetic into the retrobulbar space. After a successful block there is no sensation, no movement and no vision in the eye.

Indications:

- Intraocular surgery
- Evisceration or enucleation
- As a supplement to ketamine general anaesthesia (see page 71).

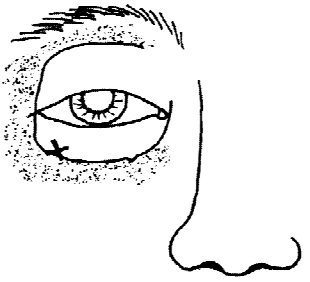


Fig. 4.3 The retrobulbar block, to show the entry point for the needle

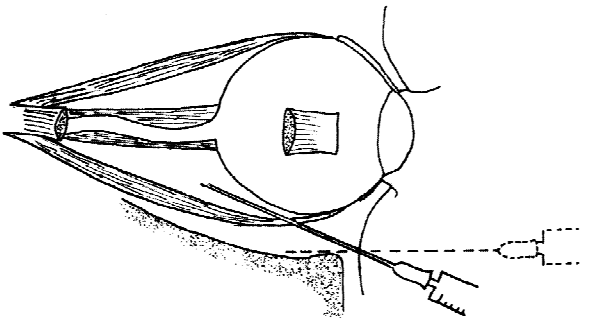


Fig. 4.4 The retrobulbar block, to show the direction of the needle for the first 15 mm (dotted line) and second 15 mm (full line)

Method:

1. Prepare the injection – 3 to 5 ml of 2% lignocaine is used. If hyaluronidase is available 2 to 3 ml is usually sufficient. (Whether or not to add adrenaline has already been discussed). In the past a long (50 mm), fine (26G) retrobulbar needle has been used to deliver the injection to the apex of the orbit, where the nerves are all close together. However the further back into the orbit the injection is given, the greater is the risk of the needle entering a nerve or blood vessel, and causing potentially serious complications. Also with very fine needles there may be some uncertainty as to which direction the tip is pointing.

   For this reason it is better to give the injection in the anterior part of the retrobulbar space, placing the tip of the needle 30 mm deep to the skin. A standard 23G needle is satisfactory. The hyaluronidase in the injection will help it to spread through the tissues. If hyaluronidase is not available, it is safer to give a larger volume of injection (5 ml) anteriorly in the retrobulbar space than to give the injection at the apex of the orbit. Many people use a needle for retrobulbar injection that does not have an acute bevel (see fig. 4.5). This lessens the risk of perforating the eyeball. However it is most important that the tip of the needle is sharp and not blunt and the best way to avoid penetrating the eye is to know the anatomy and advance the needle in the correct direction.

2. The patient lies flat and is asked to look straight ahead. This may be difficult if the patient cannot see but is best achieved by holding the patient's hand in front of his eye and asking him to look at it. Both the eyelids are swabbed clean.

3. The lower orbital rim is felt and the needle passed through the skin just above the orbital rim and about one-third of the way from the lateral end of the eyelid (fig. 4.3). It is passed straight back below the eye for 15 mm It is best to have the bevel pointing upwards towards the globe as shown in fig. 4.4. Often some resistance is felt as it passes through the orbital septum. The tip of the needle may hit the hard bone on the floor of the orbit.

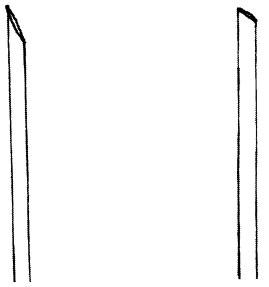


Fig. 4.5 The bevel of needles

4. The direction of the needle is now changed so that the tip is pointing slightly upwards and inwards towards the opposite occiput (fig. 4.4). This ensures that the tip enters the retrobulbar space and lies within the muscle cone. Some resistance is felt as the needle passes through the muscles and this may rotate the eye downwards slightly. The needle should be advanced no more than 30 mm in all from the skin.
5. The plunger is first withdrawn slightly to ensure that a blood vessel has not been entered, and then the injection given. There should not be any significant resistance. The needle is withdrawn, the eyelids closed with a pad and *immediate firm but gentle* pressure is applied. This may be applied with a special pneumatic balloon (the Honan balloon) inflated to 30 mm Hg. or more simply with a spongy ball or a round weight designed to fit neatly into the orbit. The most simple way of applying pressure is with the hypothenar eminence of the patient's or assistant's hand which will fit nicely into the orbit. This gentle but firm pressure should be maintained for 5–10 minutes.
6. After this time the facial and retrobulbar blocks are assessed to ensure that they are adequate. There is often some residual movement of the eye and lids but as long as most of the muscle action is blocked the operation can proceed. If movement is excessive the blocks can be repeated once only.

