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EC OPHTHALMOLOGY
Research Article

Effectiveness of Bilateral Sequential Sub-Tenon's Block for Cyclovertical Strabismus Surgery in Adults

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Received: October 22, 2021; **Published:** November 16, 2021

Abstract

Purpose: The aim of this study is to evaluate the efficacy of bilateral sequential Sub-Tenon's block (STB) during bilateral cyclovertical strabismus surgery in adults.

Patients and Methods: Sixteen adult patients (32 eyes) underwent bilateral cyclovertical strabismus surgery using bilateral sequential STB. Intraoperative akinesia, anesthesia, and occurrence of oculo-cardiac reflex were evaluated. Postoperative analgesia, nausea and vomiting (PONV) were recorded. Pre and postoperative orthoptic examinations were performed.

Results: At 5-minute post injection, adequate akinesia was achieved in 28 (87.50%) eyes. The blockage of pulling sensation was adequate in all eyes. The mean pain score after 5 minutes of injection was 0.58 ± 0.66, and postoperative pain score was 0.23 ± 0.35. The median interquartile range (IQR) surgeon satisfaction score was 10/2. No intra- or postoperative complications were recorded. No patient required additional injection of local anesthetic. Orthoptic results were acceptable.

Conclusion: Bilateral STB is an effective method of anesthesia for bilateral cyclovertical strabismus surgery in adult patients with excellent surgeon satisfaction.

Keywords: *Anesthesia; Squint Surgery; Extraocular Muscle; Oblique Muscle*

Introduction

General anesthesia remains the gold standard in strabismus surgery [1,2]. However, it can be associated with increased risk of postoperative complications which range from minor ones like nausea and vomiting to more serious life-threatening complications. Additionally, the potential lack of resources in remote public health services may limit the access to general anesthesia.

Regional anesthesia including retrobulbar, peribulbar, and episcleral block is frequently used as a safe and effective alternative to general anesthesia in many ophthalmic surgeries. Due to its more desirable safety profile, the sub-Tenon episcleral block technique (STB) became a potential alternative to needle-based blocks. Although its use has been described as early as the 1880s [3], there is insufficient literature on STB in strabismus surgery. Most reports limit its use as adjunctive to general anesthesia in pediatric strabismus surgery or in adult patients of high-risk characteristics or undergoing monocular surgery [4-8].

Purpose of the Study

The purpose of this study was to evaluate the effectiveness and safety of STB in bilateral cyclovertical muscle surgery in adults aiming to expand its use in strabismus surgery to include bilateral and complex cases.

Materials and Methods

This prospective study, conducted at the Research Institute of Ophthalmology, was approved by the local Ethics Committee and adhered to the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants. Inclusion criteria included age ≥ 20 years, and presence of cyclovertical strabismus mandating bilateral surgery.

Exclusion criteria included patients with previous conjunctiva involving surgery such as strabismus surgery, scleral explant, trabeculectomy or conjunctival biopsy. Patients allergic to the anesthetic agents and children younger than 20 years were excluded from the study. Preoperative general examination was performed, and patients were classified according to the American Society of Anesthesiologists (ASA) score and New York Heart Association (NYHA) grade. Complete eye examination and measurement of preoperative and postoperative ocular alignment were performed.

Sub-tenon injection technique

An intravenous line, oxygen nasal cannula, cardiac monitoring and continuous pulse oximetry were secured. The nasal cannula delivered oxygen at a rate of 3 L/min. Then the patient received 0.03 mg of fentanyl, 2 mg of dormicum and 20 mg of propofol for sedation before carrying out the block. Hemodynamic data including heart rate, mean arterial blood pressure, respiratory rate, and O_2 saturation (SPO_2) were recorded during the surgery starting after 5 min after anesthesia and then every 15 minutes till the end of surgery.

All surgeries were performed by one experienced surgeon (A.H) and in a standardized protocol.

