

# The effect of local anesthetic solution volume applied in retrobulbar block in cataract surgery on the duration of anesthesia and patient comfort

## *Efeito do volume da solução anestésica local aplicada no bloqueio retrobulbar na cirurgia de catarata na duração da anestesia e no conforto do paciente*

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### ABSTRACT

**Objective:** To compare the use of 2 different local anesthetic solution (LAS) volumes of 1.5 mL and 3 mL in retrobulbar block in patients undergoing cataract surgery in terms of anesthesia, akinesia, and pain levels. **Methods:** 80 patients between 18-90 years old, ASA I-II-III, were included in the study. For retrobulbar anesthesia, 1.5 mL LAS was applied to one group (Group LV), and 3 mL LAS to the other group (Group HV). The patients' ocular and eyelid motion scores were evaluated and recorded in the first, third, fifth, and tenth minutes after the block, and at 30-minute intervals for 4 hours post-operatively. One day later, the first hour of analgesic need and the number of times they took analgesic agents were asked and recorded. In addition, side effects were questioned and recorded. **Results:** The 39 (48.75%) patients were male and 41 (51.25%) patients were female. The criteria determined in terms of ocular motor score after the retrobulbar block (ocular motor score  $\leq 4$ ) were met in 92.5% of patients in Group LV in all patients in Group HV, and the time to fulfill the determined criteria in Group HV was found to be significantly lower compared to Group LV ( $p=0.004$ ). The movements of the eye in all direction except the inward movement recovered in Group LV in a significantly shorter time than Group HV ( $p=0.004$ ). There was no significant difference in pain levels and side effects between the groups ( $p=0.34$ ). **Conclusions:** After 1.5 mL LAS administration in retrobulbar block, adequate akinesia was not achieved in about one tenth of patients, but no significant difference was found between 1.5 mL and 3 mL LAS volumes in analgesic efficacy and side effects.

**Keywords:** Cataract/surgery; Anesthesia, local; Anesthetics; Akinesia; Retrobulbar block; Pain

### RESUMO

**Objetivo:** Comparar o uso de 2 volumes diferentes de solução anestésica local (LAS) de 1,5 mL e 3 mL no bloqueio retrobulbar em pacientes submetidos à cirurgia de catarata em termos de anestesia, acinesia e níveis de dor. **Métodos:** 80 pacientes entre 18 e 90 anos, ASA I-II-III, foram incluídos no estudo. Para anestesia retrobulbar, 1,5 mL de LAS foi aplicado em um grupo (Grupo LV) e 3 mL de LAS no outro grupo (Grupo HV). Os escores de movimento ocular e palpebral dos pacientes foram avaliados e registrados no primeiro, terceiro, quinto e décimo minutos após o bloqueio e em intervalos de 30 minutos por 4 horas no pós-operatório. Um dia depois, a primeira hora de necessidade de analgésico e o número de vezes que eles tomaram analgésicos foram solicitados e registrados. Além disso, os efeitos colaterais foram questionados e registrados. **Resultados:** 39 (48,75%) pacientes eram do sexo masculino e 41 (51,25%) do sexo feminino. Os critérios determinados em termos de escore motor ocular após o bloqueio retrobulbar (escore motor ocular  $\leq 4$ ) foram atendidos em 92,5% dos pacientes do Grupo LV em todos os pacientes do Grupo HV, e foi encontrado o tempo para atender aos critérios determinados no Grupo HV ser significativamente menor em comparação ao grupo LV ( $p = 0,004$ ). Os movimentos do olho em todas as direções, exceto o movimento interior, se recuperaram no Grupo LV em um tempo significativamente menor que o Grupo HV ( $p = 0,004$ ). Não houve diferença significativa nos níveis de dor e efeitos colaterais entre os grupos ( $p = 0,34$ ). **Conclusões:** Após administração de 1,5 mL de LAS no bloqueio retrobulbar, não foi alcançada acinesia adequada em cerca de um décimo dos pacientes, mas não foi encontrada diferença significativa entre os volumes de 1,5 mL e 3 mL de LAS na eficácia analgésica e efeitos colaterais.