Complications of Retrobulbar Anaesthesia

1. Inadequate anaesthesia and akinesia.
2. Retrobulbar haemorrhage.
3. Injection into a blood vessel or into the cerebrospinal fluid.
4. Injection into the eyeball.
5. Permanent neurological damage.
6. Toxic reaction from excessive anaesthetic.

The first two complications are quite common but are rarely of any serious significance. The last four complications are all serious but should be extremely rare.

1. Inadequate anaesthesia and akinesia

The best test of success of a retrobulbar block is to examine the ocular movements. If these have been blocked, there will almost always be adequate anaesthesia. If there is almost a full range of eye movements then the block may be repeated once. Sometimes the block fails because of poor technique. Either the needle is passed along the orbital floor and not into the muscle cone or alternatively the needle is not advanced far enough out of fear of penetrating the eyeball.

Despite an otherwise adequate block the eye may rotate upwards due to the continued action of the superior rectus. In these cases the superior rectus may require further anaesthesia. 1 ml of 2% lignocaine is injected above the eye either through the conjunctiva or through the upper eye lid. The eye may rotate slightly upwards if the needle tip enters the superior rectus muscle itself.

2. Retrobulbar Haemorrhage

Slight retrobulbar haemorrhage is quite common and is caused by a small blood vessel being pierced by the retrobulbar needle. Often it is only noted post-operatively, when there may be bruising of the eyelids or a subconjunctival haemorrhage as the blood tracks forward. Severe or marked retrobulbar haemorrhage causing proptosis should occur in less than 1% of cases. If there is proptosis the operation must be postponed as the raised orbital pressure will increase the risk of serious complications during surgery. A firm pad and bandage should be applied and the operation can be repeated when the haemorrhage has completely subsided. It is very unusual for any permanent damage to occur from a retrobulbar haemorrhage, but there is always the possible risk of optic nerve compression and subsequent optic atrophy. The risk of haemorrhage can be reduced by:

- Checking that the retrobulbar needle has a smooth sharp tip. Damaged or hooked tips can tear delicate blood vessels.
- Holding the needle steady after advancing and whilst injecting the anaesthetic. Excessive movement of the needle increases the risk of haemorrhage.
- Applying *gentle pressure* on the eye *immediately* after withdrawing the needle will limit any blood leaking from small vessels.
- Some surgeons suggest that the anaesthetic should be injected as the needle advances to move the tissues away from the tip of the needle.

3. Injection into a blood vessel or into the cerebrospinal fluid.

In either case this can be very serious and there is a risk that the patient may die. Injection into a blood vessel is best avoided by slightly withdrawing the plunger of the syringe before injecting. Injection into a vein can cause cardiac irregularities, collapse or convulsions. Injections into a retinal or ciliary artery can cause temporary or permanent visual defects.

The optic nerve is surrounded by dura mater containing cerebro-spinal fluid and it is possible to put the needle through the dural sheath and thus inject lignocaine into the cerebrospinal fluid. This can cause loss of consciousness, respiratory arrest and convulsions. The risk of injecting into the cerebro-spinal

fluid is reduced by taking 2 precautions. Firstly, by not advancing the retrobulbar needle more than 30–35 mm from the skin. Secondly when giving the retrobulbar injection, making sure the patient is looking straight forward and not looking up. If the patient looks up this brings down the back of the eyeball and the optic nerve and thus nearer to the path of the retrobulbar needle.