Following prepping and draping both eyes, local anesthetic eye drops (benoxinate) and topical povidone-iodine 10% were applied to the conjunctival sac. A minimal limbal conjunctival peritomy is performed by the operating surgeon according to the location of the muscle to be operated upon, a blunt 19-gauge cannula was used to irrigate lidocaine 2% (2 ml) mixed with bupivacaine 0.5% (2 ml) and 1 ml hyaluronidase (150 unit/ml) in 5 ml sterilized syringe in the sub-tenon space close to the operated area. The initial periotomy is extended to complete the surgery. After completion of surgery on one side, the same steps are performed on the other eye.

Intra and postoperative assessment

A 12-point score was used to assess the degree of akinesia as 0 (no movement), 1 (partial), 2 (flicker), 3 (full movement) for the four recti muscles, done every 2 minutes until the best akinesia score. A score of 4 or less was considered adequate for surgery. The time of onset was defined as the time passed from the end of injection to the best akinesia score (score 4 or less). At this point, the targeted muscle is hooked and the blockage of pulling sensation was graded as 0 (no pulling sensation), 1 (adequate to proceed), or 2 (inadequate to proceed).

Intraoperatively (at 10 minutes from onset of akinesia in each eye) and immediately after surgery (for the whole surgery), patients were asked to grade pain using a verbal rating scale from 0 (no pain) to 10 (worst pain). Postoperative nausea and vomiting were assessed using a numeric scoring (0 = no nausea; 1 = nausea is present, but no vomiting; 2 = vomiting once within 30 min; 3 = vomiting two or more times within 30 min). Duration of surgery was recorded for each eye. The presence or absence of an oculocardiac reflex (defined as at least 15% decrease in heart rate detected by continuous electrocardiography) was recorded for every patient.

Surgeon satisfaction was graded on a Visual Analog Scale (VAS) 0 - 10 (0 = no anesthesia-related factors inducing added difficulty of the procedure and 10 = anesthetic factors contributing significantly to the difficulties experienced during surgery). Any anesthetic-related complications were recorded.

Statistical analysis

Data were entered into a Microsoft Excel spreadsheet, then was analyzed using SPSS software for windows Version 26.

Descriptive statistics for the data are presented in the form of frequencies and percentages for categorical variables while descriptive statistics for numeric variables are presented as mean with standard deviation or median with Interquartile range. Data were presented for the patients for the variables that do not differ between eyes (n = 16), while presented for each eye when dealing with surgical details (n = 32).

Results

A total of 16 adult patients with primary cyclovertical strabismus who underwent surgery between November 2018 and November 2019 were included. All patients received bilateral surgery. The mean age of patients was 30.6 (10.3) years. 11 (68.75%) were females. Preoperative diagnoses included 3 cases of 4th nerve palsy, 3 cases of IO over-action, 3 cases of Brown syndrome, 2 cases of DVD, 2 cases of thyroid eye disease and one case of each of the following: 6th nerve palsy, 3rd N Palsy, and Duane syndrome (Table 1). The operative time varied from 15 to 42 minutes with mean of 34.8 (6.2) minutes. With regard to intraoperative pain sensation, patients reported grade 0 (no

pain), grade 1 (mild), and grade 2 (moderate) for 20 (62.50%), 9 (28.13%), and 3 (9.38%) of surgeries respectively. The onset of akinesia (time from injection to best score in minutes) (median IQR) was 5 (1). The median IQR of akinesia score was 4 (0) and 1 (1) at 5 and 10 minutes respectively. 28 (87.50%) eyes had grade 4 of the akinesia score at 5-minute post injection. The blockage of pulling sensation was adequate to complete surgery in all eyes. The median (IQR) surgeon satisfaction was 10 (2.00). 15 (93.75%) patients experienced grade 0 or 1 of PONV. No patient experienced oculocardiac reflux OCR (Table 2).

