

Ophthalmic loco-regional anaesthesia: Reducing discomfort during injection

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ABSTRACT

Loco-regional anaesthesia is commonly used for both intraocular and extraocular surgical procedures, although the provision and use of the anaesthetic technique varies worldwide. Injection techniques (retrobulbar, peribulbar and sub-Tenon's blocks) are associated with significant pain; indeed, many patients have a fear of pain. Discomfort during injection can, however, be reduced and patients can be made comfortable through reassurance, careful performance of the technique and the provision of sedation and/or analgesia. In this article, the authors describe common loco-regional anaesthetic techniques and measures to reduce discomfort during injection, thus improving patient satisfaction.

Introduction

The majority of ophthalmic surgeries are performed under local anaesthesia. Cataract surgery is the most frequently performed ophthalmic surgery in elderly patients, with an incidence of around 700 patients per 100 000 inhabitants. Cataract surgery was often performed under general anaesthesia in the past; local anaesthesia, however, has become the norm in the last decade, although much debate still exists as to the ideal ophthalmic local anaesthetic technique.

Ophthalmic local anaesthesia can be traced back to the Koller and Knapp era. They described topical anaesthesia using 5% cocaine and an early attempt at retrobulbar block.¹ Since then, local anaesthesia for eye surgery has undergone several changes such as intraconal block (retrobulbar), extraconal block (peribulbar), sub-Tenon's, subconjunctival, deep fornix and topical anaesthesia.

The provision of ophthalmic local anaesthesia varies worldwide.² The choice of a particular technique depends on several factors such as the type of ophthalmic surgery, the surgeon's preference, the patient's preference, the anaesthesia provider's preference, the training of the anaesthesia provider and the availability of or acquaintance with particular techniques and equipment.

Ophthalmic procedures and local-regional anaesthetic techniques

Both intraocular procedures (phacoemulsification cataract surgery, trabeculectomy and vitreoretinal surgery) and extraocular procedures (strabismus surgery and retinal detachment) can be performed under local anaesthesia but the modality of anaesthesia techniques varies. A less invasive technique such as cataract extraction with lens implantation may, for example, be performed under topical anaesthesia either with or without sedation in selected patients. An injection technique such as needle block (peribulbar or retrobulbar) or sub-Tenon's block is required for other ophthalmic surgical procedures requiring complete anaesthesia and akinesia. Although sub-Tenon's block is gaining popularity and is commonly used in certain parts of the world,³ needle block remains the most commonly practised technique in many developed and developing countries.⁴ In fact, in a study, 72% of the patients preferred block anaesthesia compared to topical anaesthesia.⁵

Conventional needle blocks

Retrobulbar block is described as an injection of local anaesthetic

into the muscle cone (formed by four recti muscles, superior and inferior oblique muscles).

In 1934, Dr WS Atkinson⁶ described the classical retrobulbar block in which the patients looked upward and inward; a 38-mm long needle was inserted through the skin after a skin wheal between medial two-thirds and lateral one-third of the inferior orbital margin and the needle was directed towards the apex. Two to 3 cc of local anaesthetic was injected very close to the optic nerve. Akinesia and analgesia resulted quickly but a facial nerve block was essential for the block of the orbicularis oculi muscle. Facial nerve block, however, is very painful. Both retrobulbar and facial nerve blocks were associated with significant reported complications and the technique has undergone recent changes.⁷

In modern retrobulbar block, the globe is kept in the neutral gaze position and a shorter needle (< 31 mm) is inserted as far as possible in the extreme inferonasal quadrant either perconjunctivally or percutaneously. Surface anaesthesia (oxybuprocaine or a similar eye drop) is essential for perconjunctival insertion. The needle is directed upwards and inwards but tangential to the globe and 4 to 5 cc of local anaesthetic agent is injected. A separate facial nerve block is not required.⁸

Peribulbar block was introduced as an alternative to retrobulbar block. Here, 5 to 6 mL of local anaesthetic agent is injected deliberately outside the muscle cone. The technique is essentially very similar to the retrobulbar except that the needle is not directed upwards and inwards. Instead, it remains tangential to the globe but along the inferior orbital floor. A supplementary injection called a medial peribulbar block is usually required either in the same quadrant or through an injection in the medial compartment. In this technique, the needle is inserted between the caruncle and the medial canthus to a depth of 1 to 1.5 cm.

Multiple communications exist between the two compartments and it is difficult to differentiate whether the needle is intraconal or extraconal after placement.⁹ The injected local anaesthetic agent diffuses and, depending on its spread, anaesthesia and akinesia occur. If onset is relatively fast, it is assumed that a sufficient amount of the local anaesthetic agent has entered the intraconal compartment, giving the clinical impression of a retrobulbar block. If the onset of akinesia is slow, the injection is usually extraconal.