**Descritores:** Catarata/cirurgia; Anestesia local; Anestésicos; Acinesia; Bloqueio retrobulbar; Dor

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## INTRODUCTION

In ophthalmic surgery, retrobulbar block is preferred because it provides rapid anesthesia and akinesia with lower local anesthetic solution (LAS) volumes compared to sub-Tenon's and peribulbar block.<sup>(1)</sup> In the retrobulbar block, 2-5 mL LAS is usually applied, the most commonly used LAS mixture is bupivacaine 0.5% and lidocaine 2%. Although low volume application in the retrobulbar block causes less intra-orbital blood pressure and therefore less chemosis, intraocular pressure increase is also among the possible complications of the retrobulbar block.<sup>(2-4)</sup>

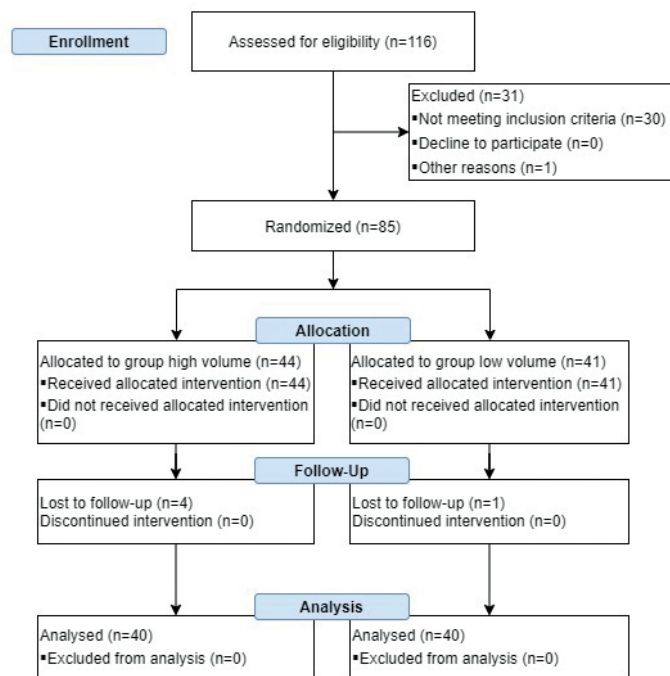
Increased intraocular pressure is important because it can lead to vision loss associated with decreased in perfusion of the eye.<sup>(5)</sup> Lung et al.<sup>(6)</sup> demonstrated that anesthetic agent injection at lower volumes in peribulbar block is associated with better ocular blood flow. Mostafa et al.<sup>(7)</sup> found that the application of high LAS volume (4 mL) in retrobulbar block caused a small but significant increase in intraocular pressure compared to low volume (2 mL). In sub-Tenon's block applications, there are also studies comparing different LAS volumes in terms of intraocular pressure changes, efficacy, and patient pain levels.<sup>(8,9)</sup>

In our study, it was aimed to compare the application of LAS in different volumes in retrobulbar block in patients undergoing cataract surgery in terms of anesthesia and akinesia, and in order to minimize the increase in intraocular pressure, LAS was applied in lower doses (in two different volumes, 1.5 mL and 3 mL) differently from previous studies in retrobulbar block. In addition, as a secondary endpoint, it was aimed to evaluate the effect of anesthetic agent application in different volumes on patients' pain levels (during and after the operation).

