

Ophthalmic regional anaesthesia

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Purpose of review

To outline recent developments emphasizing the current literature on ophthalmic regional anaesthesia including modern sharp needle and blunt cannula sub-Tenon's blocks.

Recent findings

Local anaesthesia is commonly used for ophthalmic surgery but the techniques and choice vary. Akinetic ophthalmic regional blocks such as intraconal and extraconal blocks with needles are generally safe, but although rare, serious sight and life-threatening complications continue to occur. Newer akinetic sub-Tenon's block with a blunt cannula has emerged as a safer alternative to needle blocks, but although unusual, both sight and life-threatening complications have been reported.

Summary

At present, there is no absolutely safe ophthalmic regional block. It is imperative therefore to have a basic knowledge of anatomy and technique which reduce complications.

Keywords

extraconal block, intraconal block, ophthalmic local anaesthesia, ophthalmic regional anaesthesia, sub-Tenon's block

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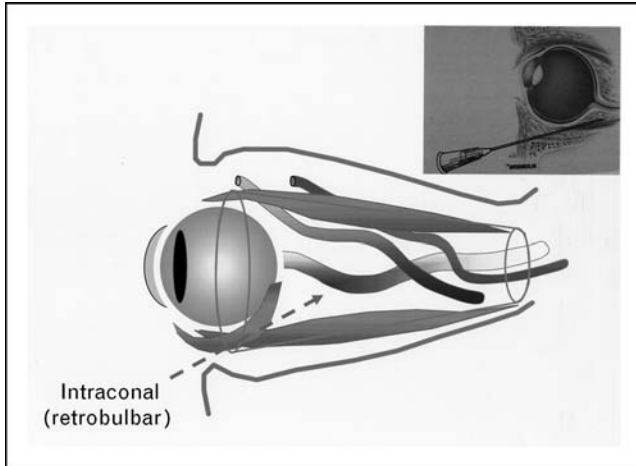
Introduction

The majority of ophthalmic procedures are performed under local anaesthesia. Cataract extraction is the most frequently performed surgery in elderly patients. The use of general anaesthesia for this surgery is now rare and local anaesthesia has become the norm [1,2]. Much debate exists regarding the ideal technique and these are broadly divided into those which affect motor function of the extraocular muscles rendering the eye akinetic and those that do not affect globe motility. Akinetic block of the eye can be accomplished by injection of local anaesthetic in or around the muscle cone through a needle or by instilling local anaesthetic under the Tenon's capsule using a blunt cannula. Anaesthesia without motor blockade is accomplished with topical application of local anaesthetic drops or gel and by intracameral injection of preservative-free local anaesthetics. The contents of this review article are relevant to akinetic blocks.

Nomenclature of ophthalmic regional anaesthesia

The terminology used for regional ophthalmic block is controversial. A name based on the likely anatomical placement of the needle is accepted widely [3]. An intraconal (retrobulbar) block involves the injection of

a local anaesthetic agent into the orbital cavity (muscle cone), behind the globe formed by four recti muscles and the superior and inferior oblique muscles (Fig. 1). In the extraconal (peribulbar) block introduced in 1986 as a safer alternative to retrobulbar block, the needle tip remains outside (Fig. 2) the muscle cone [4]. Descriptions of both retrobulbar and peribulbar blocks vary but nevertheless are commonly used in the published literature [2]. Indeed, Thind and Rubin [5] have highlighted in an editorial that a wide range of local anaesthetic injection techniques are in use, some of which may be described as retrobulbar by one clinician and peribulbar by another. Multiple communications exist between the two compartments and it is difficult to differentiate whether the needle is intraconal or extraconal after placement. Computerized tomography (CT) studies after intraconal and extraconal injections of radio-contrast material have demonstrated the existence of multiple communications between these two compartments, the injected material diffusing between the compartments [6]. Injected local anaesthetic agent diffuses and depending on its spread, anaesthesia and akinesia may occur. It is appropriate to assume in clinical settings that if there is a rapid onset of akinesia, the needle tip or injected local anaesthetic agent has entered the intraconal area. If akinesia however is slow in onset and not complete, then the needle or local

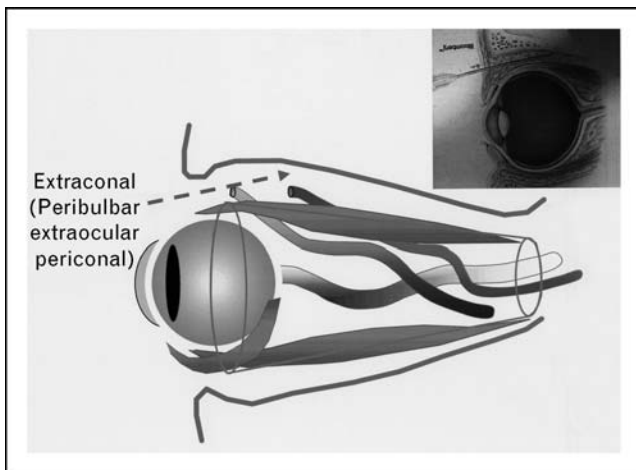
Figure 1 Intraconal block

Arrow is shown as retrobulbar placement of a needle into the muscle cone. Adapted and modified from [1].