Sub-Tenon's block

In this technique, the local anaesthetic is injected between the

Tenon's capsule and the sclera through a blunt cannula.¹⁰ This block is also known as parabulbar block, pinpoint anaesthesia and episcleral block. Surface anaesthesia is obtained with local anaesthetic drops (oxybuprocaine 0.4% single-dose containers – preferably preservative-free eye drops). The conjunctiva is cleaned with aqueous 5% povidone iodine and either the lower eyelid is retracted or a speculum is used. Without a touch technique, the conjunctiva and Tenon's capsule are gripped with a non-toothed forceps 5 to 10 mm away from the limbus, usually in the inferonasal quadrant, while the patient is asked to look upwards and outwards. A small incision is then made through these layers with Westcott scissors to expose the white sclera. A sub-Tenon cannula (2.54 cm blunt metal cannula or similar) is gently inserted along the curvature of the globe; excessive force is never applied. The injected local anaesthetic agent (4 to 5 ml) diffuses around and into the intraconal space. This results in anaesthesia and akinesia.

Sub-Tenon's block is reported to have complications similar to those of needle block; their exact incidence is not known, but it is definitely less frequent.⁷

Topical anaesthesia with local anaesthetic drops or gel

Here, local anaesthetic eye drops or gel is applied to the surface of the eye for anaesthesia. Rectus muscles are therefore not affected; anaesthesia is never complete and there is no akinesia. Although topical anaesthesia is very popular in some countries, caution is required. Chang et al,¹¹ for example, have demonstrated in a rabbit model that local anaesthetic drops can cause dose and time-dependent cytotoxicity, usually within the first minute of contact with corneal endothelium. Guzey et al¹² have demonstrated the risks of corneal endothelium damage following the application of topical anaesthesia in patients.

Assessment and preparation of patients before loco-regional technique

Most ophthalmic surgery is performed on an out-patient basis; preoperative assessment is usually limited to medical history, drug history and a physical examination. The UK Joint Colleges Working Party Report recommends that routine investigations are unnecessary and that patients need not to be fasted.¹³ Tests are therefore performed only to improve the general health of the patient, if required. Patients are advised to continue their medications, unless told otherwise. Blood pressure (in hypertensive patients) should, however, be checked. Patients receiving anticoagulants are screened for clotting results. Diabetic patients are asked to take their normal medications with food; blood-sugar levels should be checked (sedation is usually avoided if patients are allowed to consume food). Antibiotics are not necessary in patients with valvular heart disease.

Knowledge of the axial length of the eye before needle block is essential. This is usually available in patients undergoing cataract surgery. The axial length of the eye varies from 22 to 24 mm. Eyes with an axial length of more than 26 mm are more prone to globe damage (perforation and penetration); the risk of damage to the globe and optic nerve is also greater when the globe is rotated during injection.⁷ It is therefore safer to introduce a needle as far laterally as possible because, if it is introduced at the junction of the medial two-thirds and lateral one-third of the inferior orbital rim, the inferior rectus, the inferior oblique muscles and their nerves may be damaged.¹⁴

Needle blocks are generally avoided in patients receiving anticoagulants and sub-Tenon's block; in such cases, topical anaesthesia is preferred.¹⁵

Fear and discomfort during loco-regional anaesthesia

Many patients are anxious prior to and during ophthalmic surgery.¹⁶ This can be due to concerns about having their eye operated on or pain and discomfort both while the block is performed or during surgery.¹⁷ Many patients have retained visual sensations under local anaesthesia. In one survey, 16% found this distressing^{18,19}; anxiety results in catecholamine

release. Furthermore, the majority of cataract patients are elderly and have co-morbidities like diabetes and cardiovascular disease.

Preoperative counselling and sedation can be used to control catecholamine secretion, thus minimising tachycardia and hypertension. Several studies have shown that an explanation of the procedure and counselling by the surgeon prior to the operation about what to expect reduces anxiety.^{20,21} However, despite ophthalmic surgeons being aware of this, it is not widely practiced.

A systematic analysis of published literature²² suggests that peribulbar block is slightly less painful than retrobulbar block (although evidence of this is poor), that sub-Tenon's block is less painful than retrobulbar (evidence fair) and that sub-Tenon's block is less painful than peribulbar (evidence poor) during block administration.

All blocks are known to provide good or excellent intraoperative pain control. Retrobulbar and peribulbar blocks are equivalent (evidence good), sub-Tenon's block provides superior pain control to retrobulbar (evidence fair) and sub-Tenon's anaesthesia and peribulbar are similar (evidence insufficient).

Topical anaesthesia may not provide satisfactory anaesthesia similar to injection techniques but it does reduce well-known serious complications such as retrobulbar haemorrhage, globe damage and the spread of the local anaesthetic agent to unusual locations, thus producing sight and life-threatening complications.