## METHODS

After the approval of Local Ethics Committee (Unique Protocol ID: 2019/776, Date: 13.11.2019), the study protocol was registered at ClinicalTrials.gov. The study analysis was performed with the data of a total of 80 patients (ASA I-II-III) between the ages of 18 and 90 who accepted the retrobulbar anesthesia application before cataract surgery. Exclusion criteria for our study were not accepting local anesthesia, being under the age of 18, having problems in communicating, having an eyelid or eye anomaly, having a Parkinson's disease, having a high myopia with an axial length of 26 mm, being a hypersensitivity to local anesthetic agents, and bleeding or having a drug-related coagulation problem. Written consents were obtained from patients who were eligible for the study according to these criteria. While obtaining consent, it was also verbally stated to the patients that the study did not contain any risk other than the standard cataract surgery and retrobulbar block risks.

Patients taken to the operating room were monitored, and basal blood pressure, heart rate, and peripheral oxygen saturation (SpO<sub>2</sub>) values were recorded before the operation. Oxygen was administered at a concentration of 2 l/min with nasal cannula. The ocular and eyelid movements of the patients were checked and recorded before the operation. 20G intravenous (IV) cannula was attached to the patients. Before performing retrobulbar block, topical anesthesia was provided with 0.5% proparacaine drop, and operation area cleaning was done with povidon-iodine. The patients were told to look at the finger held by the assistant staff to bring the eyeball to the neutral position. Then, the LAS was slowly injected by entering the retrobulbar area with a 25G ophthalmic needle.



**Figure 1:** CONSORT Flow Diagram of participants

For the retrobulbar anesthesia procedure, 1.5 mL LAS (equal amounts of 2% lidocaine and 5% bupivacaine) was applied to one group (Group low volume, Group LV) and 3 mL to the other group (Group high volume, Group HV). The eye was gently massaged to distribute the LAS and reduce the risk of bleeding. Ocular and eyelid movements were assessed and recorded at the first, third, fifth, and tenth minutes after the retrobulbar block. In order to make an assessment, patients were asked to look upward, downward, inward, and outward and close and open their eyelids. Ocular movements were scored 2 if normal, 1 if slightly restricted, and 0 if there was no movement, separately for each direction (total score 0-8).<sup>(10)</sup> In the evaluation of eyelid movements, complete immobility was scored as 0, partial motion as 1, and normal motion as 2.<sup>(11)</sup> During the operation, blood pressure, heart rate, and SpO<sub>2</sub> values of the patients were recorded at 5-minute intervals, and patients' pain was evaluated with a 3-point scale (0: no pain, 1: not comfortable, 2: there is pain) and recorded. Any side effects that occurred during and after the operation were questioned and recorded. In addition, one day later, information about the first time they needed analgesics, and the number of times they took analgesic agents were recorded by asking the patients. Our study was conducted in accordance with the Helsinki Declaration principles. CONSORT diagram of our study is given in Figure 1.

### Statistical analysis used

In the statistical evaluation of the data, besides descriptive statistical methods (mean, standard deviation, minimum, maximum, frequency, and ratio values), Student's t-test and Mann-Whitney U-test were used to compare quantitative independent data (according to the distributions), and Chi-square test was used to compare qualitative independent data, and Fisher's exact test was used when Chi-square test conditions were not met. SPSS 22.0 (Statistical Package for the Social Sciences) software was used for statistical evaluation. For all tests,  $p < 0.05$  value was considered statistically significant.

**Table 1**  
**Demographic data of patients**

		<b>Group LV</b> <b>Mean±SD</b> <b>n (%)</b>	<b>Group HV</b> <b>Mean±SD</b> <b>n (%)</b>	<b>p-value</b>
Age (Years)		65.18±8.47	67.62±7.60	0.19 TT
Operation time (min)		23.11±0.83	22.97±0.66	0.41 TT
Axial length (mm)		13.53±3.59	13.30±3.73	0.78 TT
Gender	Male	18 (45.00)	21 (52.50)	0.66 FE
	Female	22 (55.00)	19 (47.50)	
Comorbid disease	No	15 (37.50)	12 (30.00)	0.64 FE
	Yes	25 (62.50)	28 (70.00)	
Operated eye	Right	19 (47.50)	26 (65.00)	0.18 FE
	Left	21 (52.50)	14 (35.00)	
ASA	I	14 (35.00)	10 (25.00)	0.47 FE
	II	26 (65.00)	30 (75.00)	