If the patient's airway is protected and artificial ventilation and cardiac resuscitation given, the patient should usually recover completely from unconsciousness or collapse caused by intravenous or cerebrospinal injection of local anaesthetic. *Anyone giving local anaesthesia to the eye or performing eye surgery should have training in how to resuscitate a collapsed patient and should know immediately what to do.*

4. Injection into or through the eyeball.

This usually occurs because the needle is directed and advanced incorrectly. It is vital to understand the anatomy. There is not a great deal of space between the floor of the orbit and the eyeball itself. The risk is increased in myopic eyes which are large and have thin sclera. If the injection is into the eye it will become very hard on injection and the cornea may become opaque. This serious complication usually results in blindness, and the operation should be abandoned if it occurs. If the injection is through the eye it may become very soft.

These disasters are best avoided by advancing the needle slowly and not pushing against any resistance once the tip of the needle has passed through the orbital septum. If the needle does meet resistance, in most cases it will be the bone on the floor of the orbit. It should be withdrawn just a fraction and then redirected more upwards. If resistance is still felt it is probably hitting the eyeball, and not the floor of the orbit. In this case it should be very carefully and gently redirected a little more downwards.

5. Long-term neurological damage

Permanent damage to one of the cranial nerves in the orbit may very rarely occur.

6. Toxic reaction from excessive anaesthetic

The amounts of local anaesthetic that are given for a facial and retrobulbar block, and for a peribulbar block are quite close to the recommended maximum dose for safety. This is especially true if hyalase is added because it increases the absorption rate of the anaesthetic, and this is why hyalase should not be added to the facial block. By contrast, adding adrenaline slows down the absorption rate. The signs of local anaesthetic toxicity are similar to those from injecting into the blood stream:-cardiac irregularities and collapse.

The Peribulbar block

If done carefully and correctly the incidence of serious complications with retrobulbar blocks is extremely low, but the fact that these complications do occur has led to the development of other ways of giving local anaesthesia. The most popular is the peribulbar block (fig. 4.6). It avoids some of the possible hazards of retrobulbar injection but requires two injections and takes longer to work. It also tends to cause

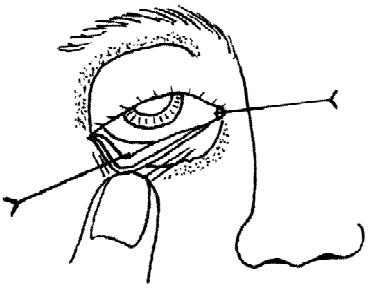


Fig. 4.6 Injection sites for the peribulbar block

proptosis because a larger volume of fluid is injected behind the eye. Because the injection is given through the conjunctiva and not the skin it is less painful for the patient.

Principle:

Two fairly large volumes of local anaesthetic are given around the eye outside the extraocular muscle cone. These spread slowly into the retrobulbar space as well producing anaesthesia and akinesia of the eye and eyelids.

Method:

1. A syringe with 10 ml of local anaesthetic is mounted on a 23G or finer gauge needle. Most surgeons add 1:100,000 adrenaline to prevent rapid absorption and if available 300 units of hyalase to help the injection to spread.
2. The patient is prepared as for a retrobulbar injection. A drop of local anaesthetic is applied to the conjunctiva.
3. The lower lid is pulled down to expose the lower fornix. The needle is inserted through the conjunctiva of the lower fornix lateral to the mid-line. The syringe is held vertically and the needle is advanced backwards and slightly outwards away from the eye so that it passes to the level of the equator of the eye. It should advance no more than 25 mm. If the patient is asked to move their eye, this will confirm that the tip of the needle is not touching the globe or the extraocular muscles. After withdrawing the plunger slightly to check that the needle has not entered a blood vessel, 5 ml of local anaesthetic is injected and the needle is withdrawn. Gentle pressure is applied for 5 minutes.
4. A second injection is given through the caruncle and passed back and slightly medially towards the nose for 25 mm. The patient should be asked to move their eye and the plunger withdrawn in the same way, and then 4 ml of local anaesthetic is injected. The needle is withdrawn and gentle pressure applied for 10 minutes. The eye is then assessed to ensure an adequate block.

There should be no need for a facial nerve block to be given with a peribulbar block as enough anaesthetic should diffuse out of the orbit to weaken the orbicularis oculi muscle.

The complications of a peribulbar block are the same as for a retrobulbar block. Because larger amounts are given into the orbit the chances of an inadequate block are less. Also there is less risk of injecting into the cerebrospinal fluid or causing permanent neurological damage. However the risks of a retrobulbar haemorrhage, injecting into the eyeball, or into a blood vessel or of toxic absorption are just the same. The same precautions about advancing the needle should be taken as with the retrobulbar injection.

