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Local Anesthesia Techniques for Ocular Surgery

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Abstract

Several anesthesia techniques are available for modern intraocular surgery. When choosing the technique, the anesthetic targets and individual characteristics for each patient should be considered. Cataract is one of the common surgeries in the elderly with chronic coronary diseases, resulting in ischemic events during general anesthesia. Thus, regional aesthesia is generally preferable due to its advantages and lower complication rates. Various local anesthesia techniques are available for ocular surgery including retrobulbar (intraconal), peribulbar (extraconal), sub-Tenon's, limbal, intracameral, and topical anesthesia. In this review, we discuss the advantages and disadvantages of such techniques.

Keywords

Ocular surgery, Anesthesia techniques, Advantages and disadvantages

One of the features of modern eye surgery is that the number of operation is large and the procedure is generally small and quick, but the patients are a high-risk group. Eye surgery such as cataract is one of the most frequently performed surgeries in the elderly. The majority of patients present with other risk factors, such as diabetes, chronic coronary diseases, hypertension and dementia. There are several different anesthetic choices, including regional anesthesia with or without sedation and general anesthesia. Besides the ophthalmological criteria, the decision-making for an intraoperative anesthesia method also depends on the expectations of the surgeon, the anesthetist/anesthesiologist, and the patient. In this article, various anesthesia techniques for ocular surgery are reviewed.

Regional Anesthesia

Inocular surgery, regional anesthesia are generally methods of choice because the old patients always combined with substantial co-morbidity and the associated higher risk for perioperative complications [1]. Briefly, regional anesthesia includes retrobulbar (intraconal), peribulbar (extraconal), sub-Tenon's, limbal, intracameral, and topical anesthesia [2].

Retrobulbar (intraconal), Peribulbar (extraconal) Anesthesia

At the retrobulbar anesthesia (RBA), local anesthetic is injected into the retrobulbar space, the area located behind the globe of the eye. This injection provides akinesia of the extraocular muscles by blocking cranial nerves 2, 3, and 6, which prevents movement of the globe. Retrobulbar block also provides sensory anesthesia of the cornea, uvea, and conjunctiva by blocking the ciliary nerves [3].

Peribulbar block is very similar to the retrobulbar block. Anesthetic is injected into the orbit; however, it is administered outside of the muscle cone. Therefore, this technique is lower risk than the retrobulbar block, but achieves a lesser degree of anesthesia and especially akinesia [4]. Absolute contraindications of RBA are hypersensitivity or allergy to local anesthetic, orbital infection or inflammation. Relative contraindications are increased axial length of the globe, bleeding diathesis, thyroid-associated orbitopathy, space-occupying lesion within the orbit, previous scleral buckling operation [5].

Complications of RBA are retrobulbar hemorrhage, globe perforation by mistake, central nervous system toxicity and optic neuropathies which are rare [5]. The incidence of retrobulbar hemorrhage is 0.1 to 1.7% and the risk increases with the use of systemic anticoagulants, non-steroidal anti-inflammatory drugs, and steroids. Rise in intraocular pressure (IOP), which precludes perfusion of optic nerve and central retinal artery, can result from increased intraconal pressure [6]. Although prompt decompression usually produces successful results, persistent scotoma or optic neuropathy may develop. In default of related retrobulbar hemorrhage, retinal vascular circumstances including central retinal artery and vein occlusions can be associated with RBA, although extremely rare [7-9].

Sub-Tenon's Anesthesia:

As previously described by Stevens [10], a blunt sub-Tenon's cannula is used without inserting a sharp needle into the retro-orbital or periorbital spaces during the injection of the anesthetic agent into posterior sub-Tenon. This technique has been shown to be effective and safe. Phacoemulsification, namely cataract surgery, with local anesthesia has been commonly used since 1996 when Fichman [11], introduced this technique. The intraoper-

ative pain and systemic sedation requirement can be decreased by performing sub-Tenon's injection. Compared to infiltration anesthesia, the major benefits of this technique are reduced risk of globe and optic disc injuries and patient anxiety, quick visual recovery and avoidance of postoperative diplopia. Sub-Tenon's anesthesia is a simple and reliable method that provides perfect anesthesia without having to intervene with sharp instruments. On the other hand, procedure-related can be seen, including subconjunctival hemorrhage, and chemosis [10]. It does not cause acute ischemic optic neuropathy, extraocular muscle paralysis, increased intraocular pressure, globe perforation, periocular hemorrhage, or retrobulbar hemorrhage [12].

If hyaluronidase is added to local anesthesia (hyaluronidase is potentially allergic though), it can increase local anesthetic diffusion and shorter the onset time. This technique provides the advantages of rapid-onset and improved anesthesia and akinesia, compared to topical anesthesia alone [13].

Topical Anesthesia

Topical anesthetic drops are used to anesthetize the cornea. Intraocular lidocaine can be used in conjunction to improve anesthesia. This method does not provide any akinesia. The progression of clear corneal phacoemulsification and intraocular structure-sensitive pain manipulation are minimal. Phacoemulsification can be performed under topical application of anesthetic drops. Recently, topical anesthesia in cataract surgery has been popularized thanks to its benefits over injected local anesthesia. This technique results in minimal pain without intra- or postoperative problems, such as ptosis, globe perforation or optic nerve lesions; and it accelerates postoperative healing. However, topical anesthesia-related pain may result in complications. Since multiple eye drops (3-5 times) are used for analgesia, these topical anesthetics have toxic effects on the corneal epithelium. Furthermore, topical anesthesia can reduce the visibility for the surgeon which complicates surgery, leads to discomfort in the postoperative period, reduces lacrimation, and rarely causes severe keratopathy [14].

