Review Article

Orbital regional anesthesia: Complications and their prevention

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Serious complications following orbital regional anesthesia are rare, but occur following both needle and blunt cannula (sub-Tenon's) techniques. Each technique of orbital regional anesthesia has its own risk/benefit profile. This article reviews the etiology, risk factors, treatment and prevention of complications of commonly used akinetic orbital blocks. Ophthalmologists and ophthalmic anesthesiologists must be prepared to deal with rare, but serious complications, that can occur with any technique of orbital regional anesthesia.

Key words: Eye blocks, ophthalmic anesthesia, regional anesthesia, retrobulbar, peribulbar, sub-Tenon's block.

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Most eye operations can be performed under local anesthesia, which can be either topical, or orbital regional anesthesia.[1,2] In recent years, the topical anesthesia has become a common modality of anesthesia for cataract surgery. However, orbital regional anesthesia is preferred by many ophthalmologists for cataract, as well as other forms of ophthalmic surgery. According to recent studies, many patients prefer orbital regional anesthesia.[3,4] Local anesthetic techniques are preferred, because they can provide orbital analgesia and/or akinesia with a lower incidence of systemic side effects, than general anesthesia.[5] These factors are especially important for frail and elderly patients, who undergo eye surgery.

Orbital regional anesthesia using needle initially, started as a traditional or classical retrobulbar (intraconal) block. This block involves the injection of a local anesthetic agent into the cone of the orbit behind the globe, formed by the four recti muscles and the superior and inferior oblique muscles [Figure 1] supplemented by facial nerve block.[6] Although this block has a high success rate, many serious complications affecting sight and life have been reported. Several techniques have been introduced as alternative to the traditional retrobulbar block, to reduce the risk of serious complications. These techniques include modern retrobulbar block with needle ≤ 32 mm (the needle placed through the skin or conjunctiva), peribulbar (extraconal) block [Figures 2 and 3] and sub-Tenon's block [Figure 4].[7] The terms, 'retrobulbar block' or 'intraconal block' and 'peribulbar block' or 'extraconal block', are frequently used interchangeably. In peribulbar block, the needle may be introduced either through the conjunctiva or skin, but the needle tip is deliberately placed outside the muscle cone. Although peribulbar and retrobulbar block have been considered as separate techniques previously, the injection is essentially made into the same adipose tissue compartment and the difference is merely a matter of needle direction and depth of insertion.[8] The peripheral peribulbar block usually takes longer to work and require larger volumes of local anesthetic with more number of injections.[9] In the sub-Tenon's block, the local anesthetic agent is injected between sclera and

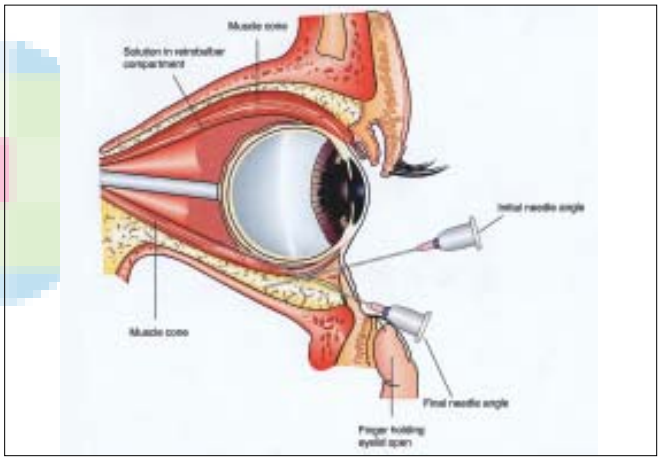

Figure 1: The needle is placed in the intraconal compartment (retrobulbar block) through the inferotemporal area.

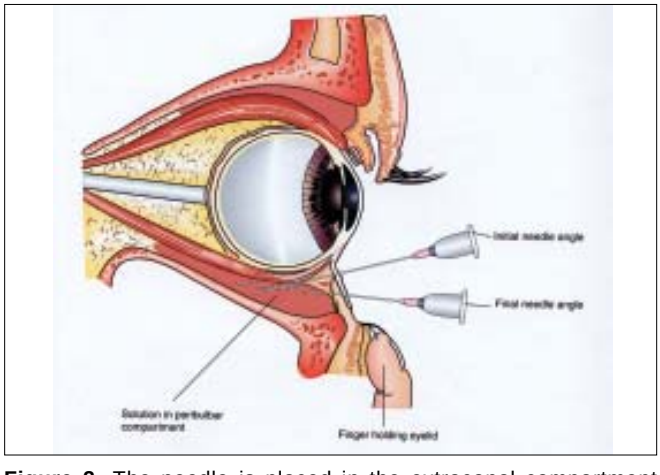

Figure 2: The needle is placed in the extraconal compartment (peribulbar block) through the inferotemporal area.