Sub Tenon's Block

Principle:

To avoid the risks from using sharp needles, a blunt cannula is advanced into the retrobulbar space to deliver the anaesthetic.

Method:

1. The conjunctiva is first anaesthetised with local anaesthetic drops. A small swab soaked in local anaesthetic and left in the lower fornix for a minute is particularly effective. A speculum is inserted to hold open the eyelids.
2. *The patient should be told to look upwards and outwards.* Using forceps and scissors a tiny incision is made in the conjunctiva in the infero-medial quadrant of the eye about 5 to 6 mm from the limbus and midway between the inferior and medial rectus muscles (fig. 4.7). This incision is then deepened very slightly to go through Tenon's capsule. The local anaesthetic drops should prevent any significant pain from this.

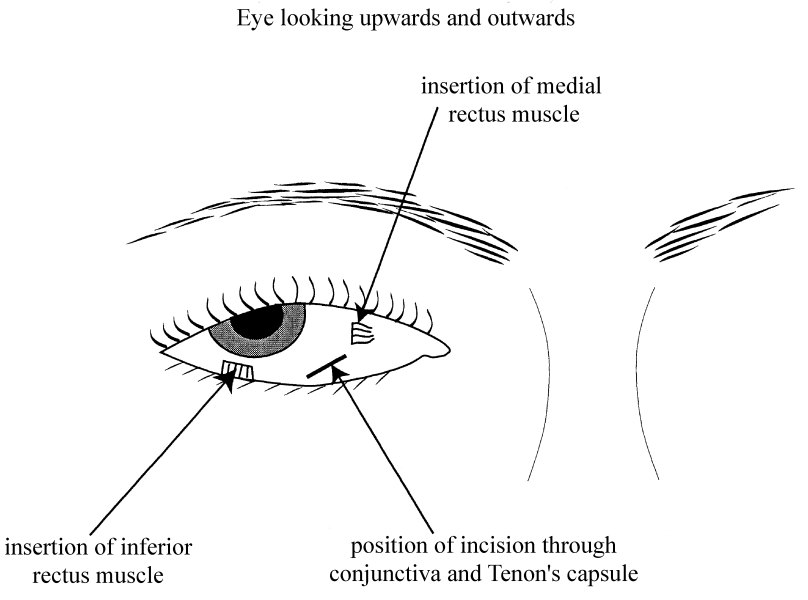


Fig. 4.7 Sub-tenon's block. To show the position of the incision in the conjunctiva

3. Specially designed cannulas are made for the sub Tenon's injection, but a blunt lacrimal cannula is a perfectly satisfactory alternative. It is mounted on a syringe with the same local anaesthetic as for a retrobulbar injection. The cannula tip is then inserted through the small hole in the conjunctiva and Tenon's capsule and passed backwards round the eye with the tip touching the globe all the way (figs. 4.8 and 4.9). The patient should continue to look up and out, as this makes it easier to advance the cannula in the right place next to the globe.

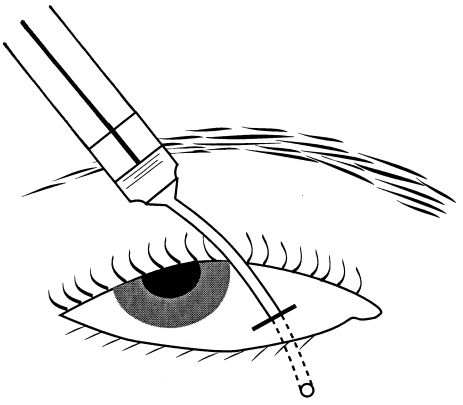
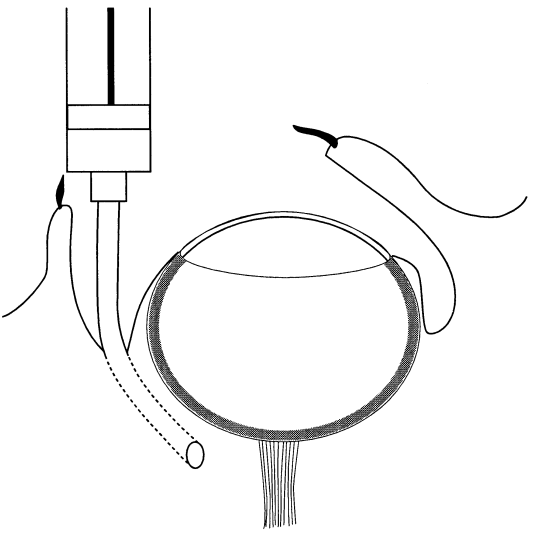


