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No-needle sub-Tenon's anesthesia for strabismus surgery

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Objective : *To study the effectiveness and results of sub-Tenon's anesthesia in a group of patients undergoing strabismus surgery.*

Setting : *Operating room, Department of Ophthalmology, Faculty of Medicine, Chulalongkorn University*

Design : *Prospective clinical study*

Patients : *Forty consecutive adult patients who underwent strabismus surgery were enrolled in this study.*

Intervention : *All patients received sub-Tenon's anesthesia using a blunt standard irrigating cannula during the surgery.*

Results : *Twenty-seven of the 40 patients (67.5%) experienced adequate anesthesia with a mild pulling sensation. Eleven patients (27.5%) had excellent anesthesia without any pulling sensation. Only 2 patients had a moderate pulling sensation which required additional anesthetic.*

Conclusion : *This method of sub-Tenon's anesthesia is simple, efficacious and has an excellent safety profile.*

Key words : *Sub-Tenon's anesthesia, Strabismus surgery.*

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สุดารัตน์ ใหญ่สว่าง. การให้ยาชาเฉพาะที่ทางช่องใต้ชั้นที่นอนในการผ่าตัดกล้ามเนื้อตา.
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- วัตถุประสงค์** : เพื่อศึกษาประสิทธิภาพและผลของการใช้ยาชาเฉพาะที่ซึ่งฉีดเข้าทางช่องใต้ชั้นที่นอนในกลุ่มผู้ป่วยตาเหล่ที่ได้รับการผ่าตัดกล้ามเนื้อตา
- สถานที่ทำการศึกษา** : ห้องผ่าตัดตา ภาควิชาจักษุวิทยา คณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย
- รูปแบบการวิจัย** : การศึกษาไปข้างหน้าทางคลินิก
- ผู้ป่วยที่ได้ทำการศึกษา** : การศึกษานี้ได้ทำในผู้ป่วยจำนวน 40 ราย ซึ่งเป็นโรคตาเหล่ และได้รับการรักษาโดยการผ่าตัดกล้ามเนื้อตา
- วิธีการศึกษา-วัดผล** : ผู้ป่วยทั้งหมด ได้รับยาชาเฉพาะที่ฉีดเข้าทางช่องใต้ชั้นที่นอนโดยใช้เข็มฉีดปลายทู่
- ผลการศึกษา** : ผู้ป่วย 27 ราย จากจำนวนทั้งหมด 40 ราย (67.5%) ไม่รู้สึกเจ็บ ในขณะที่ผ่าตัดยกเว้นมีความรู้สึกเวลากกล้ามเนื้อตาถูกดึงเล็กน้อย ผู้ป่วย 11 ราย (27.5%) ไม่รู้สึกเจ็บเลย และมีผู้ป่วยเพียง 2 ราย (5%) ที่รู้สึกเจ็บขณะถูกดึงกล้ามเนื้อตา
- วิจารณ์และสรุป** : การให้ยาชาเฉพาะที่โดยวิธีนี้ทำได้ง่าย ไม่ยุ่งยาก ได้ผลดี และมีความปลอดภัยสูง

Retrobulbar anesthesia is the most common local anesthesia used in various ocular surgeries in adult patients, including strabismus surgery.^(1,2) Although retrobulbar injection is generally safe and effective, serious complications occasionally occur from this very basic ophthalmic procedure.⁽³⁾ Previously reported complications of this technique include retrobulbar hemorrhage,⁽¹⁾ perforation of the globe,⁽⁴⁻⁸⁾ optic nerve injury,⁽¹⁾ retinal vascular occlusion,^(9,10,11) retinal detachment,⁽¹²⁾ Purtscher-like retinopathy,⁽¹³⁾ contralateral amaurosis,⁽¹⁴⁾ respiratory arrest from brain stem anesthesia,⁽¹⁵⁻²¹⁾ central nervous system complications,^(22,23) grand mal seizures,⁽²⁴⁾ ptosis⁽²⁵⁾ and strabismus.⁽²⁶⁻³¹⁾

Peribulbar (periocular) anesthesia was developed as an alternative technique to avoid some of these complications.^(32,33,34) Peribulbar anesthesia consists of one or more injections of local anesthetic around the globe but not directly into the muscle cone. Theoretically, the chance of needle penetration of the globe should thus be reduced. However, many authors have reported cases of needle penetration of the globe occurring with this technique.^(6,8,35) Ocular explosion after peribulbar anesthesia from inadvertent intraocular injection of anesthetic has also been reported.⁽³⁶⁾ Another frequently reported complication is strabismus that might be caused by the myotoxicity of the relatively large volume of anesthetic used in this technique.^(37,38,39) Peribulbar anesthesia has decreased in popularity in the past few years⁽⁴⁰⁾ because of a lower rate of adequate block that

requires multiple injections, and larger doses of anesthetic, which results in a tight orbit. In addition, the onset of blockade is not as rapid as in retrobulbar injection.

