



Regional Anesthesia in Ophthalmic Surgery

Göz Cerrahisinde Rejyonel Anestezi

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ABSTRACT

There are many anesthesia techniques for use in ophthalmic surgery. In selecting the technique to be applied, individual characteristics and anesthetic and surgical targets should all be considered for each patient. Regional techniques are preferred over general anesthesia due to their low complication rate and advantages. However, although it is relatively rare, regional techniques can also have life-threatening complications. Ophthalmologists and anesthesiologists should be prepared to handle the rare yet severe complications that the orbital regional anesthesia technique may cause. This study aims to uncover the regional anesthesia techniques used in ophthalmic surgeries and the complications that may arise.

Key words: ophthalmic anesthesia; regional anesthesia; local anesthesia; ophthalmic surgery

ÖZET

Oftalmik cerrahide kullanılan birçok anestezi tekniği vardır. Uygulanacak tekniğin seçiminde her hasta için bireysel özellikler, anestezi ve cerrahi hedefler göz önünde bulundurulmalıdır. Rejyonel teknikler komplikasyon oranlarının düşük olması ve avantajları nedeniyle genel anesteziye tercih edilmektedir. Bununla birlikte, nispeten nadir olmakla birlikte, rejyonel tekniklerin de hayati tehdit eden komplikasyonları olabilir. Göz doktorları ve anestezi uzmanları, orbital rejyonel anestezi tekniğinin neden olabileceği nadir ancak ciddi komplikasyonlarla başa çıkmak için hazırlıklı olmalıdır. Bu çalışmanın amacı göz ameliyatlarında kullanılan rejyonel anestezi teknikleri ve oluşabilecek komplikasyonları ortaya çıkarmaktır.

Anahtar kelimeler: oftalmik anestezi; rejyonel anestezi; lokal anestezi; oftalmik cerrahi

Introduction

In ophthalmic surgeries, anesthesia targets and individual patient characteristics are prioritized in the choice of anesthesia technique. Cataract surgery is the most common ophthalmic surgery, and it is widely used in the elderly population with comorbidities. Because of its advantages and low complication rate, regional anesthesia is usually favored¹. The surgeon's and patient's preferences, the patient's age, anatomical considerations, and comorbidities should all be considered when choosing regional anesthesia². For a long time, eye blocks were restricted to retrobulbar (intraconal) anesthesia administered by surgeons. However, alternative regional methods have started to be used because of changes in surgical techniques and attempts to enhance patient safety³. The selected block method

should provide adequate analgesia, akinesia, and eyeball hypotony⁴.

The patient should be monitored, prepared by supplying an intravenous route, and sedation should be administered if needed^{3,5}. There is no difference between the monitoring requirements for ophthalmic anesthesia in the awake patient and those required for procedures performed under general anesthesia².

The aim of this review is to provide information on regional anesthesia methods in ophthalmic surgery, including method selection, contraindications, and complications.

Retrobulbar (Intraconal) Anesthesia

Local anesthetic is applied to the space behind the eye. The optic nerve, the nerves that control the eye muscles

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Table 1. Retrobulbar anesthesia complications

Retrobulbar hemorrhage	Globe perforation
Retinal artery occlusion	Hypotony
Decrease in visual acuity	Optic nerve contusion
Amaurosis in the other eye	Optic atrophy
Muscle complications (ptosis, entropion, diplopia)	Brainstem anesthesia (as a result of subarachnoid or intradural injection)
Meningeal irritation	Central nervous system depression
Grand Mal seizure	Oculocardiac reflex stimulation (with globe compression)
Vasovagal bradycardia	Respiratory depression and arrest

and provide the sensation of the globe and surrounding structures are all contained in this space, which is surrounded by the muscles that move the eye⁶.

The long sensory root of the ciliary ganglion is blocked in the retrobulbar method, resulting in anesthesia in all trigeminal branches⁷. Therefore, it is the quickest (less than 5 minutes) and most comfortable surgical technique^{8,9}. However, it has a high complication rate (Table 1) and a greater loss of visual acuity than the peribulbar block¹⁰.

Local anesthetic allergy, orbital infection, or inflammation are absolute contraindications to retrobulbar anesthesia. Increased globe axial length, bleeding diathesis, thyroid-associated orbitopathy, orbital space-occupying lesion, and previous scleral buckling surgery, on the other hand, are relatively contraindicated disorders¹.