Limbal Anesthesia

To avoid potential corneal toxic effects of topical anesthesia, several techniques of surface anesthesia have been developed [15-17]. Some authors suggested an alternative method, called limbal anesthesia instead of topical anesthesia, which applied a cellulose ophthalmic sponge moistened with preservative-free lidocaine hydrochloride to the limbal region for 45 seconds prior to the start of surgery [18]. The main advantage of this technique is the lack of epithelial involvement, resulting in a greater well-being for the individual and rapid visual recovery [19].

Intracameral Anesthesia

Topical anesthesia alone may not provide adequate iris and ciliary body anesthesia. Combining phacoemulsification surgery with topical anesthesia using intracameral 0.5% lidocaine, therefore, yields improved cataract management [20,21].

Trabeculectomy involves cauterization of episcleral vessels and peripheral iridectomy, which can lead to pain. In this case, supplemental anesthesia is required during surgery. We suggest that, rather in the initiation of surgery, intracameral lidocaine should be administered during the iridectomy stage [22].

Ultrasound-guided Ophthalmic Regional Anesthesia

Although traditional techniques are reliable and safe, ophthalmic regional anesthesia is not without risk. Extraconal and intraconal blocks cause more severe complications than other peripheral nerve blocks [23]. Ultrasound may reduce the rate of intraconal needle placement and thereby reduce the infrequent but devastating consequences that may follow [24]. Ultrasonography (USG)-assisted eye blocks provide real-time visualization of the position of the needle and local anesthetic spread. In addition, USG-guided eye blocks offer real-time visualization of the position of the needle and local anesthetic spread. One of the main advantages of sonic guidance is that it is able to identify abnormalities, such as staphyloma, and rules out the hazard of globe perforation [25].

Monitored Anesthesia Care (MAC)

Eye surgery usually requires immobility of the eye and profound anesthesia of the surgical site. Regional anesthetic techniques are generally reliable and safe. Discomfort and anxiety are associated with many of these blocks, and so are rare but severe complications [26]. To ensure a painless and safe application, injection of the local anesthetic supplemented with intravenous sedation and continuous patient monitoring or MAC are frequently preferred [27-29]. According to the ASA, MAC is a planned procedure during which the patient undergoes local anesthesia together with sedation and analgesia [30]. In high risk patients, the infusion of sedatives and analgesics should be individualized. The discretion and judgment of an experienced anesthesiologist are required for the safety and efficacy profiles [31]. Combined $PtcCO_2$ and SpO_2 monitoring, short term general anesthesia for retro-bulbar block in ophthalmic surgery generates no significant hypercapnia [32]. The current routine monitoring seems to be sufficient and save.

General Anesthesia

General anesthesia is rarely used for intraocular surgery. However, for patients such as children or adults with limitations to their mental status, emergencies and for extended surgical procedures, general anesthesia may be

Table 1: Ocular Anesthesia Techniques.

Technique	Localization	Advantages/Disadvantages
General anesthesia	Rarely used.	For children or adults with restrictions to their mental status
Retrobulbar block	Anesthetic agent is injected into the orbit, inside of the muscle cone.	Higher risk but accomplishes better degree of anesthesia and particularly akinesia.
Peribulbar block	Anesthetic agent is injected into the orbit; nevertheless, outside of the muscle cone.	Lower risk than the retrobulbar block, but achieves a lesser levels of anesthesia and particularly akinesia.
Sub-Tenon block	Anesthetic agent is performed in the sub-Tenon space by a blunt-tipped cannula.	Offers the benefits of fast beginning and better anesthesia and akinesia.
Topical anesthetic drops	Topical anesthetic drops are used to anesthetize the cornea. Intraocular lidocaine can be used in conjunction to improve anesthesia.	Does not provide any akinesia.

more suitable. However, general anesthesia may increase postoperative cognitive dysfunction (POCD) and postoperative delirium and, probably, may even cause permanent cognitive decline in susceptible dementia patients. Patients should be clinically evaluated for the most suitable mode and technique of anesthesia, as the majority of dementia patients with cataracts are cooperative. Loco-regional anesthesia techniques can be safely utilized, thereby, avoiding general anesthesia. Of note, there are patients who are in the late stages of dementia for whom general anesthesia is warranted [33].

In conclusion, many anesthesia techniques can be applied in modern intraocular surgery. Given the essential role of anesthesia in ophthalmic surgery, Natasha, et al. present a quality score to evaluate the quality of ophthalmic anesthesia, particularly with regard to the development of surgical complications [34]. There are advantages and disadvantages associated with each type of anesthesia (Table 1). Regional anesthesia along with MAC is generally methods of choice. General anesthesia is mostly reserved for the pediatric patients and for patients with specific comorbidity preclude regional anesthesia and/or for patients with lengthy procedure. Careful patient screening is essential to determine which form of anesthesia is best suited. A perioperative physician should develop a checklist to avoid missing data that can influence the choice of anesthesia. A medical history and physical examination with review of medications are the mainstays for the evaluation. In addition, a particular attention should be paid to the patient's ability to communicate, to lie flat and keep still, and to follow instructions. A history of congestive heart failure, chronic obstructive pulmonary disease, chronic bronchitis, claustrophobia, anticoagulation status, and use of alpha-blockers (tamsulosin) should be addressed in each patient [35]. One should kept in mind that each technique has its own advantages and disadvantages, and the anesthesia provider should select the anesthesia technique carefully after full evaluation of the pros and cons of each technique to maximize the preferable clinical outcome.

Conflict of Interest

None.

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