To avoid injecting deep into the orbit, perilimbal anesthesia has been advocated for strabismus surgery in cooperative patients.⁽⁴¹⁾ The anesthetic is injected subconjunctivally for 360 degrees around the limbus. The dose of anesthetic used is only 1 ml, thus reducing the chances of toxicity and side effects. In all cases, intravenous sedation and analgesics are given preoperatively with monitored anesthesia care by the anesthesiologist. Therefore, it has limited application.

Topical anesthesia for strabismus surgery has also been used with limitations.^(42,43) The use of topical anesthesia seems to benefit the adult patient in whom an adjustable suture technique is indicated. It allows adjustment of muscle position to achieve the desired alignment at the time of surgery. The major disadvantages are the possibilities of patient discomfort and intolerable levels of pain. This anesthesia technique demands an extremely cooperative patient combined with an experienced surgeon who uses a delicate and gentle surgical technique.

In search of the ideal anesthesia that should be safe, effective and painless, this study reports the use of direct, no-needle sub-Tenon's anesthesia for strabismus surgery. Using a blunt irrigating cannula to infuse the anesthetic with direct visualization around the muscle and into the retrobulbar space through a sub-Tenon's

approach may reduce the complications associated with using a sharp needle to inject in a location where the tip cannot be visualized, as in retrobulbar and peribulbar techniques.

Materials and Methods

Forty consecutive adult patients between 16 and 54 years of age who underwent strabismus surgery were prospectively studied from February 1997 to June 1997 using the anesthetic technique described below. None of the patients received preoperative sedation or any other premedication.

Several drops of proparacaine hydrochloride 0.5% (Ophthetic) were instilled topically into the lower fornix of the eye preoperatively. No facial nerve block was given. During the procedure, the patient was instructed to inform the surgeon if any pain or discomfort was noticed, and the surgeon asked the patient to describe his/her sensation as well.

After the patient was sterilely prepped and draped, a lid speculum was placed and additional drops of Ophthetic were instilled onto the conjunctiva. Either a limbal or fornix incision was performed through conjunctiva and Tenon's capsule to expose bare sclera in the usual manner. Through this incision, a blunt 19-gauge standard irrigating cannula, which was routinely used for corneal irrigation during surgery, was used to infuse 2% lidocaine hydrochloride (Xylocaine) with 1:80,000 Adrenaline into the sub-Tenon's space. The cannula was inserted underneath the Tenon's capsule to infuse the anesthetic solution

around the muscle to be operated on. Then the cannula was advanced further along the globe just beyond the equator, and further solution was delivered into the retrobulbar space. One to 1.5 ml of anesthetic solution was administered at each site. Excess anesthetic solution usually flowed out from the incision site. The conjunctiva and Tenon's capsule became edematous, but this did not interfere with the surgical procedure.

Immediately following infusion of the anesthetic, the pupil began to dilate. Pupillary dilatation can be used as an early clinical sign indicating that the anesthetic has diffused posteriorly into the retrobulbar space. At this time, when the muscle was hooked, most of the patients sensed a painful pulling sensation. It usually took approximately 10 minutes for the onset of effective anesthesia, where upon the muscle was hooked without or with a mild pulling sensation. In the meantime, the surgeon could proceed with other surgical steps with the exception of traction on the muscle.

In the case of surgery to more than one muscle in the same eye, muscles subsequent to the first required only a small volume of anesthetic infused around them. If the patient felt pain or discomfort during surgery, additional anesthetic was given using the same technique.

At the end of the procedure, grading of anesthesia during surgery in each patient was evaluated by the surgeon using the criteria as shown in Table 1.

Table 1. Grading criteria for anesthesia.

Grade	Description
0	Anesthesia inadequate to proceed
1	Anesthesia adequate to proceed with moderate pulling sensation
2	Anesthesia adequate to proceed with mild pulling sensation
3	Total anesthesia, no pulling sensation

Results

Eleven patients in this study underwent single muscle surgery. Fourteen patients underwent surgery on two muscles in the same eye and another twelve patients in both eyes. Three patients underwent three muscles surgery in both eyes. In all cases, no complications from anesthesia occurred.

For some patients who underwent two or three muscles surgery, the degree of pain and discomfort differed in each muscle. In these cases, only the lower grade of anesthesia was recorded as their results.

Twenty-seven of the 40 patients (67.5%) experienced adequate anesthesia with mild pulling sensation. Eleven patients (27.5%) had excellent anesthesia without pulling sensation. Only 2 patients had moderate pulling sensation and required additional anesthetic. The grading of anesthesia during surgery is summarized in Table 2.

Table 2. Results of sub-Tenon's anesthesia in 40 patients.