Peribulbar (Extraconal) Anesthesia

By applying local anesthetic outside the muscle subject, anesthesia and akinesia are formed. The optic nerve is preserved, but additional anesthetics and multiple injections may be needed¹¹. Anesthesia takes longer to begin, and periorbital ecchymosis is more likely¹².

The complications are the same as those associated with the retrobulbar block¹⁰. Peribulbar anesthesia has been recommended as a substitute because it has comparable effectiveness to retrobulbar injection, is simple, and has a lower rate of complications. However, also for peribulbar block, globe perforation, Brown's syndrome, strabismus, contralateral amaurosis, partial oculomotor nerve palsy, and respiratory arrest have all been recorded as complications¹³.

After retrobulbar block, there have been cases of life-threatening brainstem anesthesia reported^{11,14}. The local anesthetic agent directly enters the subarachnoid space and spreads to the central nervous system in brainstem anesthesia, which is the most serious of all

complications. The cerebral duramater forms a sheath-like path for the spread of local anesthetic through the optic foramen in this potentially lethal case. The onset of symptoms following the block will range from 2 to 40 minutes. Even if the complication is unusual, it should not be overlooked, the patient should be closely monitored, and the necessary equipment should be on hand in the operating room in case of an emergency¹¹. While the retrobulbar technique is most often associated with brainstem anesthesia, it can occur with any regional anesthesia technique^{7,15}. Patients should be closely monitored during the procedure, and this should be done by someone who is not a member of the surgical team, using a monitor. This is because the full length of the surgical procedure takes almost 2–40 minutes.

Carneiro et al. compared peribulbar and retrobulbar block in patients with phacoemulsification. They reported that needle placement affects the distribution of anesthetic in the orbit and the quality of anesthesia, and that anesthesia is satisfactory if the needle placement is intraconal or contra-fixed. The retrobulbar block technique was found to be more effective¹⁶. The effect of retrobulbar block starts faster than peribulbar block and is associated with less chemosis¹⁷. Sirisha et al. concluded that preoperative preparation, appropriate drug, needle size and block type selection are essential for safe cataract surgery, and that almost ideal anesthesia is provided in cataract surgery with the double quadrant peribulbar anesthesia technique¹⁸.

Table 2 lists the complications, symptoms, and treatments associated with regional techniques.

Sub-Tenon's (Parabulbar/Episcleral/Pinpoint) Anesthesia

It is the transconjunctival injection of an anesthetic agent into the sub-Tenon's space. This technique is at least as effective as the peribulbar method. It is suitable for use in cataracts, retinal photocoagulation, trabeculectomy, strabismus, and vitreoretinal surgery¹⁰. It is a

Table 2. Regional anesthesia complications, symptoms and treatments^{2,7}

Common complications	Symptom	Treatment
Chemosis	Swollen conjunctiva	Not needed, light finger pressure
Subconjunctival hemorrhage	Bleeding	Not needed, light finger pressure
Pain	Unrest	Not needed
Rare complications		
Ecchymosis	Sudden periorbital bruising	Not needed
Retrolbulbar hemorrhage	Arterial: sudden onset proptosis, increased intraocular pressure, decreased acuity	Conservative: tamponade with external finger pressure, acetazolamide, mannitol
	Venous: slower onset, less pressure effect	Surgical: emergency lateral canthotomy, cantholysis, or orbital decompression
Globe injury	Sudden pain, change in visual acuity (May threaten vision)	Emergency ophthalmologic examination
Optic nerve damage	Altered acuity (May threaten vision)	Optic nerve sheath surgical decompression, Limited
Muscular paralysis	Diplopia, ptosis, gaze deviation/limitation	Causal treatment, Limited
Brainstem anesthesia	Neurological and cardiorespiratory changes (Life-threatening)	Supportive treatment

simple, safe, and effective method administered with a blunt needle¹⁹. It may be preferred particularly for patients with high myopia, scleral explants, and anticoagulants, as sharp needle blocks may increase their risk of complications. It is not, however, appropriate for surgery that requires intact conjunctiva, as is the case for most glaucoma procedures²⁰.

When compared to infiltration anesthesia, the major advantages of this technique are reduced patient anxiety besides globe and optic disc injuries, quick visual recovery, and avoidance of postoperative diplopia. Complications such as subconjunctival hemorrhage and chemosis, on the other hand, may arise. Nevertheless, it does not lead to complications such as acute ischemic optic neuropathy, extraocular muscle paralysis, increased intraocular pressure, globe perforation, periocular and retrolbulbar bleeding¹.

