Retrobulbar block for cataract surgery

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There are many anesthetic techniques which may be employed for cataract surgery. The author provides a step-by-step description of a regional orbital block technique which is used commonly today.

During the last decade, a number of long-acting local anesthetics—the amide group—have made it possible for cataract patients to undergo successful operations while under conduction (regional) anesthesia. The elimination of pain in the postoperative period that was commonly seen with general anesthesia and with certain earlier ester-type local anesthetics has made the regional block technique very popular today for use with the geriatric patient.

Modern day surgery and anesthesia dictate to the CRNA that his or her ability to perform regional block anesthesia is directly related to the best possible care that can be offered in the respective institution.

To master regional block anesthesia of the eye, the CRNA must have a full understanding of the anatomy, physiology and pharmaceutical ramifications as they pertain to the patient.

Anatomy

To completely block the motor nerves and muscles, that is, the orbicularis and the six ocular muscles and sensory block of the nerve supply to the globe, one must have a clear understanding of the nerve supply to the eye.

The facial nerve (7th). The temporal branch of the 7th cranial nerve passes anterior to the temporal mandibular joint and branches out to supply the motor aspect of the orbicularis muscle. (Figure 1.)

Figure 1.
Facial Nerve Distribution
The eyeball occupies the anterior half of the 2-inch long orbital cavity. The eyeball is moved within the orbital cavity by six ocular muscles. Three cranial nerves supply the six ocular muscles. (Figure 2.)

The ocular muscles arise from a fibrous cuff, called the anulus tendineus that encircles the dural sheath of the optic nerve in the retrobulbar compartment. The three cranial nerves, 3rd, 4th, and 6th, also encircle this fibrous sheath with the trochlear nerve (4th) clinging to the bony roof of the orbit.

*The ciliary ganglion.* The branch of the oculomotor nerve (3rd) lies far back in the retrobulbar compartment between the lateral rectus muscle and the optic nerve sheath. The primary innervation of the ciliary ganglion is sensory in nature supplying major branches to the eyeball and cornea.1 (Figure 2.)

**Preoperative preparation**

At our institution, cataract patients are admitted to the hospital the night before surgery. Most patients plan to stay three days. All patients are seen by an anesthetist the night before surgery. A complete medical and surgical history is taken from the patient and recorded on the anesthesia record. The patient is informed of the type of anesthesia he is to receive and a brief description is given if requested. Patients are told that if they are more comfortable with light sedation, a small amount of diazepam (Valium®) will be given to them during surgery.

On the morning of surgery cataract patients receive light preoperative medications of meperidine (Demerol®) and promethazine (Phenergan®). They also receive a “cocktail” (orange juice and ice) mixed with osmoglycyn for control of and lowering of intraocular pressure. They also receive acetazolamide (Diamox®) for the same purpose.

Patients receive Neo-Synephrine® 10% Ophthalmic eye drops in the affected eye one hour before surgery. The Neo-Synephrine® drops are repeated upon the patient's arrival in the operat-

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**Figure 2A.**

Nerves supplying the six ocular muscles.

<table>
<thead>
<tr>
<th>Nerve</th>
<th>Muscle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oculomotor nerve (3rd)</td>
<td>Medial rectus muscle</td>
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<tr>
<td></td>
<td>Inferior rectus muscle</td>
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<tr>
<td></td>
<td>Inferior oblique muscle</td>
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<tr>
<td></td>
<td>Superior rectus muscle</td>
</tr>
<tr>
<td>Trochlear nerve (4th)</td>
<td>Superior oblique muscle</td>
</tr>
<tr>
<td>Abducent nerve (6th)</td>
<td>Lateral rectus muscle</td>
</tr>
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![Figure 2. Orbital Cavity Dissected From Above](image-url)
ing room. This will help to maintain the eye in a mydriatic state.

**Intraoperative preparation**

Various monitoring parameters should be employed before the orbital block is started. These include measurements of blood pressure, ECG, and intravenous infusion. Also, an $O_2$ catheter (taped to the chin of the patient so that when the eye is draped he will get sufficient air) should be put in place.

It is our policy not to put the $O_2$ catheter inside the nasal or oral cavity because of the drying, irritating effect $O_2$ may have on the mucous membranes. By taping the catheter to the chin and tenting the drape the patient will feel less closed in.

Because the cataract patient is usually elderly, comfort during his stay in the operating room should have a high priority. Providing him with warmth, a comfortable position, and a reassuring voice are imperative.

For the patient who exhibits various symptoms of apprehension (such as anxiety or restlessness), we titrate Valium® 2-10 mg intravenously during the operative procedure. It was noted by Abrahamson and associates (1975) that the main adverse reaction to intravenous titration of diazepam during orbital block is: "difficulty in breathing because of airway obstruction due to the tongue falling backward into the throat as a result of light anesthesia employed."²

The relief of airway obstruction sometimes requires moving the head during the operative procedure. Over-sedation of the regionally blocked patient sometimes can be more bothersome to the surgeon than difficulties encountered during his surgical intervention. Unlike young adults, the geriatric patient requires very little diazepam to produce profound sleep.

