Sub-Tenon’s Infusion of Local Anesthetic for Strabismus Surgery

Mark A. Steele, MD
Judith B. Lavrich, MD
Leonard B. Nelson, MD
Harold P. Koller, MD

ABSTRACT
We used a blunt irrigating cannula to infuse tetracaine 0.5% solution into the posterior sub-Tenon’s space in 26 consecutive patients undergoing strabismus surgery under local anesthesia. All patients were sedated with combinations of fentanyl citrate and either propofol or midazolam. The results suggest that this technique is a safe and effective method of performing strabismus surgery under local anesthesia.

The use of topical anesthesia for strabismus surgery was described over a century ago.1 Despite adequate sedation, the ocular pain or “pressure” sensations patients undergoing strabismus surgery with topical anesthesia often experience are quite uncomfortable.2 More complete ocular anesthesia has been obtained with retrobulbar and peribulbar anesthetic injections.3-7 Such injections, however, are not without morbidity. Ocular complications of retrobulbar injections include globe perforation, retrobulbar hemorrhage, retinal vascular occlusion, optic nerve injury, and contralateral amaurosis.8-14 Globe perforations during peribulbar injections have been reported as well.15

We studied the safety and effectiveness of achieving local anesthesia during strabismus surgery on a sedated patient by using a blunt cannula to infuse anesthetic solution into the retrobulbar space.

MATERIALS AND METHODS
We prospectively studied 26 consecutive patients, 17 to 80 years old, who underwent strabismus surgery from August 1990 to December 1990 using the anesthetic technique described below. These patients were sedated preoperatively with intravenous fentanyl citrate (1.0 to 2.0 μg/kg of body weight). All of them received nasal oxygen and cardiac monitoring, including a pulse oximeter, throughout the procedure. An anesthesiologist maintained appropriate sedation with either a continuous infusion of intravenous propofol (loading dose of 1.0 to 1.5 mg/kg, followed by a continuous infusion of 1.5 to 3.0 mg/kg of body weight/hr) or an intermittent intravenous injection of midazolam (1.0- to 2.5-milligram boluses).16-17 Some patients received additional boluses of fentanyl citrate 0.5 μg to maintain adequate levels of sedation.

The dosages administered were based on the patient’s weight, age, and general health. Appropriate sedation is difficult to quantify; nevertheless, the sedative agents were titrated by the anesthesiologist so that the patient appeared relaxed yet was alert enough to react purposefully to verbal stimulation.

A drop of tetracaine 0.5% was instilled in the lower
cul-de-sac of the operated eye. No facial nerve block was used. A Lancaster lid speculum was inserted, a corneal light shield was placed on the cornea, and an additional drop of tetracaine 0.5% was instilled topically on the conjunctiva in the quadrant to be incised. Either a limbal or fornix incision was made through conjunctiva and layers of Tenon’s capsule to expose bare sclera. Through this incision, a 21-gauge irrigating cannula on a 3-cc syringe filled with tetracaine 0.5% solution was placed in the sub-Tenon’s space on bare sclera (Figure A). The cannula tip was directed posteriorly in the direction of each muscle to be operated upon, so that only the proximal third of the 21-millimeter cannula was exposed. The anesthetic solution was then infused into the retrobulbar space until reflux of the solution was noted at the incision site (usually after infusion of 0.75 to 1.00 cc of solution).

Ten minutes was allowed to elapse before proceeding with the planned surgical procedure. A supplemental infusion into the sub-Tenon’s space was given if the patient had any discomfort.

At the conclusion of surgery, a member of the surgical team (M.A.S. or J.B.L.) graded the patient’s discomfort during the surgery as either absent, mild, moderate, or severe. “Mild discomfort” was used to denote what appeared to be a pulling sensation, sometimes accompanied by slight pain; “moderate discomfort” was used to indicate occasional moderate pain, while “severe discomfort” was used to describe what appeared to be an intolerable level of pain. In the recovery room, approximately 15 minutes after the procedure, the patient was asked to grade the operative discomfort using the same terminology.

RESULTS

Twenty-six consecutive patients were studied. The first 11 received intravenous propofol intraoperatively. The subsequent 15 received intravenous midazolam intraoperatively.

Twenty patients underwent single-muscle surgery, and six underwent surgery on two of the extraocular muscles. Nine previously had had strabismus surgery performed on the operated eye.

The degree of discomfort as graded by the physician or the patient did not correlate with the type of strabismus operation performed or the number of extraocular muscles undergoing the procedure. Nor was there any correlation between the age of the patient and the level of discomfort.