ASA: American Society of Anesthesiologists, FE: Fisher's exact test, Group LV: Group low volume (1.5 mL), Group HV: Group high volume (3 mL), SD: Standard Deviation, TT: Student T-Test

**Table 2**  
**Mean ocular/eyelid motor score of patients and number of patients meeting the determined criteria by groups within 10 minutes after retrobulbar block**

		<b>Group LV</b>		<b>Group HV</b>		<b>p-value</b>
		<b>Mean±SD</b>	<b>Number of patients meeting the determined criteria* n (%)</b>	<b>Mean±SD</b>	<b>Number of patients meeting the determined criteria* n (%)</b>	
Ocular motor score	1st min	6.60±1.58	3 (7.50)	6.68±1.77	5 (10.00)	0.842 TT
	3rd min	5.48±1.69	11 (27.50)	4.25±2.57	22 (55.00)	0.014 TT
	5th min	4.13±1.99	24 (60.00)	2.35±1.97	35 (87.50)	<0.001 MW
	10th min	3.17±2.01	31 (77.50)	0.48±0.75	40 (100)	<0.001 MW
Eyelid motor score	1st min	1.83±0.39	0 (0.00)	1.40±0.63	3 (7.50)	0.001 MW
	3rd min	1.55±0.55	1 (2.50)	1.05±0.60	6 (15.00)	<0.001 MW
	5th min	1.38±0.67	4 (10.00)	0.75±0.59	13 (32.50)	<0.001 MW
	10th min	1.10±0.62	7 (17.50)	0.45±0.60	24 (60.00)	<0.001 MW

Group LV: Group low volume (1.5 mL), Group HV: Group high volume (3 mL), SD: Standard Deviation, TT: Student T-Test, MW: Mann-Whitney U-Test, \*: Ocular motor score≤4 / eyelid motor score=0

**Table 3**  
**Recovery times and patient numbers during the postoperative 4 hours follow-up**

	<b>Group LV</b>		<b>Group HV</b>		<b>p-value</b>
	<b>Mean±SD</b>	<b>n</b>	<b>Mean±SD</b>	<b>n</b>	
Eyelid recovery	57.00±38.91	40	105.38±63.03	39	0.004 MW
Ocular recovery	147.57±63.39	37	159.71±55.13	34	0.394 TT
Complete recovery	147.57±63.39	37	159.09±52.76	33	0.415 TT

Group LV: Group low volume (1.5 mL), Group HV: Group high volume (3 mL), SD: Standard Deviation, MW: Mann-Whitney U-Test, TT: Student T-Test

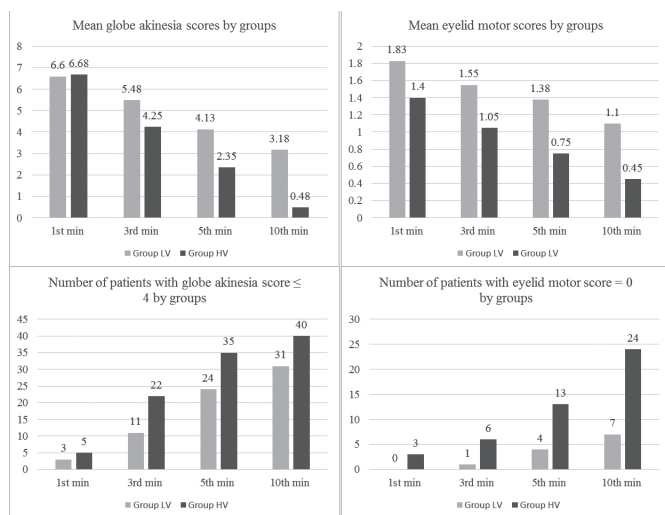
## **RESULTS**

Between 12/16/2019 -04/26/2020, a total of 116 patients were included in the cataract surgery. Since 30 of the patients used anticoagulants, and retrobulbar block operation could not be performed on one of them, they were excluded from the study. A total of 5 patients were excluded from the study because of missing data during their follow-up. Of the patients included in

