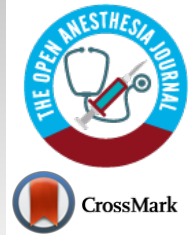




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RESEARCH ARTICLE

A Comparative Study Between Single Medial Canthus Injection Using 13 x 0.45 mm Needle and Posterior Sub-Tenon Injection as Local Anesthesia Techniques for Strabismus Surgery in Adults

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Abstract:

Background:

The quality of ophthalmic anesthesia is an important component of the surgical procedure. There is no absolutely well-tolerated local eye anesthetic technique. However, it is important to choose a technique with high efficacy and safety.

Objective:

This study aimed to compare the efficacy and safety of peribulbar block using medial canthus single injection and posterior sub-tenon injection techniques.

Methods:

This prospective observational study was carried out at the Research Institute of Ophthalmology, Cairo, Egypt during the period from March to December 2018. Consecutive 60 patients of both sexes, aged >18 years-old, scheduled for bilateral strabismus surgery were enrolled in this study. In one eye of the sixty patients, medial canthus single injection peribulbar anesthesia was used (Group A), whereas posterior sub-tenon technique was applied in the other eye (Group B).

Results:

The median total ocular akinesia score was significantly higher in group A than in group B when assessed at 1, 3, and 5 min ($p < 0.001$). Each of the intraoperative (at 5 min) and postoperative pain scores showed no significant differences between the two groups ($p > 0.05$). However, the median scores of surgeon and patient satisfaction were significantly higher in group A compared with group B (3 vs. 2 each, $p < 0.05$). No patient developed oculocardiac reflex or postoperative nausea and vomiting.

Conclusion:

Peribulbar anesthesia by medial canthus single injection showed better akinesia of the globe than sub-tenon injection technique. Otherwise, both techniques were equally effective and safe.

Keywords: Akinesia, Analgesia, Medial canthus, Peribulbar anesthesia, Strabismus, Sub-Tenon.

Article History

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1. INTRODUCTION

Strabismus surgery in adults requires proper anesthesia. This should consider the general condition of the patient, profound akinesia of the Extraocular Muscles (EOMs), and adequate analgesia of the globe [1].

In eye surgeries, local anesthesia has been reported to have a high success rate and safety. Additionally, it has the advantage of quick recovery of patients and shorter hospital stay [2].

There are different techniques of local anesthesia including retrobulbar, Peribulbar (PBA), and Sub-Tenon Anesthesia (STA). Retrobulbar block technique involves injecting a small volume (3-5 ml) of Local Anesthetic (LA) solution inside the

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muscular cone [3]. This technique has many complications such as brainstem anesthesia, globe perforation, and retrobulbar hemorrhage [4]. In the peribulbar block technique, the needle is introduced into the extraconal space with a lesser depth and angulation of needle placement. It has the advantage of less rate of complications. However, it is limited by the need for a larger volume (6-12 ml) of the LA agent [5].

The rationale for the medial canthus technique is its safety. In both sagittal and coronal axes, this approach could represent the safest site, with few main adjacent structures (nerves, vessels, or muscles) [6, 7]. Additionally, the preferred location of staphyloma is to be temporal and not nasal [8]. Furthermore, the use of the needle 13 x 0.45 mm minimizes the local trauma because of less chance of vascular complications (subconjunctival or retrobulbar hematoma) and less ocular trauma, which could be more relevant in patients using antiplatelet medications [9, 10]. The needle length (13 mm) seems to be appropriate to reach the peribulbar area, considering that the visual ocular axial length is 24 mm with one third (8 mm) external and two third (16 mm) internal. This is safer in anticoagulated patients and those with high axial length [7, 11]. Ultrasonography shows that peribulbar block leads to diffusion in the peribulbar, the retrobulbar, and strangely in the sub-tenon space (T-sign) similar to the spread of local anesthetics by sub-Tenon block [12].

Concerning sub-tenon block technique, the local anesthetic (3-5 mL) is injected into the potential space between Tenon's capsule and the sclera. Either a superficial (anterior) or deep (posterior) LA injection can be performed. In the posterior type, the LA is injected directly into the posterior intra- and extraconal spaces. It can reliably deliver both surgical anesthesia and akinesia. However, minor complications as chemosis and conjunctival hemorrhage are common [13].

To the best of our knowledge, a comparison of the efficacy and safety of peribulbar and sub-tenon anesthesia in strabismus surgery in adults has not been reported in the literature. Therefore, this study was conducted to compare the peribulbar and sub-tenon anesthesia in adult strabismus surgery with respect to globe akinesia, anesthesia, intraoperative and postoperative analgesia, and any related complications.