Type of surgery	Eyes, N (%)
IO meyectomy for IOOA	4 (12.50)
IO recession for IOOA	8 (25.00)
IO anteriorization for DVD	2 (6.25)
IR recession	4 (12.50)
Jensen's operation	2 (6.25)
SO lengthening	4 (12.50)
SO tenectomy	2 (6.25)
SR recession	2 (6.25)
SR transposition	2 (6.25)
SO transposition	2 (6.25)
Total	32 (100)

Table 1: *Type of strabismus surgery of cyclovertical muscles. IO: Inferior oblique, IOOA: inferior oblique overaction, DVD: dissociated vertical deviation, SR: superior rectus, SO: superior oblique, IR: inferior rectus.*

		N	%
Age, Mean(SD)	30.6(10.3)		
Gender	Female	11	68.75
	Male	5	31.25
Pain at 5 minutes (4-point scale) per eye	0	20	62.50
	1	9	28.13
	2	3	9.38
Pain post-operative (4-point scale) per eye	0	27	84.38
	1	5	15.63
Incidence of oculocardiac reflex	No	32	100.00
Ocular akinesia at 1 minutes (12-point scale) per eye	10	7	21.88
	12	25	78.13
Ocular akinesia at 3minutes, (12-point scale) per eye	8	21	65.63
	10	11	34.38
Ocular akinesia at 5minutes, (12-point scale) per eye	4	28	87.50
	6	4	12.50
Blockage of pulling sensation per eye	No pulling sensation	14	43.75
	adequate	18	56.25
Surgical correction	Ortho	14	87.50
	Overcorrected	2	12.50
PONV (4-point scale) for every patient	0	9	56.25
	1	7	43.75
Onset of akinesia (time from injection to best score in minutes),median(IQR)	5(1)		
Onset of ocular anesthesia (minutes), median(IQR)	3(1)		
Duration of surgery (min), mean (SD) for each eye	34.8(6.2)		
Surgeon satisfaction 10 score for every patient	7	3	18.75
	8	2	12.50
	10	11	68.75

Table 2: *Baseline and operative characteristics of patients undergoing cyclovertica strabismus surgery under bilateral sub-Tenon block.*

Discussion

There is a worldwide changing trend in ophthalmic anesthesia techniques. Local anesthesia has become increasingly more popular than general anesthesia. However, in strabismus surgery, regional anesthesia came into use late because of the uncertainty that it can overcome the pain - related to extraocular muscles traction and the risk of OCR [9-11].

Several authors described the use of local anaesthesia as a general anesthesia adjunct in pediatric strabismus surgery. This was found to significantly reduce the incidence of OCR and the need for intraoperative anesthetic and opiates, and decrease postoperative pain, nausea, and vomiting [5,12].

Millan used peribulbar anesthesia for monocular surgery for large angle horizontal strabismus with good results [13]. Cheng compared the effectiveness of retrobulbar and general anesthesia in monocular small to moderate horizontal muscle surgery [14]. Their results showed no differences regarding postoperative nausea and vomiting associated with the two techniques. The retrobulbar anesthesia group experienced less postoperative pain and shorter hospital stay. Therefore, they recommended to consider the use of local anesthesia in cooperative patients undergoing strabismus surgery for small and moderate angles of deviation [14].

Snir compared propofol sedation (deep sedation) combined with STB versus general anesthesia for monocular and binocular strabismus surgery (excluding SO surgery) in adults. The STB group had a significantly shorter operative time, fewer episodes of oculocardiac reflex, less postoperative nausea, vomiting, and pain with higher patient satisfaction [15]. However, the use of propofol is not risk free, as it may pose significant cardiac and respiratory risks particularly in high risk patients [16]. We did not find it is necessary to use any type of sedation as topical anesthesia offered adequate analgesia allowing for pain free initial periotomy, although we are aware of the need of cooperative patients.

Despite this growing use of local anaesthesia in strabismus surgery, general anesthesia is still preferred for complicated and bilateral cases. Cyclovertical strabismus surgery presents numerous challenges for the strabismologist due to relatively difficult exposure of the muscles, increased operative time, and the higher incidence of oculocardiac reflex as compared to horizontal rectus muscles [9,17]. Therefore, this kind of muscle surgery is usually operated upon under general anesthesia. Moreover, bilateral surgery presents a challenge of its own, as bilateral blocks are needed to be performed in one sitting doubling the risk of any potential complications. Bilateral regional anesthesia is not commonly described in the literature and considered to be risky. A computerized Pubmed search for bilateral Subtenon block for cyclovertical muscle surgery failed to yield any results, although this technique has been used for other indications [18].