the study 39 (48.75%) were male, and 41 (51.25%) were female, and mean age was 66.35±8.11 years. The mean operation time was 13.41±3.64 minutes. Demographic data of the patients are presented in table 1.

There was no significant difference between the groups in vital signs (mean arterial pressure, heart rate, and SpO<sub>2</sub>) before and during the operation (Supplement Table 2).

The most favorable conditions for the operation were deter-



**Figure 2:** Mean ocular, eyelid motor scores and number of patients with ocular motor score  $\leq 4$ , eyelid motor score = 0 by groups within 10 minutes after retrobulbar block

mined as total ocular motor score  $\leq 4$  and eyelid motor score = 0. As a result of the first 10 minutes of follow-up after retrobulbar block, In Group LV, the determined criteria for the ocular motor score in 31 (77.50%) patients and for the eyelid motor score in 7 (17.50%) patients were met, while in Group HV, the determined criteria for the ocular motor score in all patients and for the eyelid motor score in 24 (60.00%) patients were met (Figure 2 and Table 2). In Group LV, the ocular movements of 9 patients who did not meet the determined criteria in the first tenth minute were re-evaluated after 5 minutes, and in the 15th minute, 6 of the 9 patients met the criteria and 3 patients did not. After the retrobulbar block, the time to meet the criteria of the ocular motor scores (3 patients in Group LV are not included in the calculation) was found to be significantly longer ( $p=0.004$ ) in Group LV than in Group HV ( $6.81 \pm 4.51$  min,  $4.28 \pm 2.54$  min, respectively). Since the determined criteria for eyelid motor scores were not met in the majority of patients in both groups, mean eyelid akinesia times were not calculated.

Patients were also questioned for intraoperative pain, 36 (90.00%) patients in Group LV and 32 (80.00%) patients in Group HV stated that they did not feel any pain at all. Two patients in Group LV and 7 patients in Group HV were not comfortable, and two patients in Group LV and one patient in Group HV stated that they had pain. There was no significant difference between the groups in terms of intraoperative pain ( $p=0.34$ ). Six patients, 4 patients in Group LV and 2 patients in Group HV, had postoperative pain. Among these patients, in Group LV, 1 patient needed analgesic 3 times, while other patients only had 1 time. Postoperative intraocular pressure was measured as high in 2 patients in Group LV, and no side effects were observed in either group.

Postoperative ocular motor movements in 3 patients in Group LV and 6 patients in Group HV did not fully recover (total ocular motor score = 8) after 4 hours of follow-up. While eyelid motor movements fully recovered (eyelid motor score = 2) in all patients in Group LV, only one patient in Group HV did not. The mean complete recovery (ocular motor and eyelid) time was found as  $147.57 \pm 63.39$  minutes in Group LV and  $159.09 \pm 52.76$  minutes in Group HV. There was no statistically significant difference between the groups ( $p=0.394$ ). The mean recovery time for eyelid movements was found to be  $57.00 \pm 38.91$  minutes in Group LV and  $105.38 \pm 63.03$  minutes in Group HV, recovery time in Group LV was significantly ( $p=0.004$ ) lower (Table 3).

## DISCUSSION

In this study, we aimed to compare the use of LAS in different volumes (1.5 mL and 3 mL) in terms of akinesia and pain levels in retrobulbar block applied to patients undergoing cataract surgery. As a result of our study, neither one-tenth of patients had ocular akinesia criteria (ocular motor score  $\leq 4$ ) nor eyelid akinesia criterion (eyelid motor score = 0) in more than three-quarters with a 1.5 mL LAS, and the time to fulfill the determined criteria in Group HV was significantly lower than Group LV. While postoperative eyelid recovery time was significantly lower in Group LV, complete recovery time did not differ significantly between the groups. There was no significant difference between the groups in terms of intraoperative pain levels, postoperative analgesic requirement, and side effects.