Grade	Number of patients
0	0
1	2 (5%)
2	27 (67.5%)
3	11 (27.5%)

Discussion

The ideal anesthesia for ocular surgery including strabismus surgery should be efficacious and safe. Retrobulbar and peribulbar anesthesia have proved to be effective and relatively safe over many years of use.^(33,34) Despite the advantages of retrobulbar and peribulbar anesthesia, rare but significant complications have been reported. Most of the significant complications such as globe perforation, retrobulbar hemorrhage, direct injection into the central nervous system,

optic nerve injury were caused by mechanical injury from the sharp or relatively sharp needle that was blindly passed into the orbit to administer the anesthetic. In an attempt to minimize these complications, a direct, no-needle sub-Tenon's anesthesia is used instead of these techniques.

Sub-Tenon's infusion of anesthesia was first reported by Mein and Flynn in 1989.⁽⁴⁴⁾ They used this technique as a method of augmenting retrobulbar anesthesia during long ocular procedures such as scleral buckling and pars plana vitrectomy. In 1990, Hansen and coworkers⁽⁴⁵⁾ reported using this technique as the primary method of achieving local anesthesia for cataract surgery. Modifications of this technique used in various ocular procedures have been reported with fewer potential anesthetic complications and excellent anesthesia.^(46,47,48)

The sub-Tenon's anesthesia technique is easy for every ophthalmic surgeon to perform. It does not require the surgeon to learn new anatomical landmarks, new surgical techniques and new instruments. The blunt 19-gauge cannula of Bishop-Harmon style used to infuse the anesthetic solution is the same as the one used to irrigate the cornea with balanced salt solution during surgery. Some surgeons prefer a 21-gauge cannula.⁽⁴⁶⁾ I find that a 19-gauge diameter cannula is suitable for delivery of sub-Tenon's anesthetic in strabismus surgery, because it allows a relatively free flow of the solution without any tissue resistance.

Many investigators have described modifications of this cannula. Stevens⁽⁴⁹⁾ designed a 19-gauge cannula with a gently curved shaft to facilitate movement along the contour of the globe. Fukasaku⁽⁵⁰⁾ named his sub-Tenon's anesthesia technique as pinpoint anesthesia, and used a specially designed 24-gauge, curved cannula for cataract surgery. Another modification is the Conner sub-Tenon's retrobulbar cannula (Storz ophthalmics). This 23-gauge cannula has a rounded tip with three side ports for a multidirectional spray to provide an even and diffuse distribution of anesthetic within the muscle cone. He suggests slowly spraying the anesthetic solution in order to lessen pain and discomfort to the patient during delivery of the anesthetic.

Sub-Tenon's anesthesia is more appropriate for strabismus surgery than other ocular surgery. The conjunctival and Tenon's incision to expose bare sclera that is used to infuse the anesthetic, is a routine step in strabismus surgery. Though excellent anesthesia is achieved with this technique, akinesia is usually incomplete.⁽⁴⁷⁾ However, akinesia is not necessary in strabismus surgery.

The pupil begins to dilate immediately following infusion of the anesthetic and reaches its maximal dilatation within 5 minutes. This signifies blockade of the short ciliary nerves that carry the parasympathetic fibers innervating the iris sphincter. At least 10 minutes is allowed for

the anesthetic to diffuse posteriorly in the retrobulbar space to achieve adequate anesthesia and akinesia. Akinesia is noted to have a slower onset. This technique provides excellent anesthesia but less effective akinesia, because there is a higher concentration of anesthetic in the anterior orbit adjacent to the globe where the long ciliary nerves enter the back of the globe. In contrast to retrobulbar anesthesia, where the higher concentration of anesthetic is in the posterior orbit and anesthetizes nerves to the extraocular muscles at the muscle cone. Good akinesia may result, but less anesthesia.⁽⁵⁰⁾

In spite of good diffusion of anesthetic into the retrobulbar space with adequate anesthesia, some patients still felt an uncomfortable pulling sensation when a muscle was hooked and manipulated. Additional topical anesthetic drops or infusion of a top-up of the anesthetic solution may minimize this discomfort. This pulling sensation is produced at the origin of the muscle. Care must be taken to ensure gentle manipulation, thereby exerting very little traction on the muscle, and to use less time to perform this part of the procedure. Patients receiving retrobulbar anesthesia may experience this pulling sensation as well.⁽⁴¹⁾

The only noted side effect of the sub-Tenon's anesthetic infusion was the conjunctiva and Tenon's capsule edema, but the surgery could proceed without difficulty. The edema had almost disappeared by the end of the surgery.

The risks of anesthesia are a concern to both the surgeon and the patient. This type of anesthesia can be used with safety in strabismus surgery and in all ocular surgeries. I believe that sub-Tenon's anesthesia may eliminate many of the complications from anesthesia that have concerned us for a long time.

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