Regional anesthesia techniques have a low rate of serious complications (0%, 07). When compared to the sub-Tenon's technique, sharp needle techniques were found to have a 2.5-fold increase in risk⁷. Table 3 compares the techniques of retrolbulbar, peribulbar, and sub-Tenon's.

Subconjunctival Anesthesia

Subconjunctival anesthesia, an alternative to retrolbulbar and peribulbar block, offers anterior segment anesthesia. It is used in pterygium excision, conjunctival biopsy and tumor excision, cataract, and glaucoma surgeries^{5,10}. Its use with other types of block and intravenous sedation has been found to be safe and effective in evisceration surgery with transscleral implants²¹. Additional topical anesthesia may be needed. The

surgeon can face challenges due to eye movements and inadequate iris anesthesia¹⁰.

Topical Anesthesia

While needle blocks are preferred instead of general anesthesia for short surgical procedures (15–20 minutes), there has been a transition to topical anesthesia due to the potential harms of blunt needle insertion around the eyes²². Topical anesthesia refers to local anesthesia applied to the cornea and conjunctiva as drops or gels²³. It has some disadvantages, including the lack of akinesia, low patient comfort, and anxiety. Patients should be carefully chosen for suitable procedures^{12,23}.

Topical anesthesia has recently gained popularity in cataract surgery. Phacoemulsification can be conducted under topical anesthesia¹. In modern phacoemulsification cataract surgery, many surgeons use intracameral infiltration (irrigation fluids containing local anesthetics) besides topical anesthesia, which has decreased the need for the invasive block²⁰. However, since extracapsular cataract surgery and small incision cataract surgeries without phacoemulsification require transscleral incisions, which are commonly used in developing countries, this procedure alone does not provide adequate anesthesia²⁰.

Drops such as 0.5% bupivacaine, 0.4% benoxinate, 4% lidocaine, and 0.5% proparacaine are preferred for topical anesthesia. However, it has been reported that frequent use of these drops in the preoperative period may cause corneal clouding. For this reason, the deep topical fornix nerve block (DTFNB) method was tried. In this method, small sponges with anesthetic solution are placed deep into the conjunctival fornix. Its advantage has been that it combines the safety, ease

Table 3. Comparison of retrobulbar, peribulbar, and sub-Tenon's anesthesia^{10,18}

	Retrobulbar Anesthesia	Peribulbar Anesthesia	Sub-Tenon's Anesthesia
Advantages	Adequate akinesia and anesthesia Low volume Quick effect Low pressure in the orbit (but intraocular pressure may increase) Minimal anterior hemorrhage	Adequate akinesia and anesthesia Complications less than the retrobulbar technique Injection away from important structures of the apex No globe rotation Minimal anterior hemorrhage	Simple Adequate anesthesia Partial movement in the eyeball (at surgeon's request) Low volume Quick effect Relatively safe Low vision and life-threatening complications Less increase in intraocular pressure Effective time up to 60 minutes Less patient anxiety
Disadvantages	Requires experience Injection close to the important structures of the apex High complication rate Retrobulbar hemorrhage Loss of visual acuity Pain	Requires experience Even if the needle is tangent to the globe, important structures may be damaged. More volume Multiple injections Late-onset (up to 30 minutes) Periorbital ecchymosis and chemosis Intraocular pressure increase	Chemosis Conjunctival bleeding Risk of infection Difficult to apply in those with a background of previous or repeated eye operations

of administration and rapid onset of topical anesthesia with the wide anatomical distribution of retrobulbar anesthesia. In this method, 0.2% topical ropivacaine has become preferred over topical bupivacaine in cataract surgery due to its vasoconstrictive and long duration of action²². Wang et al. applied intracameral lidocaine in addition to topical anesthesia in small-incision cataract surgeries and showed that patients described less pain, were more comfortable, and collaborated better with the surgeon when compared to the group in which only topical anesthesia was applied²⁴.

This technique produces minimal pain with no intra- or postoperative complications including ptosis, globe perforation, or optic nerve lesions, and speeds up postoperative recovery. Pain from topical anesthesia, on the other hand, may lead to complications. Toxic effects on the corneal epithelium can occur when more than one topical anesthetic eye drop (3–5 times) is applied for analgesia. Additionally, topical anesthesia can reduce the surgeon's field of vision to the point that surgery becomes difficult. It may lead to pain, reduced lacrimation, and in extreme cases, severe keratopathy in the postoperative phase¹.