LAS volume used in retrobulbar block application varies from clinic to clinic. Retrobulbar injection of LAS was performed as 4.5 mL in the study of Ye et al.<sup>(12)</sup> in the pediatric population, 5 mL in the study of Aksu et al.<sup>(13)</sup>, 6 mL in the study of Mete et al.<sup>(14)</sup>, and 7 mL in the study of Akar et al.<sup>(15)</sup>. Haddadi et al.<sup>(16)</sup> injected only 2 mL of lidocaine 2% and hyaluronidase 1/15.000 mixture for retrobulbar block. It was seen that the lowest LAS volume used in retrobulbar block applications was 2 mL. According to our knowledge, our study is the first study that retrobulbar anesthesia was performed with 1.5 mL LAS injection in the literature.

After retrobulbar or peribulbar block applications, intraocular pressure increase can be seen. Robinson et al.<sup>(17)</sup> showed that the increase in intraocular pressure decreased ocular perfusion pressure. Another study found that a decrease in perfusion pressure was associated with a decrease in retinal blood flow.<sup>(18)</sup> In the study of Lung et al.<sup>(6)</sup> investigating the intraocular hemodynamic effects of the volume applied in the peribulbar block, LAS was applied in two different volumes, 2 mL and 4 mL. In both groups, intraocular pressure increase was found to be maximum in the first minute after peribulbar block, return to normal levels in the fifth minute, but there was less decrease in blood flow in the 2-mL group compared to the 5-mL group. In another study<sup>(19)</sup> examining the relationship between the amount of applied volume and intraocular hemodynamic changes in retrobulbar block, 2 mL injection was applied to one group and 5 mL injection to the other group, and systolic retinal and ciliary perfusion pressures were measured after injection. In the 5 mL injection group, it was found that perfusion pressure in the LAS applied eye decreased by an average of 5.6 mmHg compared to the other non-administered eye, but there was no significant decrease in pressure in the 2 mL injection group. As a result, it was stated that increased injection volumes may be associated with deterioration in intraocular hemodynamics. In our study, the groups could not be compared in this respect since preoperative intraocular pressure measurement could not be done after retrobulbar block due to limitations in our operating room. However, during the postoperative examination, intraocular pressure of two patients was high in Group LV, and this is thought to be due to other volume-independent causes.

Patton et al.<sup>(8)</sup> evaluated the relationship between the amount of anesthetic volume and the efficacy and safety of the block, LAS was applied to patients undergoing cataract surgery in two different volumes of 3 mL and 5 mL in the sub-Tenon's block. Although effective analgesia was provided in both volumes, it was found that there was less ocular movement at the onset of the operation with 5 mL volume. Sohn et al.<sup>(9)</sup>, applied the LAS in three different volumes, 3, 5, and 7 mL in sub-Tenon's block



in vitreoretinal surgery, and the applied volumes were compared in terms of anesthetic and analgesic effects. Although effective anesthesia is provided with all three volumes, considering the various complications, especially the increase in intraocular pressure, it was concluded that lower volumes such as 3 mL and 5 mL should be preferred depending on the condition of the patient. As a result of our study similar to these two studies, it was found that although better akinesia was achieved at higher volumes, lower volumes did not cause any deterioration at the analgesia level. In line with these results, low volumes should be preferred in order to reduce complications.

