

# Intramuscular Injection of Anesthetic Agent into the Left Lateral Rectus Muscle during Retrobulbar Anesthesia

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**Purpose:** Strabismus is a well-recognized complication of retrobulbar anesthesia, which is used in cataract surgery. It often manifests as paresis, and sometimes as contracture in its late stages.

**Case summary:** Herein, we report the case of a patient with left lateral rectus paresis that was caused by intramuscular injection of an anesthetic agent to induce retrobulbar anesthesia. The presenting symptom was diplopia, which increased on left lateral gaze, and which had completely recovered after conservative treatment using steroids.

**Conclusions:** In cases of such retrobulbar anesthesia-related strabismus, patient management is tailored to individuals.

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**Key Words:** Intramuscular injection of anesthetic agent; Lateral rectus; Retrobulbar anesthesia; Strabismus after retrobulbar anesthesia

Strabismus after cataract surgery is a well-recognized complication of retrobulbar anesthesia. Extraocular muscle damage is the most common cause, and the inferior rectus is one of the most frequently implicated muscles, probably because of its anatomical location.<sup>1</sup> However, damage to the lateral rectus, inferior oblique, and even superior rectus muscles can occur.<sup>2</sup>

The damage may be due to direct trauma from the needle or bridle suture, or it may be the result of myotoxicity caused by the local anesthetic or by subconjunctival gentamicin injection.<sup>3</sup> In some cases, paresis may persist, whereas in others, the initial muscle damage may be followed by muscle fibrosis and overaction.<sup>4</sup>

Herein, we report the case of a patient with left lateral rectus paresis that was caused by intramuscular injection of an anesthetic agent to induce retrobulbar anesthesia; orbital magnetic resonance imaging (MRI) was carried out immediately after diagnosis. The patient had left lateral gaze limitation with diplopia, which had completely recovered within 4 weeks of conservative treatment.

## CASE REPORT

A 25-year-old woman visited our clinic (Konkuk University Medical Center, Seoul, Korea) complaining of decreased visual acuity in the left eye; the symptom had persisted for several months. She had a history of hypertension and proliferative diabetic retinopathy, but not of strabismus. Her initial best corrected visual acuity values were 20/20 and 20/40 in the right and left eye, respectively, while her intraocular pressure (IOP) measurements were 20 mmHg in the right eye, and 21 mmHg in the left eye. Fundus examination of the left eye revealed that an epiretinal membrane

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had formed on the posterior pole, and that vitreous hemorrhage had occurred. Therefore, we decided to perform a pars plana vitrectomy (PPV) using retrobulbar anesthesia.

We used a 23-gauge, 35-mm retrobulbar needle to inject a 1:1 mixture of 4% lidocaine and bupivacaine into the inferotemporal quadrant of the orbit. We then carried out a successful PPV, during which no bridle suturing was performed, and no subconjunctival gentamicin was injected.

On the second post-operative day, binocular horizontal diplopia was noted. Orthoptic evaluation showed a left esotropia of 30 prism diopters in the primary position; the esotropia increased on left lateral gaze (Table 1). There was no abnormal head posture, ptosis, anisocoria, or diurnal variation. An ocular motility evaluation revealed a -3 limitation (on a scale of -1 to -4; Fig. 1). A forced duction test for left lateral gaze, which was performed under topical anesthesia, was negative. However, a force-generation test for lateral gaze-also conducted under topical anesthesia-revealed a weak tug in the left eye. The remainder of the eye examination was normal. General physical and

systemic neurologic examinations were within normal limits. We then used MRI to image the brain and orbit; this revealed swelling of the lateral rectus muscle with T2 hyperintensity (Fig. 2). The swelling had likely been caused by the intramuscular injection of anesthetic agent. On this basis, we diagnosed left-eye lateral rectus paresis due to intramuscular injection of anesthetic agent.