Figure B shows the number of patients receiving either propofol or midazolam who experienced each of the degrees of discomfort as graded by the physician during the procedure and by the patient approximately 15 minutes after the procedure. No patient experienced “severe discomfort” as graded by the physician or the patient. The two patients who experienced “moderate discomfort” as judged intraoperatively by the physician, postoperatively reported no discomfort when questioned in the recovery room. Of the 11 patients who experienced “mild discomfort” as judged by the physician intraoperatively, 7 (64%) claimed to have had no discomfort and 4 (36%) claimed to have had only mild discomfort.

There were no intraoperative or postoperative complications.

DISCUSSION

Safe and effective local anesthesia can be accomplished using a blunt cannula to infuse tetracaine 0.5% solution into the sub-Tenon’s space. Hansen and coworkers used this method to deliver a lidocaine and bupivacaine mixture in the retrobulbar space for patients undergoing cataract surgery. An ester-type anesthetic was chosen for this study, since it has known topical anesthetic efficacy, rapid onset, and relatively
short duration, thus permitting its use for "same day" adjustable suture cases. Tetracaine 0.5% rather than proparacaine 0.5% was selected, since it is available in single-dose sterile containers without preservative and thus may have less surface toxicity.

Administering anesthesia without using a sharp needle virtually eliminates the risk of vascular laceration and optic nerve injury such as have been reported as complications of retrobulbar injections. Scleral perforation, which has been reported to occur with both retrobulbar and peribulbar injections, is similarly avoided.

The variable anesthesia occurring when traction was placed on the extraocular muscle is probably due to the differential posterior diffusion of the anesthetic solution among the patients studied. Even in the presence of total topical anesthesia, anterior traction on the muscle can result in a painful "pulling" sensation if the sensory innervation to the more proximal portions of the muscle closer to the annulus of Zinn is not adequately blocked. In preliminary trials, this sensation always occurred when we did not wait 10 minutes after infusing the anesthetic solution. Waiting allows the anesthetic to diffuse posteriorly in the retrobulbar space.

In all patients pupillary mydriasis was noted between 1 and 5 minutes after the anesthetic infusion. This is strong evidence that anesthetic diffused posteriorly into the retrobulbar space. The anesthetic solution no doubt blocks the short posterior ciliary nerves in the posterior sub-Tenon's space which carry the parasympathetic fibers innervating the iris sphincter muscle.

It is also conceivable that the anesthetic solution diffuses posteriorly through the posterior Tenon's capsule into the muscle cone. Once there, the anesthetic can block the ciliary ganglion and nerves to the extraocular muscles. Although we did not formally test it, we noted a marked akinesia of the globe in the direction of the quadrant infused with the tetracaine solution.

Despite apparent infusion of the anesthetic into the retrobulbar space, 11 (42%) of the patients still sensed an intraorbital "pulling" sensation, often accompanied by some pain (graded by the physician as "mild discomfort") when a muscle hook was placed under the muscle. Two (8%) of the patients seemed to experience moderate pain (graded by the physician as "moderate discomfort") at this point in the procedure. This sensation always ceased when the muscle was disinserted from the globe. Reducing the traction on the muscle hook at this point was helpful in minimizing this discomfort.

As expected, the surgeon's estimation of the degree of patient discomfort was usually higher than the patient's own retrospective estimation in the recovery room. This differential was probably due to the desired retrograde amnesic properties of both propofol and midazolam. As the data in Figure 3 suggest, midazolam may provide better retrograde amnesia than propofol. For most patients, adequate sedation is a necessary adjunct to local anesthesia, since even seemingly stoic patients often become apprehensive intraoperatively. We now prefer to use midazolam rather than propofol injections, since several patients sedated with the latter agent became extremely disoriented intraoperatively, forcibly moving their head about, despite instructions to remain motionless. Additionally, many of the anesthesia staff members prefer midazolam, since it is more easily titrated to appropriate sedation levels. Finally, using propofol requires preparation of the emulsion for use in a continuous infusion pump, a task that some find to be a nuisance that can simply be avoided by using midazolam.

One side effect of the anesthetic infusion into sub-Tenon's space was that Tenon's capsule and the conjunctiva became edematous. However, this did not interfere with the surgical procedure.

In a sedated adult patient, the infusion of tetracaine 0.5% via a blunt cannula in the sub-Tenon's space is a safe and effective alternative to using retrobulbar and peribulbar injections to obtain local anesthesia during strabismus surgery. Further investigation of the potential benefits of mixing hyaluronidase with the anesthetic solution are warranted. Theoretically, doing so would permit more complete diffusion of anesthetic into the retrobulbar space and thus possibly eliminate the mild discomfort that some of the patients in this study experienced.

Also, future investigations may demonstrate that the use of amide-type agents such as lidocaine and mepivacaine may be more effective anesthetics than tetracaine when infused via this sub-Tenon's approach. Theoretically, this approach would permit more complete diffusion of anesthetic posteriorly in the retrobulbar space before placing traction on the muscle with the muscle hook.

REFERENCES