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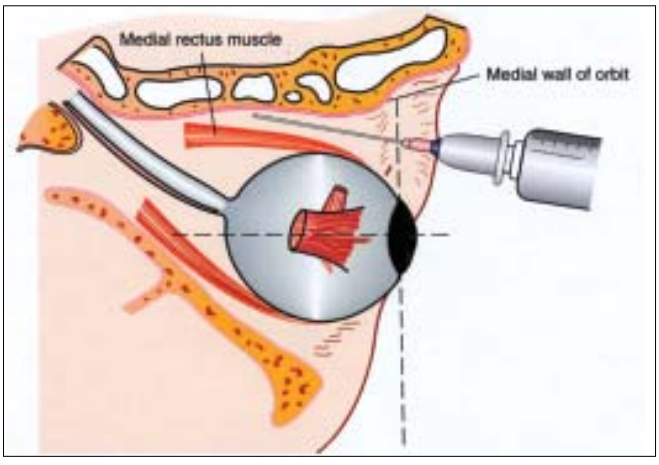

Figure 3: The needle is inserted into the medial peribulbar compartment the needle is inserted between the caruncle and the medial canthus.

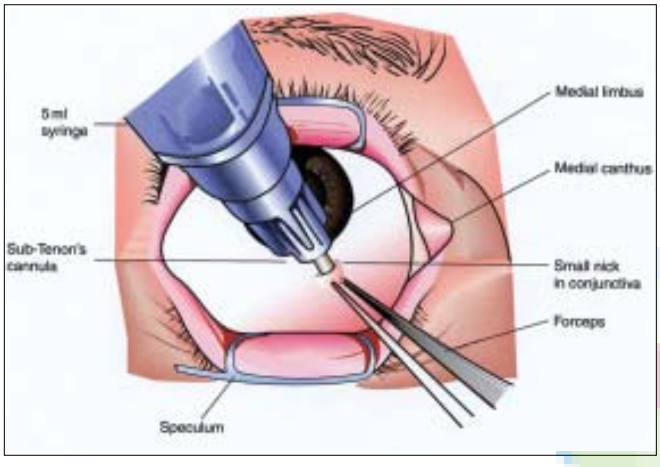

Figure 4: A sub-Tenon cannula is inserted into the sub-Tenon's space.

the Tenon capsule.[10]

Complications[11,12] arising from orbital regional anesthesia may be local, or may manifest systemically and may arise immediately or may be delayed. Complications are related to the method of administration or local anesthetic agent and adjuvant used.

Needle block complications

Conjunctival edema (chemosis) and subconjunctival hemorrhage (ecchymosis)[11] may occur after needle block. Peribulbar block is associated with frequent chemosis and subconjunctival hemorrhage than retrobulbar block, due to anterior spread of the local anesthetic agent and the damage of minor blood vessels with needle tip, respectively. These minor complications usually do not interfere with surgery, and resolve spontaneously within few hours. Lid hemorrhage is another minor complication of needle block and has been estimated to occur in 4% of patients.[13]

Retrobulbar hemorrhage

It is a serious complication of both the intraconal and extraconal blocks, which occurs following bleeding behind the globe. The hemorrhage may be either venous or arterial in origin and may be concealed, or revealed. Spread of blood into the periorbital tissues increases the tissue volume and pressure.