On the third day after surgery, the patient began taking oral prednisolone (50 mg; 1 mg/kg)-with a tapering schedule-to reduce inflammation and fibrotic change in the left lateral rectus muscle. During steroid use, her blood sugar level was carefully controlled by an internist. The patient was encouraged to move her eyeball to the left lateral side to protect against muscle contraction. At the 2-week follow-up, the patient reported an improvement in symptoms. Four weeks after surgery, she had orthotropia in all directions, and extraocular motility had returned to normal without any remaining complications (Fig. 3).

## DISCUSSION

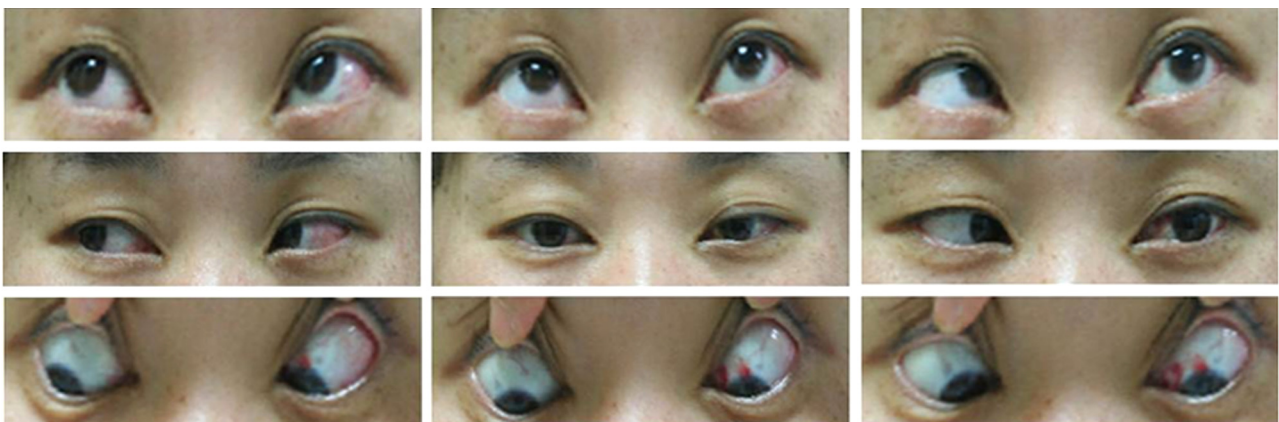
Retrobulbar anesthesia is routinely used in ocular surgery. However, serious complications can occur, such as scleral perforation, retinal embolization, necrosis of the eyelids and sclera, central retinal artery occlusion, and strabismus.<sup>4</sup> The muscle dysfunction that occurs after retrobulbar anesthesia may be the result of myotoxicity of local anesthesia,<sup>3</sup> direct trauma to the muscle belly caused by the injection needle,<sup>5</sup> or Volkmann's ischemic contracture-which occurs because local anesthetics are injected intramuscularly.<sup>6</sup>

**Table 1.** Orthoptic evaluation of the patient on the second post-operative day

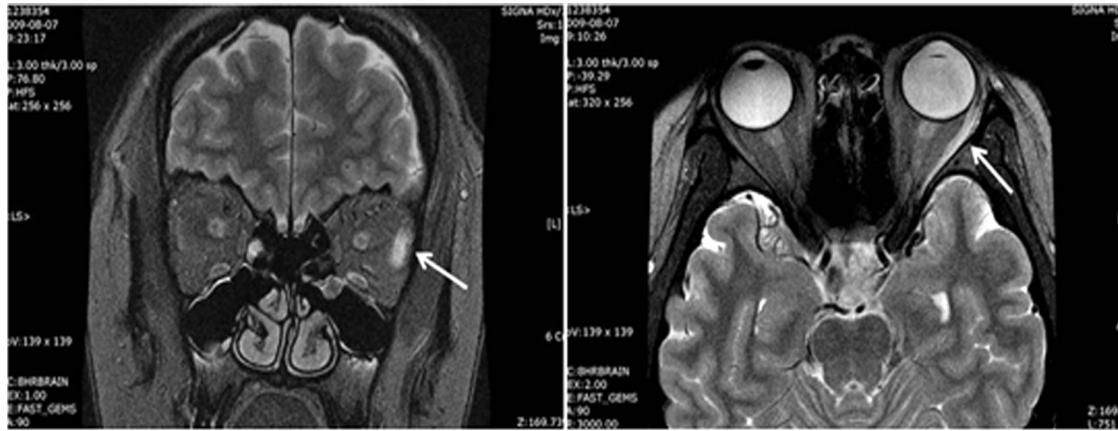
Near		Distant	
	35 LET		30 LET
orthophoria —	35 LET — 50 LET	orthophoria —	30 LET — 50 LET
	35 LET		30 LET