Intracameral Anesthesia

Iris and ciliary body anesthesia may not be adequately provided by topical anesthesia alone. In phacoemulsification surgery, using intracameral 0.5% lidocaine in addition to topical anesthesia improves cataract management². Intracameral lidocaine improves analgesia, has a quick effect, and is a simple and safe tool for increasing patient cooperation during manipulation phases^{7,25}.

Limbal Anesthesia

It is a surface anesthesia technique that is used to prevent the potentially toxic effects of topical anesthesia on the cornea. It is the application of a cellulose ophthalmic sponge moistened with lidocaine hydrochloride without a preservative to the limbal region 45 seconds prior to the start of the surgery. It has the advantage of not including the epithelial involvement, allowing for a quicker visual recovery¹.

Use of Ultrasound in Ophthalmic Anesthesia

Visualization of needle placement helps to apply faster, safer and more successful eye blocks. Ultrasound is also useful for detecting needle or cannula-related problems. The use of color doppler allows to see fluctuations in ocular blood flow and to evaluate patients with compromised circulation²². Pre-block ultrasound evaluation may prevent the risk of perforation, especially in myopic patients due to the increased ocular dimensions²⁶. In severe myopia, the risk of globe perforation increases up to 30 times²⁷. Ultrasound is also useful to see the spread of local anesthetic. Luyet et al. showed that intracanal extension was correlated with the success of the block in their study in which they applied peribulbar block for posterior segment surgery²⁶. Ultrasound-guided blocks may take longer, but this time will decrease as you get used to the technique over time²⁷.

Regional Anesthesia Contraindications

Patient unwillingness, local anesthetic allergy, and localized infection at the injection site are all absolute contraindications for regional anesthesia in ophthalmic surgeries. Anticoagulation, coagulation dysfunction for another cause, perforated globe, severe trauma, and cognitive impairment are, whereas, relative contraindications²³.

Anticoagulant treatment reduction or cessation prior to significant ophthalmic surgeries (e.g. orbital surgery) might be sufficient, but its suggestibility in cataract surgery is debatable. The risk of cost/benefit should be considered, as discontinuation of the anticoagulant may lead to thrombotic complications². If the International Normalized Ratio (INR) is within the target value range, anticoagulant treatment is not a contraindication of sub-Tenon's anesthesia. When the INR value of a patient taking warfarin is less than 3.7, the risk of major hemorrhagic complications is relatively lower²³.

Because of the length, thickness, and application inadequacies of the needles used in regional techniques, a local anesthetic can spread centrally if the optic nerve sheath is perforated²⁸. In other words, the properties of the needles used in the development of complications that can occur in invasive procedures are critical²⁸. With the widespread use of ultrasonography instruments in recent years, safer blocks have been developed by examining anatomical patterns, needle advancement, and drug diffusion²⁷.

Conclusion

Since regional anesthesia procedures and local anesthetics have a lower complication rate than general anesthesia, they are commonly used in ophthalmic surgery. However, although the patient is conscious and defensive reflexes are protected in these methods, central nervous system involvement and respiratory depression may grow as a result of simultaneous sedation, leading to life-threatening complications. Preoperative evaluation of the patients is important. Patients who will not be given anesthesia should also be thoroughly checked for complications that might arise as a result of the local anesthetic effect, their age, co-morbid conditions, and drug use history. During the preoperative phase, patients should be fully informed of the surgical process and any potential complications, and their consent should be obtained. Just the anesthetized eye is visible during ophthalmic procedures as the patient's

eye region is covered after it is prepared sterile. The patient's face is entirely covered so that no breathing motions or sounds can be observed. Cooperation with the elderly patient is also difficult. Therefore, it is critical to monitor these patients in order to identify potential complications, intervene early, and begin treatment. For this reason, the patient should be monitored with electrocardiogram (ECG), non-invasive blood pressure, and pulse oximetry in regional techniques, such as in general anesthesia, and an intravenous path should be available, as well as basic resuscitation devices in the operating room. As a result, the intraoperative and postoperative complications should be considered by the ophthalmologists and anesthesiologists, and they should be prepared for these complications.

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