When the literature was reviewed, a single study was reached on the relationship between amount of volume applied in retrobulbar block and akinesia. In the study by Mostafa et al. (7), one group received 2.5 mL LAS and the other group received 4 mL in retrobulbar block. As a result of the study, while better akinesia was achieved in higher volume, it was also determined that there was a temporary but significant increase in intraocular pressure. However, it was not stated whether there was any difference between the two groups in terms of patient satisfaction. Unlike the study, the groups were compared in terms of intraoperative and postoperative pain in our study. In our study, although better ocular akinesia was obtained in Group HV, no difference was found between the groups in terms of intraoperative and postoperative pain assessment.

The short recovery time of eyelid and ocular motor movements is one of the factors affecting patient comfort. In our study, postoperative eyelid recovery time was found to be significantly lower in Group LV, and this is an expected condition due to the use of less LAS. Recovery times in all directions except inward movement were significantly shorter in Group LV for the first 180 minutes. The reason for only the recovery times of the inward ocular movement to be similar between the groups may be that more concentrated LAS accumulation in an area close to the medial muscles after injection (Supplement Table 3). Similarly, as a result of the first 10-minute follow-up after the retrobulbar block, while the third and fifth minute ocular movement scores were not significantly different between the groups for inward direction, the ocular movement scores for other directions were significantly higher in Group LV (Supplement Table 1). After 1.5 mL LAS injection, the inward movement of the eye was blocked faster than other directions and recovered later.

In our study, although there was a significant difference between the groups in terms of recovery time of individual ocular movements (except inward direction), there was no significant difference between the groups in terms of ocular recovery time (total score of ocular movements=8) and complete recovery time (total score of the eyelid and ocular movements=10). This was due to the fact that only the inward movement of the eye recovered in Group LV close to Group HV. In our study, the time to meet the determined criteria for the ocular movement score was found to be significantly lower in Group HV compared to Group LV. However, while the works such as transfer of the patient whose surgery was finished, cleaning of the operating room, and preparation for the new patient continued, thanks to the retrobulbar block being made in another room and making patients ready for operation, the operating room layout or the number of patients operated on during the day was not affected.

There are also studies in which various adjuvant agents are added to LAS that are frequently used in retrobulbar block.

(20) In a study using muscle relaxant as an adjuvant agent in retrobulbar block<sup>(21)</sup>, patients were given 2.5 mL LAS (lidocaine and atracurium or saline) injection, and a better akinesia was achieved in the group where muscle relaxants were added. In the study, it was stated that 60 of 64 patients had complete akinesia (defined as 0-1mm movement in 1 or both directions), of the patients without complete akinesia, one was in the group in which atracurium was added, and three were in the saline group. In our study, no adjuvants were added to the LAS, and the determined criteria for ocular movements were not met in 3 of 40 patients in the 1.5 mL injection group. With a combination of adjuvants such as local anesthetics and muscle relaxants, it may be possible to achieve complete or adequate akinesia in more patients with low volumes. With a combination of local anesthetics and an adjuvant (such as muscle relaxants), it may be possible to achieve complete or adequate akinesia in more patients with a low-volume LAS.

## CONCLUSION

It was observed that postoperative ocular (except inward direction) and eyelid movements recovered significantly in a shorter time by using 1.5 mL LAS in retrobulbar block, while the inward movements of the preoperative and postoperative eyes in both volumes were similarly blocked and recovered. If the surgeon does not request complete akinesia during the operation in patients undergoing cataract surgery, it is thought that retrobulbar block can be performed with a 1.5 mL injection without any significant difference (between 3 mL injection) in terms of analgesic efficacy. More comprehensive studies are needed to investigate the efficacy and safety of adding adjuvants to LAS to achieve better akinesia at lower volumes such as 1.5 mL.

### **Limitations**

Due to the lack of necessary equipment in our operating room, intraocular pressure could not be measured, therefore intraocular pressure differences between the groups could not be evaluated. In addition, postoperative ocular and eyelid akinesia follow-up was limited to 4 hours due to bed and personnel limitations in our hospital. In terms of the applicability of the technique, surgeon satisfaction was also not questioned.

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