In this study, we report our results on using bilateral sequential STB for bilateral cyclovertical muscle surgery. A combination of lidocaine, bupivacaine, and hyaluronidase was used. This mixture accelerated the onset of sensory block and globe akinesia and prolonged the duration of globe anesthesia. Thus, time for suitable conditions to start surgery was shortened, allowed for longer pain free surgery, while minimizing postoperative discomfort. It was associated with more physiological muscle stretch and complete elimination of the life threatening oculo-cardiac reflex. It also, increased the patient's satisfaction with no need for postoperative analgesia.

Bupivacaine provides prolonged anesthesia with an analgesic action of 6 - 12 hours. Lidocaine is used to compensate for delayed onset of action of Bupivacaine, while Hyaluronidase improves the diffusion of the anesthetic and akinesia of extraocular muscles. Pre-block sedation was provided along with topical anesthesia to allow for a pain free conjunctival dissection for proper block placement. Our technique of bilateral sequential STB provided excellent intraoperative ocular akinesia and analgesia in all operated patients. No supplemental doses of STB or IV sedation was needed in any patient in our study.

Similarly, Vohra reported the use of bilateral STB for bilateral strabismus correction. However, his report included only three high risk-patients [1].

Bilateral STB has several potential advantages. First, it avoids the risks of general anesthesia and reduces recovery time and hospital stay sparing health resources[15]. Second, it has the added advantage of blocking the oculocardiac reflex. In this study, no patient experi-

enced sudden bradycardia, despite not using IV atropine, which is known to completely block the OCR. In contrary, Aletaha reported an incidence of OCR up to 85.5% in their series operated upon under general anesthesia [17]. They found that the risk was higher on operating upon the cyclovertical muscles as compared to horizontal rectus muscles, while ensuring gentle pressure during operation. They attributed this due to the more difficult exposure of cyclovertical muscles and more traction exerted during surgery [17].

Several authors found that STB can significantly reduce the incidence of OCR during strabismus surgery [12,20,21]. Third, using a blunt cannula to inject the anesthetic solution avoids complications such as globe perforation, optic nerve injury, or inadvertent subarachnoid or intravenous anesthetics injections [22]. This is particularly important when planning bilateral blocks for a patient in one surgical episode [19]. Simultaneous bilateral needle blocks can put the patient at greater risk for these serious complications.

STB is superior to other ophthalmic procedures for strabismus surgery as the conjunctiva and sub-Tenon space are opened during strabismus surgery. Therefore, the rest of surgery would be completed through the same STB incision. In thyroid eye disease, STB is particularly safer compared to GA or needle-based blocks as the eyelid and orbital anatomy are distorted in addition to the increased risk of OCR related to pulling on tight muscles [23].

In the present study, STB was performed by the operating surgeon after prepping and draping the eye. This makes this technique much safer as the strabismologist is highly familiar with it, unlike the anesthesiologists who may be uncomfortable with using scissors and exploring unfamiliar anatomical structures [24].

Regarding postoperative nausea, vomiting and pain, none of our patients experienced postoperative vomiting. Postoperative pain scores were low in our study. Similar results were reported by several authors. This may be related to blocking the OCR and reducing postoperative pain [5,6,20,25].

Limitation of study

included Lack of control group and small sample size and the lack of pediatric patients.

Conclusion

In conclusion, it has been shown that bilateral simultaneous STB for cyclovertical muscle surgery is safe and provides adequate anaesthesia, akinesia and analgesia while reducing the risk of oculocardiac reflex, postoperative pain, nausea and vomiting. Consideration should be given for its use for every cooperative healthy adult patient undergoing bilateral cyclovertical muscle surgery.

Disclosure

The author reports no conflicts of interest in this work.

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Volume 12 Issue 12 December 2021