2. METHODS

2.1. Study Design, Setting and Ethical Approval

This prospective observational study was carried out at the Research Institute of Ophthalmology, Cairo, Egypt during the period from March to December 2018. This study was carried out after the approval of our institutional review board. The techniques were explained to the participants, and informed consent was obtained from each participant. All patients' data were kept confidential after assigning a code number to each patient, known only by the researchers.

2.2. Eligibility Criteria

Consecutive 60 patients (with a total number of 120 eyes) of both sexes, aged >18 years-old, American Society of Anesthesiologists (ASA) I and II, scheduled for bilateral strabismus surgery were enrolled in this study. Patients with a

history of allergy to local anesthesia or coagulation disorders, patients with complicated recurrent producers, uncooperative patients who can't lie flat and those who refused local anesthesia were excluded from the study.

2.3. Methods

Routine preoperative assessment, insertion of a peripheral intravenous catheter, patient's monitoring including continuous electrocardiography, pulse oximetry, and automated noninvasive blood pressure measurement were performed.

Before induction of the blockade, Benox eye drops (containing benoxinate, to produce surface anesthesia) were applied on the eye ball, and propofol (30 mg), fentanyl (20 mic) and midazolam (2 mg) were injected to obtain a brief period of sedation during eye puncture. Oxygen was administered through nasal canula at 3 L/minute.

In each of the sixty patients, medial canthus single injection peribulbar anesthesia was used in one eye (Group A), whereas posterior sub-tenon technique was applied in the other eye (Group B). The two eyes were randomized into the two groups, and the surgeons and the observers (rating pain, patient satisfaction) blinded to the groups.

2.3.1. Medial Canthus Single Injection Peribulbar Anesthesia

Each patient was laid supine, and the lids and periorbital area of the eye to be operated was cleaned with 5% povidone iodine. The technique was done using 13 x 0.45 mm needle, which was fully inserted in the semilunar fold just above the caruncle lacrimal at an angle of 90° in both the longitudinal and transverse axes. The needle was fully advanced in an anteroposterior direction at a parallel situation among the globe and the medial wall of the orbit. The LA mixture was injected, and the eyelids were closed, and then ocular compression device was applied for 10 min.

2.3.2. Posterior Sub-Tenon Technique

An eyelid speculum was inserted to improve access and prevent blinking, and the patient was asked to look up and out to assist in exposing the inferonasal quadrant. Tenon capsule was raised with a pair of a blunt nontoothed forceps and a small incision was made in the tissue using a pair of ophthalmic scissors to expose the sclera. Then, sub-Tenon cannula (19G x 22mm) was inserted and passed posteriorly following the curvature of the globe until its tip was pierced to pass the equator, and the LA solution was slowly injected. The cannula was withdrawn, the eyelids were closed, then the ocular compression device was applied for 10 min. We used the infero-nasal quadrant because of the ease of access to this quadrant.

In both techniques, the local anesthetic mixture composed of 6 mL mixture of lidocaine 2% and bupivacaine 0.5% in a ratio of 1: 1 with 30 IU hyaluronidase was slowly injected. Then, compression was applied for 2 minutes using Honan balloon, set at 30 mm Hg, to lower intraocular pressure and improve the spread of the anesthetic solution.

Orbital akinesia was assessed and scores of 0 to 2 (0 = no akinesia, 1 = partial akinesia, and 2 = complete akinesia) were

given to each muscle of the four recti with a total score of 8. Akinesia score was checked at 1, 3, and 5 minutes intervals after giving the LA. The time of onset was defined as the time elapsed from the end of injection to the best akinesia score. Time of onset of anesthesia (min), intra-operative (at 5 min) and post-operative pain assessment using VAS scores were recorded. If the VAS score was over, we either gave sedation or resorted to general anesthesia. In addition, patients and surgeon's satisfaction were determined during the surgery using a subjective verbal score from 0 (total dissatisfaction) to 10 (total satisfaction).

During the whole procedure, patients were carefully monitored for heart rate, O₂ saturation, and noninvasive blood pressure every 5 minutes. In addition, the occurrence of Occulocardiac Reflex (OCR) and post-operative nausea and vomiting were recorded.

2.4. Statistical Analysis

Data analysis was carried out using SPSS version 22. Categorical variables were summarized as frequencies and percentages. All numerical variables were checked for normality by Shapiro Wilk test. Normally distributed numerical variables were presented as mean ± SD, while abnormally distributed numerical variables were expressed as the median and interquartile range (25th - 75th percentile). Differences between the two groups were tested using Wilcoxon Signed Ranks Test for non-parametric paired data. A *p*-value of < 0.05 was considered statistically significant.