**Local anesthesia**

When it comes to the selection of a local anesthetic, the amide-type drugs are preferred over the ester-type. The amide-type drugs, such as lidocaine (Xylocaine®), mepivacaine (Carbocaine®), bupivacaine (Marcaine®), and etidocaine (Duranest®), are metabolized by hepatic microsomal enzymes. This breakdown prolongs the duration of the block and is of great benefit in the continuation of pain relief in the postoperative period. In recent years, many studies have been done comparing various local anesthetic agents and their duration of block and postoperative control of pain.²,³,⁴,⁵,⁶

Originally lidocaine with adrenalin was used to potentiate the length of anesthesia. However, "This seems to have some danger of damage to the optic disc by using adrenalin in retrobulbar anesthesia for glaucoma surgery. A constriction of the small arteries might cause ischemia of the optic disc. Another reason not to give adrenalin is that many patients, especially elderly ones, have cardiac disease."³

Recently bupivacaine and etidocaine have held center stage. Thornburn (1976) compared etidocaine and mepivacaine as to their time of onset and length of anesthesia effect, as well as the patient's experience with postoperative pain. They found that 80% of the 47 patients studied who received etidocaine never experienced any postoperative pain, compared to about 50% in the mepivacaine class. Thornburn further states: "...the greatest asset of etidocaine is that only a few (22%) of the patients ever experienced pain."³

Bupivacaine like etidocaine has a prolonged blocking period. Although not a complication, injection of bupivacaine subcutaneously for the lid block (Van Lint technique) causes many patients to experience a significant burning sensation. Patients should be apprised of this prior to injection.

Kennerdell and associates (1976) found in their study of 101 patients undergoing retrobulbar block that a combination of one-half bupivacaine and one-half mepivacaine was very desirable. It provided the advantages of both agents, that is, the rapid onset of mepivacaine and the long blocking effect of bupivacaine.² At our institution, a combination, Marcaine® (bupivacaine) 0.5% and Carbocaine® (mepivacaine) 2.0% mixture, is used.

The addition of hyaluronidase (Wydase®) to the anesthetic solution helps to produce hypotony and shorten the induction time of retrobulbar blocks. Mendel (1978), in his study of 27 cases for cataract surgery, found that the mean induction time for patients with hyaluronidase added to their local anesthetics was 3 minutes, whereas without hyaluronidase it was 10 minutes.⁸

**Equipment**

The following equipment should be assembled: (Photo 1.)

1. Alcohol prep-sponges.
2. A 5 cc glass syringe.
4. An 18-gauge needle (only for the withdrawal and mixing of anesthetic solutions from multidose vials).
5. Bupivacaine (Marcaine®) 0.5% 50 cc vial.
6. Mepivacaine (Carbocaine®) 2.0% 50 cc vial.
7. Hyaluronidase (Wydase®) 1 cc vial.
8. A medicine glass.

*A technique for mixing* the necessary solutions is as follows:

1. With an 18-gauge needle and a 5 cc syringe, withdraw 10 cc of Marcaine®, 5 cc of Carbocaine®, and 1 cc of Wydase®. Place in sterile medicine glass and mix.

2. Draw up 5 cc of mixed solution and apply the 1\(\frac{1}{2}\) -inch, 25-gauge needle. Now all is in readiness for the Van Lint Block. (See the block technique description which follows.)

3. After the Van Lint block has been administered, detach the 25-gauge needle and draw up 5 cc of mixed solution and attach a second 1\(\frac{1}{2}\)-inch 25-gauge needle. Now, all is in readiness for the retrobulbar block. (See the block technique description which follows.)

**Block technique**

Paresis of the orbicularis muscle (the Van Lint technique) is obtained by infiltration anesthesia in the region of the terminal branches of the facial nerve (7th). About 1 cm temporal to the lateral canthus, a 25-gauge, 1\(\frac{1}{2}\)-inch needle is inserted subcutaneously through the skin to the orbital margin, where it is pushed to the bone while the anesthetic solution (in a 5 ml syringe) is injected. The hub of the needle is raised so that the shaft takes a downward direction toward the inferior orbital margin for a distance of about 1\(\frac{1}{2}\)-inches to the middle-third of the lower orbital margin.

As the needle advances, several milliliters of anesthetic solution are slowly injected. (Figure 3, position 1.) This distends the tissue at the inferior orbital margin. The needle is withdrawn to the site of the puncture but is kept under the skin.

The point is turned upward, and the needle is pushed along the superior orbital margin for a distance of about 1\(\frac{1}{2}\)-inches to the middle third of the superior orbital margin while the anesthetic solution is injected, 2-3 ml. (Figure 3, position 2.)

Simultaneous motor and sensory block is obtained, and thus, the patient is prevented from squeezing down during intraocular surgery. Com-
Figure 3.
Van Lint Technique.

Figure 4.
Retrobulbar Block.
plete akinesia must be obtained before the operation is started.