anaesthetic agent has not reached the intraconal area in a sufficient amount and the block is extraconal [7]. A combination of intraconal and extraconal block is described as the combined retro-peribulbar block. In sub-Tenon's block, local anaesthetic agent is injected under the Tenon's capsule [8]. This block is also known as parabolbar block [9], pinpoint anaesthesia [10] or medial episcleral block [11].

Practice of ophthalmic regional anaesthesia

Provision of ophthalmic local anaesthesia varies and there is no recent published literature, which indicates the exact use of a particular technique worldwide. According

Figure 2 Extraconal block

Arrow is shown as peribulbar placement of a needle outside the muscle cone. Adapted and modified from [1].

to a survey [12], local anaesthesia was used commonly in patients undergoing cataract surgery with topical anaesthesia with or without sedation and intracameral (56%), peribulbar (19%), retrobulbar with or without facial nerve block (23%) and others 2%. Phacoemulsification of cataract and lens implant may be performed under topical anaesthesia with or without sedation in selected patients [2] but other intraocular procedures (extracapsular cataract extraction, trabeculectomy, vitreoretinal surgery, etc.) and extraocular procedures (strabismus surgery, retinal detachment, etc.) require complete anaesthesia and akinesia. According to a recent report 'Cataract National Dataset Electronic Multicentre Audit of 55 567 operations: anaesthetic techniques' [13**], local anaesthesia was used in 95.5%, with topical anaesthesia alone (22.3%), topical and intracameral (4.7%), sub-Tenon (46.9%), peribulbar (19.5%) and retrobulbar in 0.5%. Although there is a lack of published data worldwide on the use of local anaesthetic technique, it appears that needle block remains a common technique in many countries [14*], whereas sub-Tenon's block is established in only a few [15**].

Choice and preference of ophthalmic regional anaesthesia

There are numerous studies illustrating the diversity of preference for anaesthetic technique. Similar diversity occurs in reports of patient preference. Friedman *et al.* [16] reported that 72% of patients preferred an anaesthetic block to topical anaesthesia. Ruschen *et al.* [17] also supported this view with patients reporting higher satisfaction scores with sub-Tenon's block over topical anaesthesia alone. According to an evidence report [18], there are conflicting reports on the relative effectiveness of akinetic blocks suggesting peribulbar and retrobulbar anaesthesia produce equally good akinesia and equivalent pain control. There is insufficient evidence in the literature however to make a definitive statement concerning the relative effectiveness of sub-Tenon's block in producing akinesia when compared with peribulbar or retrobulbar block. However, individual studies [19**] reveal different and sometimes contradictory conclusions. The choice of which technique to use will always depend on a balance between the patient's wishes, the operative needs of the surgeon, the skills of the anaesthetist and the type of surgery.

Assessment and preparation of patients before ophthalmic regional anaesthesia

Preoperative assessment is usually limited to medical history, drug history and physical examination. The UK Joint Colleges Working Party Report [20] recommended that routine investigations are unnecessary. Tests are only performed to improve the general health

of the patient if required [18]. Patients are not starved unless sedation is used. Diabetic patients should receive their normal medications with food to avoid infusion of insulin [20]. However, the blood sugar level must be checked and should be within the normal range. Patients receiving anticoagulants are screened for clotting results and are advised to continue their medications unless told otherwise [21,22]. Needle blocks are generally avoided in patients receiving anticoagulants and antiplatelet agents, sub-Tenon's block or topical anaesthesia being preferred [21]. Antibiotics are not necessary in patients with valvular heart disease. Knowledge of the axial length of the eye before needle block is essential and is usually available in patients undergoing cataract surgery because eyes with an axial length more than 26 mm are more prone to globe damage [23*].

Needle blocks

In 1934, Atkinson [24] described the classical retrobulbar block in which patients looked upward and inward and a 38-mm long needle inserted through the skin after the formation of a wheal between the medial two-third and lateral one-third of the inferior orbital margin. The needle was directed towards the apex and 2–3 ml of local anaesthetic injected very close to the optic nerve. Akinesia and analgesia resulted quickly but a facial nerve block was essential to block the orbicularis oculi muscle. Both retrobulbar and facial nerve blocks were associated with significant complications and the technique has recently evolved [7,23*].