3. RESULTS

This study included 60 adult patients scheduled for bilateral strabismus correction surgery. Their age ranged from 25.0 to 67.0 with a mean of 42.0 ± 12.4 years. More than half (53.3%) of them were males, and ASA physical status was

either ASA I (56.7%) or II (43.3%) as shown in Table 1.

Table 1. Demographic data of the studied patients (n = 60).

Age (years)	Range		25.0 - 67.0
	Mean ± SD		42.0 ± 12.4
Sex	Female	N	28
		%	46.7%
	Male	N	32
		%	53.3%
ASA	I	N	34
		%	56.7%
	II	N	26
		%	43.3%

Table 2 illustrates that the median total ocular akinesia score of the four recti muscles was significantly higher in group A than in group B when assessed at 1 min (4.5 vs. 4, *p* = 0.011), 3 min (6 vs. 4, *p* = 0.002), and 5 min (8 vs. 6, *p* < 0.001) after injection of local anesthetic mixture. Regarding time elapsed before the onset of anesthesia, there were non-significant differences between groups A and B (*p* > 0.05). Moreover, the frequency of the need for sedation was non-significantly lower in group A compared to group B (6.7% vs. 16.7% respectively, *p* > 0.05).

Table 3 illustrates that each intraoperative (at 5 min) and postoperative pain VAS scores ranged from 0.0 to 5.0 with no significant differences between the two groups (*p* > 0.05). However, the median surgeon and patient satisfaction scores were significantly higher in group A than group B (3 vs. 2 each, *p* < 0.05).

Intraoperative and postoperative monitoring revealed that no patient developed occulocardiac reflex or postoperative nausea and vomiting.

Table 2. Comparison between the studied groups as regard onset of akinesia, anesthesia, and the need for sedation.

		Groups		Wilcoxon Signed Ranks Test	
		A	B	Z	P value
Ocular Akinesia (1 min)	Minimum	1.0	.0	2.54	0.011*
	Maximum	8.0	8.0		
	Median	4.5	4.0		
	IQR	4.0-7.0	2.0-6.0		
Ocular Akinesia (3 min)	Minimum	1.0	.0	3.147	0.002*
	Maximum	8.0	8.0		
	Median	6.0	4.0		
	IQR	4.0-8.0	2.0-6.0		
Ocular Akinesia (5 min)	Minimum	1.0	2.0	4.195	< 0.001*
	Maximum	8.0	8.0		
	Median	8.0	6.0		
	IQR	6.0-8.0	4.0-8.0		
Onset of Anesthesia	Minimum	1.0	1.0	0.517	0.605
	Maximum	3.0	3.0		
	Median	2.0	2.0		
	IQR	1.0-2.0	1.0-2.0		
Need for Sedation	Yes N (%)	4 (6.7)	10(16.7)	2.911	.088
	No N (%)	56 (93.3)	50 (83.3)		

*significant at *p* < 0.05

Table 3. Pain score, surgeon and patient’s satisfaction of the studied groups.

		Groups		Wilcoxon Signed Ranks Test	
		A	B	Z	P value
Intraoperative Pain VAS Score (5 min)	Minimum	.00	.00	.203	0.839
	Maximum	5.00	5.00		
	Median	.00	.00		
	IQR	.00-2.00	.00-2.00		
Postoperative Pain VAS Score	Minimum	.00	.00	.203	0.839
	Maximum	5.00	5.00		
	Median	.00	.00		
	IQR	.00-2.00	.00-2.00		
Surgeon Satisfaction Score	Minimum	1.00	1.00	3.62	< 0.001*
	Maximum	3.00	3.00		
	Median	3.00	2.00		
	IQR	3.00-3.00	2.00-3.00		
Patient Satisfaction Score	Minimum	1.00	1.00	3.108	0.002*
	Maximum	3.00	3.00		
	Median	3.00	2.00		
	IQR	3.00-3.00	2.00-3.00		

*significant at $p < 0.05$

4. DISCUSSION

The quality of ophthalmic anesthesia is an important component of the surgical procedure. It has been reported that suboptimal anesthesia increases the rate of surgical complications [14].

There is no absolutely well-tolerated local eye anesthetic technique. However, it is important to choose a technique with high efficacy and safety [15]. Therefore, this study aimed to compare the efficacy and safety of peribulbar block using medial canthus single injection and posterior sub-Tenon injection techniques.

This study revealed that peribulbar anesthesia mediated by a single medial canthus injection provided a higher level of globe akinesia than sub-tenon anesthesia. Likewise, the surgeon and patient’s satisfaction were significantly higher with peribulbar anesthesia. Otherwise, both techniques have shown similar efficacy concerning the onset of anesthesia, the need for sedation, and both intraoperative and postoperative analgesia. Additionally, PBA and sub-tenon block provided the best safety profile with no recorded cases of OCR or postoperative nausea and vomiting.