Left esotropia of 20 prism diopters was evident in the primary position; this increased on left lateral gaze. Measurements are in prism diopters.

LET = left esotropia.



**Figure 1.** Motility examination 1 day after retrobulbar anesthesia: patient shows left esotropia in the primary position; this increases during left gaze and decreases during right gaze.



**Figure 2.** MRI in the coronal plane (A) and axial plane (B) shows a T2-hyper-intense signal in, as well as swelling of, the left lateral rectus muscle (arrow). MRI = magnetic resonance imaging.



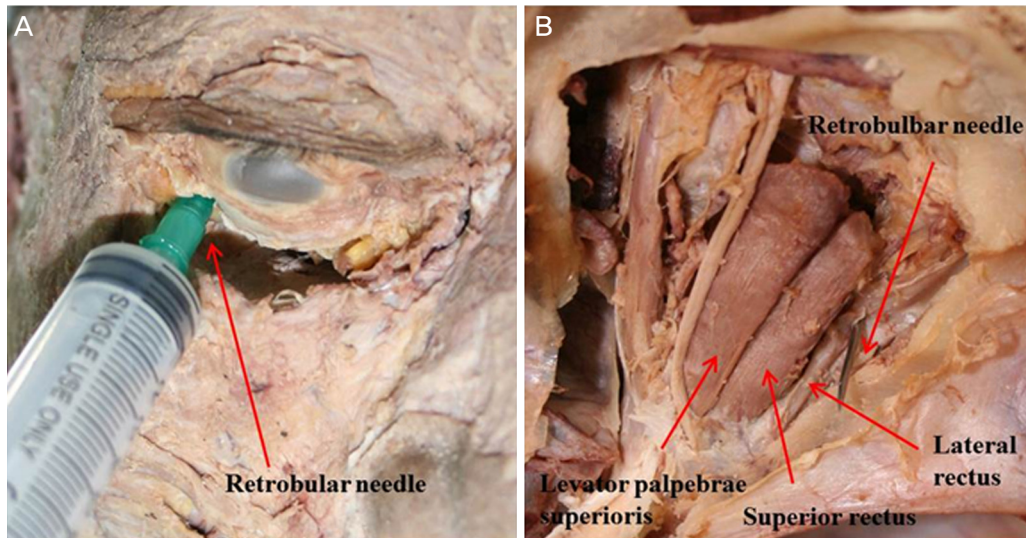
**Figure 3.** Motility examination 4 weeks after retrobulbar anesthesia: patient shows orthotropia in all directions, as well as normalized extraocular motility.

Herein, we have reported a case of lateral rectus paresis caused by the intramuscular injection of anesthetic agent; the paresis improved after systemic steroid treatment, with no further complications. That is, we have shown that muscle damage caused by intramuscular injection of anesthetic can be reversible. Left lateral gaze limitation after retrobulbar anesthesia is highly suggestive of strabismus caused by intramuscular injection of an anesthetic agent, particularly when combined with a high density T2 image of the left lateral rectus muscles. Negative forced duction testing, combined with the absence of suggestive soft tissue signs, can rule out thyroid eye disease. Also, in our patient, extraocular motility returned to the normal range after 2 weeks. This finding, combined with the absence of diurnal variation or other suggestive symptoms such as ptosis, excluded myasthenia gravis.