In modern retrobulbar block, surface anaesthesia is obtained (oxybuprocaine or a similar eye drop especially for perconjunctival injection) and usually aqueous 5% povidone iodine instilled. The globe is kept in a neutral gaze position and a shorter needle less than 31 mm is inserted as far as possible in the extreme inferonasal quadrant either perconjunctivally or percutaneously [23*]. The needle is directed upwards and inwards but tangential to the globe and 4–5 ml of local anaesthetic agent injected. Two per cent of lidocaine remains the local anaesthetic agent of choice but all available local anaesthetic agent has been used. A separate facial nerve block is not normally required.

In peribulbar block, surface anaesthesia is obtained as above. The globe is kept in a neutral gaze position and a shorter needle less than 31 mm is inserted as far as possible in the extreme inferonasal quadrant perconjunctivally. The technique is essentially very similar to retrobulbar block except that the needle is not directed upwards and inwards and the needle remains tangential to the globe but along the inferior orbital floor. A volume of 5–6 ml of local anaesthetic agent is injected specifically outside the muscle cone [7].

A supplementary injection is usually required either in the same quadrant or through an injection in the medial compartment called a medial peribulbar block. In this technique, the needle is inserted between the caruncle and the medial canthus to a depth of 1–1.5 cm and 3–5 ml of local anaesthetic injected [7]. A single medial peribulbar block with 6–8 ml of local anaesthetic has been advocated if akinesia is essential in patients with myopic eyes [25].

Cannula block

Surface anaesthesia is obtained with local anaesthetic drops (oxybuprocaine 0.4% or similar eye drop). The conjunctiva is cleaned with aqueous 5% povidone iodine. The lower eyelid is retracted or a speculum used. Using no touch technique, the conjunctiva and Tenon's capsule are gripped with a nontoothed forceps 5–10 mm away from the limbus usually in the inferonasal quadrant while the patient is asked to look upwards and outwards. A small incision is made through these layers with Westcott scissors to expose the white sclera. A sub-Tenon's cannula (2.54 cm blunt metal cannula or similar) is gently inserted along the curvature of the globe but excessive force is never applied. The injected local anaesthetic agent (4–5 ml) diffuses around and into the intraconal space resulting in anaesthesia and akinesia [8,26]. Other quadrants may also be used for sub-Tenon's block [26].

Discomfort and fear during ophthalmic regional anaesthesia

Many patients are anxious prior to and during ophthalmic surgery. This can be due to anticipated pain, discomfort or fear of seeing during surgery. Fung *et al.* [27] 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 anaesthetist. 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 treatment.

With regard to pain control, there are disagreements about the superiority of an individual technique. Overall there is moderate evidence [18] that sub-Tenon's block produces better pain control than retrobulbar and peribulbar block. There is weak evidence that sub-Tenon's block produces better pain control than topical anaesthesia. A recent study [28,29**] suggests that up to 43% of patients undergoing sub-Tenon's block suffer varying degrees of pain during administration. All topical local anaesthetic drops sting on application. Proxymetacaine 0.5% and oxybuprocaine 0.4% eye drops sting least on

application but do not provide adequate surface anaesthesia. Tetracaine 1% eye drops sting most but produce good surface anaesthesia. Many clinicians instil proxymetacaine or oxybuprocaine first, followed by tetracaine and this sequence seems to reduce the discomfort. Injection of any local anaesthetic agent irrespective of the type of the block is painful and associated with burning sensations around the globe giving an unpleasant experience. Local anaesthetic agents which are stored in the fridge are believed to produce more pain during injection but this has been recently discounted and it remains controversial whether warming local anaesthetic helps [29**]. Injection of diluted local anaesthetic agents before the main concentrated injection is also believed to reduce discomfort [7].

Many patients have retained visual sensation under all types of ophthalmic local anaesthesia and different types of surgery [30–32]. In one survey [33], 16% found this distressing. Anxiety results in catecholamine release. The majority of cataract patients are elderly and have comorbidities such as diabetes and cardiovascular disease. Preoperative counselling and sedation can be used to control catecholamine secretion minimizing tachycardia and hypertension. Several studies [30] have shown that an explanation of the procedure itself and counselling as to what may be expected reduces anxiety.

Sedation during ophthalmic regional anaesthesia

Many clinicians prefer to use sedation to reduce anxiety, discomfort and fear during ophthalmic regional anaesthesia. However, ophthalmic surgical techniques have changed over the years and hence modified the need for sedation and analgesia. The type of block used for ophthalmic surgery also alters the requirement for sedation and analgesia. Selected patients, in whom explanation and reassurance have proved inadequate, may benefit from sedation [20]. Ideally the patient should be awake and cooperative during surgery, with no residual sedation or prolonged somnolence. If sedation is used for the block, an agent with fast onset is required ensuring that the patient is amnesic but does not move during the injection. There should not be any haemodynamic or respiratory depression and no after effects so that the patient is ready for discharge soon after surgery. The routine use of sedation is discouraged because of an increased incidence of adverse intraoperative events [34]. At present, there is no consensus about what is the ideal sedative/analgesic regimen. It is essential that when sedation is administered, a means of providing supplementary oxygen is available. Equipment and skills to manage any life-threatening events must be immediately available [20].