In a study involving 19,000 patients who had retrobulbar and peribulbar blocks, the incidence of retrobulbar hemorrhage was only 0.03%.[14] An incidence ranging between 0.4% and 1.7% have also been reported.[2,15] Interestingly, in a study which compared the incidence of retrobulbar hemorrhage with different needle techniques, the authors found that the incidence was 0.4% with the peribulbar technique and 0.7% with the retrobulbar technique.[2] Blindness from a retrobulbar hemorrhage has been reported,[16] but most patients have a good visual outcome.[2,15]

Venous hemorrhage due to perforation of a vein, is slow in onset and usually presents as markedly blood stained chemosis and raised intraocular pressure. It is possible to reduce the intraocular pressure by intermittent digital pressure with a gauze pad over the closed lids. Before the decision is made to proceed with surgery or postpone it for a few days, it is advisable to measure and record intraocular pressure.[17]

Arterial hemorrhage due to perforation of artery occurs quickly and is more difficult to control. Urgent measures must be taken to stop hemorrhage and reduce elevated intraocular pressure. Firm digital pressure usually stops the bleeding. Consideration must then be given to reduce the intraocular pressure, so that the blood supply to the retina is not compromised. Lateral canthotomy, intravenous acetazolamide, intravenous mannitol or even paracentesis, may need to be considered.[17]

The risk of developing retrobulbar hemorrhage is greater, when a long (≥ 38 mm) needle is advanced deep into the orbit where vascular structures are most tightly packed. Larger diameter needles are more likely to cause tear in a blood vessel.[18] Other risk factors suggested, are pre-existing vascular and hemorrhagic diseases.[12]

Some authorities advocate discontinuing Aspirin and Warfarin before eye surgery, because of the concerns of potential hemorrhagic complications in the perioperative period, although they have a different mechanism of action.[19,20] However, this practice is questionable because of reports of clotting-related-complications in some patients.[19,20] Numerous studies have failed to demonstrate an increased risk of sight-threatening complications, by continuing Aspirin or Warfarin till the time of surgery.[13,14,21-16] However, some studies suggest that there is an increased risk of minor bleeding-related-complications in patients who receive Warfarin or Aspirin at the time of surgery.[21-23,25-27] Two studies showed no increased risk of even minor hemorrhage, with patients continuing Aspirin and Warfarin till the time of surgery.[13,14]

In an observational non randomized study involving over 19,000 patients for cataract surgery, the use of Aspirin and Warfarin were studied and it showed similar but low rates of serious bleeding complications in both group of patients who continued Aspirin to within 14 days of surgery, or stopped Aspirin ≥ 14 days before surgery (about 0.06% in both groups).[14] Similarly, there was no serious bleeding-related-complications in two group of patients who continued Warfarin to within 4 days of surgery, or stopped Warfarin ≥ 4

days before surgery. The authors concluded that there was no evidence, that continuing these drugs increased the risk of serious hemorrhagic events. They also noted that stopping these drugs before surgery did not increase the rate of clotting related complications, but recognized that the absolute number of these complications were small and therefore, their study might not have the power to detect a small difference. They suggested performing a large randomized, controlled trial and recognized the difficulty of performing such a trial. It would require over 20,000 patients on anticoagulant therapy to obtain a definitive result.

Globe damage

Damage to the globe is a rare, but serious complication which is reported following both intraconal and extraconal block[2,28-30] and even following other forms of local anesthesia for minor procedures such as eyelid surgery. Globe perforation refers to double puncture wounds (wound of entry and exit), whereas globe penetration has only wound of entry. The incidence of this complication is similar with both techniques,[2,30] which varies from 0%,[31-32] to 0.1%.[2,33-36] Classical peribulbar technique involved one or more injections purposely, outside the "cone" of extraocular muscles.[31] Many perform peribulbar block using needles 22 to 25 mm long, in or near the anterior intraconal space, introducing the needle in a similar direction as the retrobulbar block. This may account for the similar rates of globe perforation with the peribulbar and retrobulbar techniques. Patients with an axial length of ≥ 26 mm are prone to globe perforation.[29,30,37] According to Duker *et al*,[29] 45% of globe perforations occurred in patients who had an axial length of ≥ 26 mm. They calculated that myopic patients have a 30 fold increased risk of perforation during intraconal injections.[29] Posterior staphyloma (posterior outpouching of the globe) can be associated with myopia. In a review of 50,000 patients who had needle block, 7 patients had globe perforation and they all had posterior staphyloma.[38] A single medial peribulbar injection technique is advocated in these patients.[39] A non-needle technique such as topical or sub-Tenon's, may also be a safer alternative in these patients. Other risk factors for globe perforation include enophthalmos, repeated injections, uncooperative patient, previous scleral buckling, bevel of the needle turned away from the globe, lack of knowledge of orbital anatomy or technique and patients who had previously undergone retinal detachment or corneal refractive surgery.[12,18]

Signs and symptoms of perforation include intense ocular pain, sudden loss of vision and hypotonus. Interestingly, in one review, about 50% of the patients had no immediate symptoms or signs of perforation.[29]

If globe perforation is suspected, the surgeon should be informed immediately. Ophthalmoscopy or ultrasound is performed to assess the damage. Cancellation of elective surgery and referral to a retinal surgeon should be strongly considered.