The inferior rectus is the muscle most commonly af-

fected by retrobulbar anesthetic injection;<sup>1</sup> the lateral rectus muscle is involved quite rarely by comparison. However, lateral rectus muscle involvement after inferotemporal injection has been reported,<sup>7</sup> and in our the present case, we used an inferotemporal injection site. Therefore, the lateral rectus may have been severely damaged by the needle, or by the local anesthetic agent, in our case. To elucidate whether the lateral rectus can be injured at the time of injection, we simulated retrobulbar anesthesia on eleven cadavers and then performed orbital dissections. We found that direct needle injury to the lateral rectus is indeed possible during retrobulbar anesthesia (Fig. 4).

In 1985, Rainin and Carlson reported that experimental injection of 0.75% bupivacaine (Marcaine) into the human extraocular muscles at the time of cataract surgery often produced post-operative strabismus.<sup>3</sup> In 1992, the same authors reported, with their coworkers, that experimental in-



**Figure 4.** Orbital dissections with simulated retrobulbar anesthesia were performed on cadavers to ascertain whether the lateral rectus could be injured at the time of injection. (A) Local anesthetic is injected into the retrobulbar space through the inferior-temporal palpebral area. (B) Cadaveric dissections show that the needle can indeed cause injury to the lateral rectus during retrobulbar anesthesia.

jection of either lidocaine (Xylocaine) or bupivacaine into monkey or human extraocular muscles caused extensive damage, sometimes even destroying the muscle fibers throughout most of the cross section of the muscle.<sup>8</sup> The fibers often regenerated in young monkey muscles, but in the two elderly humans studied, surgical specimens one week after the injection showed only scar tissue beginning to form. The authors opined that younger extraocular muscles tend to regenerate and recover, whereas older muscles regenerate poorly and are replaced by fibroblasts, eventually leading to contracture. Consistent with their suggestion, our young (25-year-old) patient recovered without any restrictions to ocular motility. This suggests that the age of the patient is an important prognostic factor for recovery.

As a conservative treatment, our patient received oral prednisolone to reduce inflammation and fibrotic change in the left lateral rectus muscle. Steroids are used routinely by many surgeons to reduce inflammation and fibrosis after ophthalmic surgical procedures.<sup>9,10</sup> For instance, patients with persistent diplopia after an episode of orbital myositis—a non-specific orbital inflammatory syndrome involving one or more of the extraocular muscles—are typically managed using steroids. Furthermore, with regards to glaucoma, clinicians often consider using steroids to reduce post-operative inflammation and fibrotic change after filtration surgery. In our case, to avoid further muscle trauma,

we chose not to carry out subconjunctival or intramuscular steroid injection. Instead, we administered systemic steroids to reduce inflammation and fibrotic change in the left lateral rectus muscle. To ascertain the ability of systemic steroids to reduce inflammation and fibrotic changes in the extraocular muscles after trauma, further prospective *in vivo* studies will be necessary.

To reduce the myotoxicity of local anesthesia, several investigators have used hyaluronidase in the retrobulbar injection. Specifically, this substance disperses the local anesthetic agent more quickly; this may allow a lower volume of anesthetic agent to be used, and may reduce high concentrations more quickly, providing protection from local anesthetic myotoxicity.<sup>11</sup> Also, using blunt cannula techniques to administer local anesthetics via sub-Tenon's infusion not only reduces the chance of retrobulbar hemorrhage, but also significantly lessens the risk of strabismus caused by local anesthetic agents.<sup>12</sup> Furthermore, operators need to be aware that one of the warning signs during retrobulbar anesthesia is pain. Direct injection into the extraocular muscle is typically associated with significant pain; this should signal the anesthetist or ophthalmologist to stop the injection.<sup>13</sup> Future studies should focus on more safe and uncomplicated methods of local anesthesia for ophthalmic surgery.

To summarize, it is important that ophthalmologists are



aware of strabismus as a complication of retrobulbar anesthesia. Patients receiving retrobulbar anesthesia should be informed of the potential adverse effects of the procedure, such as ocular motility disorder or strabismus. It is also important to note that the lateral rectus muscle may be involved, and that MRI is a useful diagnostic tool. Steroid treatment may reduce inflammation and fibrotic change in the extraocular muscle. Besides that, the age of a patient may be another important prognostic factor for recovery.

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