Complications of ophthalmic regional anaesthesia

Complications of needle blocks range from mild to serious and have been reported and published in many reviews [35–37]. The complications may be limited to the orbit or may be systemic. Orbital complications include failure of the block, corneal abrasion, chemosis, conjunctival haemorrhage, vessel damage leading to retrobulbar haemorrhage, globe perforation, globe penetration, optic nerve damage and extraocular muscle damage. Systemic complications, such as local anaesthetic agent toxicity, brainstem anaesthesia and cardio-respiratory arrest may be due to intravenous or intrathecal injection, spread or misplacement of drug in the orbit during or immediately after injection. Risk factors that enhance potential for accidental needle penetration of the globe include increased optical axial length, recession of the eye and limited operator experience. Intraconal injection requires placement of an acutely angled needle deep within the orbit. If the antero-posterior distance of the eye is significantly longer than average, there is a greater risk of accidental injection into the posterior part of the globe by steep angulation of the needle. Antero-posterior length is increased with myopia, staphyloma, and prior scleral buckle surgery. An in-situ scleral buckle deforms the globe, enlarging the axial length. A staphyloma is an aberrant outpouched section of globe, typically located posteriorly at the nexus of eye wall and optic nerve. Ideally, confirmation of globe length (<26 mm) and shape (no staphyloma) can be accomplished if a preoperative ultrasound has been performed. Additionally, the surface anatomy should be assessed to determine the globe–orbit relationship as the presence of marked globe recession in the orbit may enhance the risk of posterior pole puncture. The ultimate location of the tip of an intraconal block needle is typically more proximate to the posterior pole of the globe than anticipated. The extraconal approach of shallower needle placement with minimal angulation may diminish the likelihood of encountering the globe's hind surface; however, inadvertent needle penetration can nonetheless occur at the globe's periphery. This risk is particularly enhanced if the eye is myopic, as globe dimensions increase in all axes with near-sightedness.

Sub-Tenon's block is considered a safe alternative to needle block; however, a number of complications both minor and major have been reported [8,26]. Commonly encountered complications of sub-Tenon's block are mostly minor. These include pain upon injection, reflux of local anaesthetic, chemosis and conjunctival haemorrhage with varying incidence. Visual analogue pain scores are typically low but outliers have been reported. Smaller cannulae may afford a marginal benefit [38]. Anterograde reflux and loss of local anaesthetic upon injection occur if

the dissection is oversized relative to the gauge of the cannula. Inadequate access into the sub-Tenon's space can also promote overspill and chemosis. The incidence of chemosis varies with the volume of local anaesthetic, dissection technique and choice of cannula [19^{••},39]. Shorter cannulae are associated with increased likelihood of conjunctival chemosis being up to 100% in some studies [39]. Conjunctival haemorrhage is common [19^{••}] with some studies reporting up to 100% incidence [39]. According to a recent study [40], conjunctival haemorrhage occurred in 19% in the control group, 40% in the clopidogrel group, 35% in the warfarin group and 21% in aspirin group. Occurrence can be reduced with careful dissection, application of topical epinephrine or controversially the use of handheld cautery [41,42[•]]. A number of major complications from sub-Tenon's blocks have been reported [8,26]. These include significant orbital haemorrhage, globe perforation, orbital cellulitis, postoperative diplopia, optic neuropathy, pupillary/accommodation defects, retinovascular and choroidovascular occlusion and central spread of local anaesthetic with cardiopulmonary sequelae including death [43^{••}]. These complications tend to be associated with the use of longer more rigid cannulae and higher volume of local anaesthetic [8,26]. The likelihood of encountering these rare outcomes may be diminished with use of shorter flexible cannulae and low volume [44[•]]; however, the incidence of common minor complications rises as length and rigidity fall [45].

Conclusion

Ophthalmic regional anaesthesia provides excellent anaesthesia for ophthalmic surgery with a high success rate. Satisfactory anaesthesia and akinesia can be obtained with both needle and cannula techniques. Retrobulbar, peribulbar and sub-Tenon's blocks are invasive techniques. All injection techniques are associated with pain, sight and life-threatening complications albeit rare and at present there is no absolutely safe technique.

References and recommended reading

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Additional references related to this topic can also be found in the Current World Literature section in this issue (p. 690).

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