Fig. 4.8 Advancing the cannula around the globe of the eye



Fif. 4.9 To show the final position of the cannula before making the injection

4. After aspirating to check for the absence of cerebro-spinal fluid or blood, the injection is then given.

This is an extremely effective and safe way of giving an injection directly into the retrobulbar space. The use of a blunt cannula means there is minimal risk of damage to the eye, blood vessels, nerves etc. However it requires more preparation, and sterile instruments are needed to incise the conjunctiva. It can be done by an assistant wearing sterile gloves or by the surgeon when he is fully scrubbed up and ready to start the operation. ***It is also a very useful technique if the patient starts having problems in the middle of the operation, because a sub Tenon's injection can be given when the eye is open.***

General Anaesthesia

General anaesthesia for intraocular surgery requires an anaesthetist and proper anaesthetic equipment.

Ketamine is a useful and very safe intravenous general anaesthetic and is particularly valuable for young children who cannot be operated on using L.A. It is ideal for "eye camp" work where full anaesthetic facilities are not available. It can be given by intramuscular or intravenous injection. Alternatively an i.v. infusion can be used for longer periods of anaesthesia. As various strengths of ketamine are available – 10 mg/ml, 50 mg/ml, or 100 mg/ml it is important to check the strength of the solution before calculating carefully the volume for injection. The recommended dose for intravenous injection is 2 mg/kg body weight, and anaesthesia will start in 30 seconds and last for about 10 minutes. For intramuscular injection the dose is 10 mg/kg body weight, the anaesthesia starts within 3 minutes and lasts for up to 20 minutes. If the effect is wearing off supplementary "top up" injections may be added if necessary, using a slightly smaller dosage. Ketamine may cause an increase in secretions and so a preoperative intramuscular injection of atropine should be given. The dose of atropine varies according to the weight of a child, up to a maximum of 0.6 mg (0.1 mg is sufficient for a 10 kg child). Ketamine may cause unpleasant dreams or hallucinations, but these are reduced by giving an oral premedication of diazepam. For a small child 1–2 mg is adequate. Ketamine is a very good analgesic but it does not reduce muscle tone or eye movements. For intraocular surgery it is therefore necessary to supplement the ketamine anaesthesia with a standard retrobulbar block so as to prevent eye movements. For a child with a small orbit a smaller volume of retrobulbar local anaesthetic should be given – 1.5 ml is usually satisfactory.

Schedule for Pre-Operative Preparation

Day before surgery:

Check blood pressure, urine, heart and lungs
Check eyelids, lashes and lacrimal system
Look for septic spots
Apply antibiotic drops or ointment
Face and head wash

Morning of operation:

Face wash
Trim eyelashes (if eyelid drapes are not available)
Reassure patient

A half to one hour pre-op:

Give sedation orally, if indicated, but usually not necessary.
Apply antibiotic drops
Mydriatic drops, if a cataract extraction

- Cyclopentolate (or alternative parasympathetic blocker)
- Phenylephrine 10% (or 2.5% or alternative sympathetic stimulator)
- Prostaglandin inhibitor if available (Ketorolac, Diclofenac or Flurbiprofen)

Immediately pre-op:

Check the dilatation of the pupil
Repeat mydriatic drops if not fully dilated
Instill LA drops
Give the local anaesthetic blocks and apply pressure to the orbit
Check that LA block is adequate
Apply skin preparation
Drape the eye and insert the speculum
Irrigate the conjunctival sac

Summary of local anaesthetic blocks, all with 2% lignocaine

Facial block (with adrenaline)	5 ml
Retrobulbar or sub Tenon's block (adrenaline optional)	up to 5 ml without hyalase up to 3 ml with hyalase
Peribulbar block (with adrenaline)	up to 10 ml without hyalase 8 ml with hyalase