Long term visual acuity is usually poor. Only about 25% of patients with a globe perforation from a needle had visual acuity > 20/60.[25] Retinal detachment occurring as a complication of globe perforation is predictive of a worse visual outcome.[29] There is a controversy about the use of sharp and blunt needles. There are experienced practitioners who successfully use each type of needle with very low complication rates. The advantages of sharp needle include less pain for the patient, less or no sedation required, greater ease in controlling bleeding from an inadvertently punctured vessel and less damage to the globe if globe perforation occurs.[40] The advantages of the blunt needle include increased chance of recognizing resistance if the globe is encountered and therefore less chance of perforating the globe. However, there is a greater chance of permanent damage to the globe, if perforation does occur with a blunt needle.[12]

Ocular explosion or rupture of the globe is another potential complication of globe penetration. It is a devastating eye injury that usually results in blindness, or only light perception.[41,42] It is caused by inadvertent injection of local anesthetic agent into the globe. Experimental evidence shows that the globe will rupture, if less than 2 ml is injected into it.[41,42] This injury could be avoided by minimising the number of injections, use of blunt needle, noting negative aspiration before injection, inspection of aspirate for blood or vitreous fluid and to wiggle the syringe before injecting, to ensure that the globe is not pierced by the needle (although not universally accepted). It is also recommended to discontinue the block if corneal edema or resistance to injection occur and to inspect the globe before placement of a Honan's device or ocular massage, for evidence of corneal edema or hypotony.[41,42]

Optic nerve injury

Injury to the optic nerve and central retinal artery contained within the nerve are rare.[12,18] This artery is the first and smallest branch of the ophthalmic artery, arising from that vessel, as it lies below the optic nerve. It runs for a short distance within the dural sheath of the optic nerve and about 35 mm from the orbital margin, pierces the nerve and runs forward in the centre of the nerve to the retina.[17]

These complications are thought to occur from the direct needle-stick injury to the optic nerve, secondary to hemorrhage within or around the optic nerve, or pressure necrosis from local anesthetic agent within or around the optic nerve.[18] These can result in marked loss of vision or blindness and optic atrophy (a late finding).

Risk factors for optic nerve injury include patients with small orbits, placement of a long needle deep into the apex and the patient looking up and in at the time of the block, during the classical retrobulbar block.[12,43-46] Katsev *et al*. measured the distance from the inferior lateral orbital rim (the traditional insertion point of most sharp needle techniques) to the optic foramen in 120 cadaver orbits and found that in about 20% of the skulls, this distance was 45 mm or less.[44] They postulated that a 38 mm needle could injure the optic nerve while it was encased in the relatively immobile annulus of Zinn, in an orbit less than 45 mm. They recommended using shorter needles such as 31 mm or less, to eliminate this possibility. Pautler *et al* reported 2 cases of blindness from optic nerve injuries, with a 38 mm needle during retrobulbar block.[47] Both patients were instructed to look up and in during the block. The authors postulated that when the patient is asked to look up and in, this brings the medially positioned optic nerve more lateral and closer to the needle tip. CT scan[45] and MRI[46] have confirmed this finding. It is therefore, recommended that a patient should look straight

ahead (primary gaze position), during needle block. Surgical decompression of the optic nerve sheath should be considered, but the prognosis is poor.[43]

Myotoxicity

Damage to extraocular muscles from orbital blocks can result in strabismus (causing diplopia), ptosis (drooping upper eyelid) and entropion (infolding of the eyelid).[48] However, not all cases of extraocular eye muscle problems are caused by orbital block, such as diplopia from the pre-existing condition that is unmasked after cataract surgery, sensory deviations and optical aberrations.[49]

Possible mechanisms of extraocular eye muscle damage include direct needle trauma, ischemic pressure necrosis caused by a large volume of local anesthetic, direct myotoxic effects of the local anesthetic agent on extraocular muscles and use of high concentrations of Lidocaine.[12,48,49]