Fung et al²³ measured patient satisfaction using the IOWA Satisfaction with Anaesthesia Scale (ISAS) in patients undergoing cataract surgery. All patients received topical local anaesthesia and intravenous sedation was administered by an anaesthesiologist. Although patient satisfaction was high, the incidence of intraoperative and postoperative pain was 13% and 37%. They concluded that pain during and after cataract surgery is common and is a major reason for lower patient satisfaction with their cataract care.

The factors influencing the choice of loco-regional anaesthesia for ophthalmic surgery are shown in Table I.

Need for the presence of an anaesthesiologist

Topical anaesthesia may be associated with increased complications from unrestricted eye movement and insufficient pain control. This group is more likely to require sedation, even though the administration of any intravenous sedation is known to increase the incidence of adverse events.¹⁰

In a recent excellent review, Vann et al²⁴ stressed that topical anaesthesia may have altered the involvement of anaesthesiologists. They do not, however, seem to abolish the need for anaesthesiologists, since anaesthesiologists still have a role to play in eye surgery, especially when sedation is used: anaesthesiologists provide comfort and safety not only during the surgical intervention but also during needle placement.

It is not, however, unusual to find that ophthalmic block is given without sedation or analgesia in the absence of an anaesthesiologist in high-risk elderly patients suffering from coexisting diseases in an ambulatory setting, resulting in the patients suffering in silence. However this may not be acceptable to patients in the units where patient's comfort is highly desirable (private sector).

Reducing discomfort during injection block

A good explanation of the anaesthesia and surgery, reassurance and the gentle placement of the needle or blunt cannula are of paramount importance.

All topical local anaesthetic drops sting on application. Oxybuprocaine 0.4% eye drops sting least on application but they do not provide adequate surface anaesthesia. Tetracaine

Table I: Factors influencing choice of loco-regional anaesthetic techniques for ophthalmic surgery

	Topical anaesthesia	Sub-Tenon's block	Peribulbar block and/or retrobulbar block
Indication	Cataract surgery in selected patients	Cataract surgery and other extraocular surgery especially in patients receiving anticoagulants, aspirin or NSAID	Both intraocular and extraocular surgery requiring complete akinesia
During block procedure	0	+	+
– pain	++	++	++
– anxiety	0	+	+
– discomfort			
– need for			
* sedation	++	±	±
* analgesia	++	0	0
* monitoring	yes	yes	yes
During surgery	acceptable	better	best
– surgical conditions	++ (1:10)	+ (1:10)	± (1:30)
– pain	++	±	±
– movement			
– monitoring			
* ECG	yes	yes	yes
* SpO ₂	yes	yes	yes
Postoperative period	immediately	vision returns more quickly	vision return may take
– patient can see	no	no	> 2 hours
– recovery needed			
Complications of technique	0	very rare	rare
* globe perforation	0	0	rare
* toxicity (IV)	0	very rare	rare
* retrobulbar haemorrhage	0	very rare	0.2-0.5%
* brain stem anaesthesia	yes	0	0
* corneal toxicity	0	0	yes
* increased intraocular pressure			rises but returns to normal within 10 min

1% eye drops sting most but they produce good surface anaesthesia. Many clinicians instil oxybuprocaine first, followed by tetracaine: this sequence seems to reduce discomfort. The injection of any local anaesthetic agent, irrespective of the type of block, is painful and is associated with burning sensations around the globe, resulting in an unpleasant experience. Local anaesthetic agents stored in a fridge produce more pain during injection; such anaesthetic agents should therefore be warmed to room temperature before use. The injection of a diluted local anaesthetic agent before the main concentrated injection is also seen to reduce discomfort during the main injection.²⁵

Sedation and analgesia during ophthalmic blocks

Ophthalmic surgical techniques have changed over the years, hence the need for sedation and analgesia. The type of block used for ophthalmic surgery also alters the requirements for sedation and analgesia. The choice of anaesthetic care is often made based on the surgeon's and anaesthesiologist's skills and the patient's comfort as well as the needs and expectations of the patient. Whether the patient needs sedation and/or analgesia depends on the intensity of the noxious stimulus.

Sedation and analgesia remain the main constituents in the prevention of the pain of needle or cannula insertion. At present, however, there is no consensus about the ideal sedative/analgesic regimen. The patient should ideally be awake and cooperative during surgery, with no residual sedation or prolonged somnolence; there should be no cause for delay in discharge from hospital. Virtually all patients are operated on in an out-patient surgical setting. If sedation is used for a block, an agent with fast onset is required to ensure that the patient is amnesic but does not move during the injection. There should be no haemodynamic or respiratory depression and no after effects. The ophthalmic surgeon prefers a conscious, cooperative patient.