In the current study, the medial canthus single injection peribulbar approach provided more adequate akinesia of the globe than sub-tenon’s anesthesia. Previous studies comparing the level of akinesia in patients who had PBA and STA for cataract surgery revealed inconsistent results. A study from Nigeria revealed better akinesia with PBA [13]. Another study showed a better effect of anesthesia on ocular movement in patients in the STA group [16]. Also, comparable akinesia scores in BPA and STA techniques have been reported [17].

The observed conflicting results among different studies could be explained by the differences in the amount of injectate used for BPA and STA. Additionally, variations in the time of assessment of akinesia among these studies is another

important reason. Our study has the advantage of using similar amount (6 ml) of anesthetic mixture in both techniques. Similarly, a study in which the same volume of anesthetic solution was used for BPA and STA in cataract surgery showed non-significant differences in the quality of globe akinesia [18]. Furthermore, assessment of the efficacy of BPA and STA in anterior segment eye surgeries revealed significantly higher akinesia scores with BPA (mean 2.79 ± 0.43) compared to STA (mean 2.56 ± 0.66) [19].

In the present study, intraoperative and postoperative analgesia were comparable in BPA and STA groups with no significant differences. Similarly, a randomized controlled trial reported equal analgesic effects of both BPA and STA in patients who underwent cataract surgery [20]. In contrast, the patient’s pain perception was more frequent with BPA (56%) than posterior STA (24%) during phacoemulsification surgical procedure [16]. Additionally, many studies demonstrated that sub-tenon anesthesia was more effective as compared to the peribulbar block in terms of ocular analgesia. Consistent with our findings, it has been reported that STA is used to relieve postoperative pain in patients scheduled for ophthalmic procedures under general anesthesia [21].

Ultrasonography showed that injecting the LA agent using sub-tenon technique opens the episcleral space circumferentially giving a characteristic “T-sign”. Then, the LA agent diffuses into intraconal and extraconal spaces, resulting in anesthesia and akinesia of the globe and eyelids, while in the peribulbar block the LA spread in the peribulbar, retrobulbar, and stragely in the sub-Tenon’s space [12].

The patient and surgeons’ satisfaction level in our study was significantly higher with BPA compared with STA. This is contrary to the previous reports showing that STA provides better patients’ satisfaction than BPA [22]. The increased surgeons’ satisfaction with BPA in our work might be due to BPA related adequate akinesia. Actually, complete akinesia is

important to minimize ocular complications, particularly when dealing with uncooperative patients [23].

Oculocardiac reflex is a serious complication during strabismus surgery for which prevention and proper management is required. It is induced by the manipulation of extraocular muscles. The afferent limb of this reflex is the ophthalmic division of the trigeminal nerve, from which fibers pass through the gasserian ganglion to the main sensory nucleus of the trigeminal nerve, and the efferent pathway is the vagus nerve. It is manifested by bradycardia, arrhythmia and even cardiac arrest [24]. This reflex is associated with an increased incidence of postoperative nausea and vomiting by stimulating the oculometric reflex [25].

The current study revealed that PBA and STA provided the best safety profile with no recorded cases of OCR or postoperative nausea and vomiting. In agreement with this finding, Talebnejad *et al.* [26] concluded that sub-Tenon injection of bupivacaine as a local anesthetic significantly prevented OCR and decreased the severity of bradycardia in pediatric patients who underwent strabismus surgery.

Bias was minimized by applying both BPA and STA techniques in the same patient. Patients' perception of pain and acceptability of LA as well as surgeon's satisfaction were recorded during and immediately after the surgery. So, recall bias was avoided.

CONCLUSION

Peribulbar anesthesia by medial canthus single injection showed better akinesia of the globe than sub-Tenon injection technique. Otherwise, both techniques were equally safe and effective regarding intraoperative and postoperative analgesia, onset of anesthesia, and the need for sedation.

LIST OF ABBREVIATIONS

ASA	=	American Society of Anesthesiologists
EOMs	=	Extraocular Muscles
LA	=	Local Anesthetic
OCR	=	Oculocardiac Reflex
PBA	=	Peribulbar Anesthesia
STA	=	Sub-Tenon Anesthesia

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The protocol of this study was approved by the Research Ethics Committee of the Research Institute of Ophthalmology, Cairo, Egypt.

HUMAN AND ANIMAL RIGHTS

No animals were used in the study. All humans research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2008.

CONSENT FOR PUBLICATION

An informed consent was obtained from each patient. All

patients' data were kept confidential after assigning a code number to each patient, known only by the researchers.

AVAILABILITY OF DATA AND MATERIALS

Not applicable

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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Declared none.

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