Experiments involving injection of the local anesthetic agent directly into the extraocular muscles of monkeys demonstrated a temporary disruption of the myocytes, but rapid regeneration of normal muscle tissue.[50] But a similar experiment in elderly human patients demonstrated permanent damage to the extraocular muscles[51] and this presumably may be because elderly muscle tissues do not regenerate quickly. Absence of the enzyme Hyaluronidase mixed with local anesthetic has been suggested as another possible risk factor for extraocular muscle damage in several retrospective surveys,[52-55] but this correlation is not universally accepted.[56,57]

Transient strabismus on the first postoperative day is common after eye surgery. The most common permanently injured muscle from an eye block is the inferior rectus, but other muscles can be involved. Johnson *et al*,[56] identified post-operative strabismus in 0.18% of patients receiving retrobulbar blocks with a 38 mm needle. In contrast, Hamilton[58] found no cases in 8,500 patients, when he used a 31 mm needle in the extreme inferotemporal quadrant (just above the orbital rim directly below the lateral canthus) approach to the retrobulbar space. He believed that the needle tip is less likely to strike the orbital floor and anterior aspect of the inferior rectus muscle, compared to the traditional insertion point.

The superior rectus can be injured with a 38 mm needle if it is advanced too far in the superior direction, hitting the underside of the muscle, as the needle passes through the intraconal space.[12]

Ptosis is common on the first postoperative day after eye surgery. It occurs in 50% of eye operations.[59] Ptosis resolves in 95% of patients by the 4th postoperative day and in 99%, within 5 weeks. The incidence of ptosis is the same with needle orbital blocks and general anesthesia.[59] It is believed that ptosis can be caused by dehiscence of the levator aponeurosis and is associated with large volume of local anesthetic.[51] Therefore, the smallest effective volume of anesthetic agent is advocated. Surgical causes of ptosis include, use of a superior bridal stitch, or application of a lid speculum.[59]

Central spread of local anesthetic agent and brain stem anesthesia

Spread of local anesthetic to the central nervous system after needle eye blocks has been well described.[60,61] The cerebral dura matter provides a tubular sheath for the optic nerve as it passes through the optic foramen. This sheath fuses to the epineurium of the optic nerve and is continuous with the sclera, providing a potential conduit for local anesthetic to pass subdurally to the brain. Central spread occurs, if the needle tip has perforated the optic nerve sheath and if injection is made.[62,63]

Central spread may also occur on a rare occasion, if an orbital artery is cannulated by the needle tip. Retrograde flow of anesthetic agent from a branch of the ophthalmic artery through the internal carotid artery, to the midbrain can occur. An immediate seizure would result and cardiovascular instability is possible. The toxic intra-arterial dose has been estimated to be as low as 3.6 mg of Bupivacaine, which approximately than 0.75 cc of 0.5% Bupivacaine.[64] To reduce the risk of this complication, one should always aspirate before injecting local anesthetics. If blood is aspirated, the needle must be redirected.

The incidence of the central nervous system complication with a 38 mm retrobulbar needle is between 0.2, to 0.3%.[60,61] In one series, there was only one case of central nervous system (CNS) spread in 6,800 (0.015%) extraconal (true peribulbar) blocks. Thirty eight mm needles were used in this study, although it was reported that they were advanced to a maximum of 25 mm.[40]

The time of onset of symptoms is variable, but major sequalae develop usually in the first 15 minutes after the injection. The onset of central nervous system toxicity is almost instantaneous, if arterial injection has occurred.[12] The sympatomatology of central spread is varied and depends upon which part of the CNS is affected by the local anesthetic. A range of different signs and symptoms has been described involving the cardiovascular and respiratory systems, such as temperature regulation, vomiting, temporary hemiplegia, aphasia and generalised convulsions. Palsy of the contralateral oculomotor and trochlear nerves with amaurosis, is characteristic of central nervous system spread.

Treatment consists of respiratory and cardiac support. Bag and mask ventilation is frequently required, but the episode often resolves spontaneously in and intubation may not be necessary. Because of the possibility of systemic complications, all patients receiving eye anesthesia must be monitored and personnel with resuscitation expertise must be immediately available.

Intraconal and extraconal blocks should always be made with the patients looking straight ahead in primary gaze position, as optic nerve is slack in this position. The slackness allows the nerve to be pushed aside. Injection should not be made too deeply into the orbit where the optic nerve is tethered to its sheath, as it emerges through the optic foramen. It is a good practice to aspirate before injection, to avoid intravascular injection.