The method of introducing the needle and syringe for orbital (retrobulbar) block is shown in Figures 4, 5, and 6. The needle and syringe are introduced just above the lower orbital rim temporally and are carried straight back in line with the orbital apex while the patient is encouraged to look well up and nasally.

To make it easier for the patient to concentrate, we ask one of the circulating nurses to stand at the patient's head and wiggle her fingers. The patient is encouraged constantly to watch the wiggling fingers. When the needle is felt to touch bone, (Figure 4, position 1), it is tilted up, aimed more directly at the apex, and introduced well toward this target for about 1-1½ inches. (Figure 4, position 2.) The needle should be traveling between the rectus inferior and rectus lateral muscles. (Figure 5.)

A small amount of anesthetic solution is injected as the needle progresses. This is to push away any fiber or vessels that may come into contact with the end of the needle as it heads toward the retrobulbar compartment and muscle cone. When the needle has penetrated for 1-1½ inches,
the plunger is retracted; this is done to assure that the needle has not penetrated the lumen of a vessel.

A dosage of 3-5 ml of anesthetic solution is then injected into the retrobulbar compartment. The bulk of the solution is injected close to the ciliary ganglion. (Figure 4, position 2; Figure 6.)

After the injection, intermittent pressure is exerted on the globe for about five minutes. (Figure 7.) The patient is then instructed to open his eyes and look up, down, right, and left. The blocked eye should be quite stationary while the opposite eye moves freely in all directions. If this is not achieved, pressure may be exerted for a few more minutes; if the result is still inadequate, more of the anesthetic agent, 1-2 cc, should be injected.

Intraocular pressure should be definitely sub-normal. If there is any doubt about this, a sterile tonometer should be used and enough further pressure should be exerted to achieve real hypotony. In the rare event that orbital bleeding should occur, surgery must be postponed.8

Complications

Local complications of retrobulbar block include: retrobulbar hemorrhage, central retinal artery occlusion, intravascular injection of the local anesthetic, optic nerve neuropathy and atrophy, and perforation of the globe.

The most common complication of the retrobulbar block is hemorrhage. It is likely that most of these complicating hemorrhages result either from trauma to the inferior oblique muscle or puncture of a deep vessel by a needle that is too sharply tipped. “Retrobulbar hemorrhage following puncture of an orbital vessel may result in proptosis. This may be avoided by injecting a small amount of anesthetic agent ahead of the needle as it advances to push blood vessels away, and also by using a blunt pointed needle.”9

Goldsmith (1967), and the team of Kraushar, Scefenfreud, and Freilich (1974) reported on central retinal artery occlusion following retrobulbar hemorrhage.10,11 In the presence of proptosis intraocular surgery must be postponed.

The intravascular injection of the anesthetic agent may produce severe systemic reactions. This can be avoided by aspirating to make sure that the needle is not in an artery or a vein before any anesthetic agents are injected.

Meyers and associates (1976) reported two cases of grand mal seizures following retrobulbar block. These cases were controlled by an intra-
venous barbiturate (Sodium Pentothal®) and/or diazepam. Meyers and associates are quick to point out the rare occurrence of convulsive seizures in their search of the literature.12

Trauma to the optic nerve has been reported on some occasions by operators who have pierced the muscle sheath and outer fibrous layer of the optic dura and nerve. Patients will usually complain of light flashes or tiny lights moving quickly in their field of vision. When this occurs the needle should be withdrawn and an alternative anesthetic technique should be chosen. Optic neuropathy and atrophy have been reported.13

Ramsay and Knobloch (1978) reported on three cases in a series of 4,000 retinal detachment cases of perforation of the globe following retrobulbar injection. “A major contributing factor in all cases was the presence of significant myopia. Myopic eyes are more susceptible to perforation because of their increased anteroposterior diameter and thinner sclera as compared to emmetropic or hyperopic eyes.”14

Postoperative treatment

The cataract patient is seen the first postoperative day by a member of the anesthesia department. If required, the patient will receive satisfactory analgesics for control of eye pain the night of the surgical day. As reported by Carolan and associates (1974) and Thornburn (1976) those patients who receive bupivacaine or etidocaine as their anesthetic agent are, for the most part, pain-free the first 8-12 hours following surgery. As previously reported, a large percentage of those patients are pain-free.3,5

If an intraocular lens has been implanted to replace the cataract lens, the patient may receive other medications in the postoperative period to control the body's reaction to its new lens. Typical of these medications are Maxitrol® and scopolamine hydrobromide (Isopto-Hyoscine®).

Cataract patients are usually ambulated the first postoperative day and are released the morning of the third day from the hospital.

Conclusion

Selection of a long acting amide-type local anesthetic for the performance of the retrobulbar block as it relates to the cataract patient is a must. To master the technique of orbital (retrobulbar) block the CRNA must have a full knowledge of the anatomy and physiology involved together with the associated clinical complications.

For the past seven years, CRNAs have been performing the orbital block at our hospital. The CRNA is involved with the cataract patient from the initial visit the night before surgery, until his discharge from the hospital. That special closeness to the patient and the all important surgical team spirit make a significant contribution to a successful operation and recovery.

REFERENCES


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