Whether sedation is used or not varies considerably in different parts of the world. Explanation and reassurance have proved to work in some patients but, in the majority, these are inadequate, again depending on the choice of the anaesthetic technique used. Premedication with benzodiazepines and/or opioids to relieve anxiety and pain associated with the injection has been used but this may delay street fitness postoperatively, which is why it is seldom used in this category of patients. Short-acting benzodiazepines, opioids and small doses of intravenous anaesthetic induction agents are favoured, the dose being kept to a minimum.

Small doses of sedative drugs lack analgesic activity, which may lead to undesirable patient movement and pain. Large doses of sedative drugs may result in unwanted haemodynamic and respiratory depression and prolonged sedation. Narcotic analgesic supplements, too, have side effects (such as respiratory depression, desaturation, nausea and vomiting, especially in older patients) and may result in recall if a small dose is used. Published studies are inconsistent in the recommendation of doses and dose finding studies are lacking.

Author's preferred pain-free injection method

A team approach is essential.

The patient, in her or his own clothes, is positioned comfortably in an easy chair, which can be adjusted later during surgery. Intravenous access is established and essential monitors are attached (blood pressure, heart rate and oxygen saturation) in a well-equipped anaesthetic-block corner; supplementary oxygen (3 l/min) via a nasal mask. Topical anaesthetic oxybuprocaine hydrochloride 0.4% eye drops are then instilled on the conjunctiva of the inferior fornix. Sedation is given, usually between 2 to 5 ml of propofol (20 to 50 mg), through titration and assessing the reaction of the patient. Although Hocking and Balmer²⁶ suggest the use of propofol based on their formula involving

the patient's weight and age ($56 + [0.25 \times \text{weight in kg}] - [0.53 \times \text{age in yrs}]$), we use the above dose with good clinical results.

Many studies have compared the efficacy of propofol with other benzodiazepines. Both agents produce adequate sedation and postoperative amnesia but propofol has added advantages (such as reduced postoperative nausea and vomiting, lower intraocular pressures and earlier street fitness).

When sedation is considered adequate, the ophthalmic block is performed. The anaesthesiologist controls the needle should the patient move; for firm control of the needle, it is essential that the hand holding the needle is supported by the zygoma bone. We use either a transconjunctival or transcutaneous approach of the retrobulbar or peribulbar block.

Chemosis and rapid injections can add to the development of pain during the block. Short and sharp needles are favoured, since these reduce discomfort on insertion, although at the expense of reduced tactile feedback and hence a higher risk of failure to recognise globe perforation. Blunt and dull needles are favoured, since it is believed that blood vessels are pushed rather than traumatised and tissue planes may be more accurately defined.

Verbal responses and grimacing are often seen during injection techniques but the patient does not recall these events. With propofol, the patient almost never recalls anything of the procedure and frequently asks, for example, "When am I going to be injected in my eye?"

During the surgical intervention itself, no sedatives and/or opioids are given. This allows the surgeon to be in contact with the patient at all times. A nurse holds the patient's hand and the patient is asked to squeeze the nurse's finger if communication is required; nursing staff are trained to cope with respiratory obstruction (chin lift, jaw thrust and mask ventilation), if necessary. An anaesthesiologist is at hand but is not necessarily in the operation room.

Other techniques

Most opioids last longer than the injection technique itself. Ultra short-acting opioids (with a half-life of three minutes and elimination half-time of ten minutes) are safer and more efficacious. Holas et al²⁷ and Reware et al²⁸ showed superior analgesia with remifentanyl (0.5 µg/kg) and even improved pain relief and lack of movement during the block if propofol (0.5 mg/kg) is added. Remifentanyl as a sole agent is safe and effective and can provide acceptable conditions, although recall may occur. Remifentanyl (0.3 µg/kg) significantly reduced pain in a double-blind study during retrobulbar nerve block for cataract surgery.²⁹

Other considerations

A local anaesthetic agent of choice is selected that is safe, painless to inject and produces rapid onset of dense motor and sensory block. Duration should be sufficient for surgery; it should not be excessively prolonged. Our choice of local anaesthetic solution has changed over the years and now consists of 5 cc ropivacaine 1%.

Conclusion

Eye blocks provide excellent anaesthesia, with a high success rate, for ophthalmic surgery. Satisfactory anaesthesia and akinesia can be obtained with both needle and cannula techniques. Sub-Tenon's peribulbar and retrobulbar blocks are invasive techniques; sub-Tenon's block is especially a surgical procedure. Most patients are anxious during the injection around the eye. All injection techniques are associated with pain. Careful titration of propofol and/or remifentanyl allows a pain-free injection without any recall of the procedure. The short action of these drugs usually leads to full recovery from their effects before surgery starts. Creating optimal conditions for ophthalmic surgery is one of the most vital aims of perioperative management. Preventing painful stimuli, especially during injection nerve-

block placement, enhances both the comfort and the safety of the patient.

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