Complications of 7th nerve block

The facial nerve block is performed to block orbicularis oculi muscle during low volume classical retrobulbar block. This nerve may be blocked at several points after exiting from the base of skull. This block is very painful and associated with

skin bruising. Many complications such as hemifacial palsy, spread of local anesthetic to the vagus nerve, glossopharyngeal or spinal accessory nerves, neurogenic pulmonary edema and other rare complications have been reported.[11,12] Modern needle block utilizing higher volume local anesthetic usually blocks the terminal branches of the 7th nerve and paralysis of the orbicularis per se is not required.

Oculocardiac reflex (OCR)

This is manifested as bradycardia and hypotension in response to mechanical stimulation of the globe. Less commonly, other arrhythmias or asystole can occur. Meyers states that OCR is a common complication of intraconal block.[65] Hamilton disputes this and noted that OCR never occurred in a series of 12,000 retrobulbar and peribulbar block.[40] However, 0.6% of patients in this study were noted to have had a vasovagal episode sometime in the perioperative period, but not during the injection of local anesthesia or during surgery.[40]

The afferent pathway is via the ciliary nerves to the ciliary ganglion, then via the ophthalmic branch of the trigeminal nerve to the brain. The efferent pathway is via the vagus to the heart.[18]

OCR is commonly seen during general anesthesia for eye surgery and is especially common in children.[66] It usually can be reduced or abolished by administering atropine.[67] Prophylactic administration of retrobulbar and peribulbar block has been used, but their use does not reliably abolish OCR and hence, is not recommended.[18]

Allergic reactions

Allergic reactions from amide anesthetic commonly used for eye anesthesia, such as Lidocaine and Bupivacaine are rare. There are case reports of allergic reactions following the use of Hyaluronidase mixed with local anesthetic agent.[68-70]

Sub-Tenon's block

Turnbull introduced the concept of sub-Tenon's block in 1884.[71] This needleless block was reintroduced in the early 1990's.[72-74] Classic articles appeared in 1992.[10,75] The block is performed by using small surgical scissors to cut a small hole in the conjunctiva and the underlying Tenon capsule. A blunt cannula is inserted into the sub-Tenon's space and local anesthetic agent is administered.[10] The use of sub-Tenon's block appears to have increased rapidly in many countries This has happened in anticipation, that the use of sub-Tenon's block will reduce the incidence of serious complications that occur with traditional needle blocks. Minor complications with this technique occur with a fairly high frequency. These include: pain on injection (15-33%), chemosis (6-100%) and subconjuntival hemorrhage (7-100%).[76,77]

As sub-Tenon's block has become more widely utilized, a few case reports of severe ocular and systemic complications have appeared. It is interesting to note, that most of these complications have been previously reported with needle techniques. These case reports include cases of globe perforation,[78,79] orbital and retrobulbar hemorrhage,[80,81] two case of hyphema,[79] muscle trauma and diplopia,[82,83] local anesthetic spread to CNS,[79] retinal dysfunction,[79] orbital cellulitis,[84] chronic dilatation of pupils,[85] foreign body falling into sub-Tenon's space[86] and orbital swelling from high concentrations of hyaluronidase.[87] The exact mechanism of these complications is not clear, but they may be due to forceful or inappropriate placement of the metal posterior sub-Tenon's cannula. Many of these reports contain suggestions to prevent such complications.

There are only a few published observational studies with large numbers of patients, examining the rate of serious complication with sub-Tenon's block.[2,76] These studies suggest a low rate of serious ocular and systemic complications. Eke *et al*,[2] conducted a prospective, non-randomized, observational study in the U.K, examining different local anesthesia techniques for eye surgery, during a 3 month period in 1996, utilizing voluntary responses to report the number of cases performed and any associated complications. Reviewing 4,400 patients who underwent sub-Tenon's block, they found no globe perforations and no retrobulbar hemorrhages (although they did note one expulsive hemorrhage which was not thought to be due to anesthetic). Guise examined retrospectively 6,000 patients who underwent sub-Tenon's block between the years 1995 and 2000.[76] The only serious ocular complication reported was one large subconjuntival hemorrhage, which was not sight-threatening. There was 0.2% rate of medical adverse events related to the cardiovascular system.

Is it possible to prove that sub-Tenon's block has less risk of serious complications, than traditional needle blocks? To answer this question, it is important to compare the rate of serious complications of sub-Tenon's block to the rate of serious complications of needle blocks, in a randomized, double-blind and prospective manner. Unfortunately, it is unlikely that such a study will ever be performed. As serious complications are rare, it has been estimated that one would need a sample size of over 20,000 patients to have sufficient power to demonstrate that one technique was superior to another.[2]

In lieu of randomized, double blind studies, additional observational studies with large numbers of patients, examining the rate of complications of sub-Tenon's and other blocks will be helpful in determining complication rates. Data has been collected from one such study. This study examined complications from well over 100,000 orbital blocks in the U.K. The results are expected to be published soon.[88]

Precautions with the use of oculocompression devices

The use of a compression device after orbital injection is common, particularly after high volume needle local anesthetic injection, to limit an excessive increase in the intraocular pressure.[7] Intraocular pressure does not increase after sub-Tenon's block.[89] A rise in intraocular pressure can be reduced by simple gentle massage, but more often, a ball or balloon is used.[7,90] In patients with known retinal circulatory insufficiency, ocular compression may not be desirable.[7] Some authors believe that such compression is unwarranted or even dangerous.[91] If compression is used, it is important that the amount of pressure applied will not compromise intraocular circulation (25 mm Hg or less) and that the device should not be left in place for more than 20 minutes.[7]

Adverse events and sedation

Although sedation is common during topical anesthesia, but in selected patients, in whom explanation and reassurance have proved inadequate, it is beneficial in patients receiving akinetic blocks. Short acting benzodiazepines, opioids or small doses of intravenous anesthetic agents are favored, but dosage must be minimal. Routine use of sedation is discouraged[92] because of increased intra-operative events.[93,94] It is essential that when sedation is administered, a means of providing supplementation oxygen equipment and skills to manage any life-threatening events, must be immediately accessible.[92]

Advantages and disadvantages of different techniques

There are conflicting reports on the relative effectiveness of akinetic blocks. The evidence indicates that peribulbar and retrobulbar blocks produce equally good akinesia and equivalent pain control during cataract surgery.[95] Comparative studies consistently found no difference between the two techniques. Although various published studies (limited data) suggest that peribulbar block is comparatively safer than retrobulbar block, the exact incidence of life and sight threatening complications of either technique requires a very large randomized study.

There is insufficient evidence in the literature to make a definite statement concerning the relative effectiveness of sub-Tenon's block in producing akinesia, when compared with peribulbar or retrobulbar block. However, individual studies reveal different and sometimes contradictory conclusions.[95] Advantages, disadvantages, complications and prevention of various orbital regional blocks, are shown in Tables 1, 2 and 3.

Conclusion

It is clear that serious complications can occur from all techniques of eye blocks. Before attempting to perform any regional orbital block, it is essential to learn the anatomy of orbital structures and the safe block technique. Dissection of a human cadaver orbit, when available, is an excellent method to learn the anatomy of the orbit. Safe block can be best accomplished by working with an experienced practitioner of orbital blocks, until mastery of safe block technique is assured. Ophthalmic anesthesia providers should have enough knowledge and be prepared to deal with serious adverse events, in all patients who have ophthalmic blocks.

Table 1: Important pros and cons of classical retrobulbar block

Advantages	Disadvantages
Low volume	Skill required
Rapid onset	Injection very close to key structures in the apex while the globe is rotated
Low pressure in orbit (but intraocular pressure may rise)	Risks of damage to globe and major structures similar but perceived as more frequent than peribulbar block
	Retrobulbar hemorrhage
Minimum anterior hemorrhage	Separate 7th nerve block and its complications

Table 2: Important pros and cons of peribulbar block

Advantages	Disadvantages
Reasonable akinesia	Skill required
Reliable anesthesia	Although needle remains tangential to the globe key structures may be damaged
Injection away from the key structures of the apex	Chemosis due to anterior spread of higher volume local anesthetic agent
Minimum anterior hemorrhage	Risks of damage to globe and major structures similar but perceived as less frequent than retrobulbar block
No rotation of globe	Multiple injections required as injected anesthetic agent is away or outside the cone
	Rise in intraocular pressure and need for oculocompression

Table 3: Pros and cons of sub-Tenon's block

Advantages	Disadvantages
Simple	Surgical procedure and skill required
Fast onset	Chemosis
Reliable anesthesia	Conjunctival hemorrhage
Relatively safe	Serious life and sight threatening complications reported but less frequently compared to needle blocks
Minimum risk to globe	Risk of infection
Easily topped up	Difficult to perform in patients who had previous and repeated eye surgery

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