

# THE EFFECT OF ADDITION OF LOW DOSE ATRACURIUM TO LOCAL ANESTHETIC IN RETROBULBAR BLOCK FOR CATARACT SURGERY

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## Abstract

**Background:** Addition of some neuromuscular blockers to local anesthetics proved to be effective in improving the quality of anesthesia in different regional techniques. This study was carried out to determine whether the addition of low-dose atracurium to a local anesthetic has any effect on the onset and duration of akinesia in retrobulbar block.

**Patients and Methods:** This study was conducted on sixty-four unpremedicated, ASA I or II patients scheduled for cataract surgery under local anesthesia. The patients were assigned to one of the two treatment groups in a randomized, double-blind manner. The case group received 2 ml of 2% lidocaine (40 mg) and 0.5 mL atracurium (5 mg). The control group received 2 ml of 2% lidocaine (40 mg) and 0.5 ml 0.9% NaCl. The onset of akinesia (the inability to move the eye in all four directions) was scored as 0 to 2: 0, no akinesia; 1, partial akinesia; and 2, complete akinesia. The onset and duration of akinesia and also adverse effects and complications of each method were recorded throughout the study.

**Results:** In 4 out of 64 patients, complete akinesia was not achieved and statistical analysis was done on 60 others with complete akinesia. With regard to age, sex, weight, and duration of the surgery, there were no significant differences between the case and control groups. The onset of complete akinesia was quicker and duration longer in the case group than in the control group. The onset of complete block was  $4.7 \pm 1.1$  minutes in the case group and  $6.9 \pm 0.96$  minutes in the control group ( $P < 0.001$ ). The duration of akinesia was  $104.07 \pm 17.6$  minutes in the case group and  $87.1 \pm 16.2$  minutes in the control group ( $P < 0.001$ ).

**Conclusion:** This study demonstrated that atracurium had a local action on the extraocular muscles. It shortened the onset period of retrobulbar block, prolonged its duration, and provided excellent surgical conditions without any specific complications.

**Keywords:** Akinesia, Atracurium, Nondepolarizing neuromuscular blockers, Retrobulbar anesthesia.

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## Introduction

There are different approaches to the delivery of local injection anesthesia for cataract surgery. The two main approaches are retrobulbar and peribulbar.

The retrobulbar approach appears to be more commonly practiced. This block can provide adequate anesthesia, akinesia and control of intraocular pressure as well as postoperative analgesia<sup>1,2</sup>. The most fearful complications with this technic are globe perforation, brain stem anesthesia and retrobulbar hemorrhage, which is the most frequent complication and occurs in 1% of the cases<sup>1,3,4</sup>.

Many believe that the peribulbar block is a safer technique, but to produce akinesia a larger volume of anesthetic solution is required. In addition, development of akinesia takes longer and is more frequently inadequate after peribulbar injections compared with retrobulbar injection<sup>1</sup>.

Some clinical trials have shown that addition of a neuromuscular blocker (e.g., vecuronium or pancuronium) to the local anesthetic solution improves the quality of anesthesia in different regional techniques<sup>5-7</sup>. The beneficial effect of atracurium added to local anesthetics on akinesia in peribulbar block in the cataract surgery has been reported<sup>5</sup>.

The aim of this study was to determine whether the addition of low-dose atracurium to a local anesthetic mixture had any effects on the onset time and duration of akinesia in retrobulbar block in patients who undergoing cataract surgery.

## Patients and Methods

This study was conducted on sixty-four unpremedicated ASA I or II patients undergoing cataract surgery (phacoemulsification and intraocular lens implantation) with local anesthesia<sup>8</sup>. All patients gave informed consent and the study was approved by the Local Ethics Committee. The patients with a history of abnormal bleeding, allergy to local anesthetics, cardiac, hepatic or renal failure, Parkinsonism, unstable angina, clustropobia, high myopia, and monocularly were excluded.

Patients were assigned to one of the two treatment groups in a randomized, double-blind manner. The case

group comprised 31 and the control group included 33 patients. The case group received 2 mL of 2% lidocaine (40 mg) and 0.5 mL atracurium (5 mg). The control group received 2 mL of 2% lidocaine (40 mg) and 0.5 mL 0.9% NaCl.

Local anesthetic solutions were prepared by a nurse anesthetist. All the blocks were performed by the same experienced ophthalmologist who was unaware of the mixture administered. The onset of akinesia (the inability to move the eye in all four directions) was determined by the ophthalmologist for the first 10 minutes and was scored as 0 to 2:0, no akinesia; 1, partial akinesia; and 2, complete akinesia (Table 1).

*Table 1*  
*Akinesia scoring system after retrobulbar injection of lidocaine or a mixture of lidocaine and atracurium.*

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**0:** more than 2-mm movement in any main direction.

**1:** 1-mm movement in more than 2 main directions or 2-mm movement in any main direction.

**2:** 0- to 1-mm movement in 1 or 2 main directions.

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The onset time of complete akinesia was recorded for each patient. All the patients were monitored by automatic noninvasive blood pressure, heart rate, and pulse oximetry throughout the surgical procedure and during the first postoperative hour. After completion of surgery, an anesthesiologist unaware of group assignment recorded the offset time of akinesia in the recovery unit. The adverse effects and complications were also recorded during the study.

Statistical analysis was performed using Student's *t* test. The results are expressed as mean and standard deviation (SD). Significance was determined at the  $P < 0.5$  level.

## Results

In 4 out of 64 patients, complete akinesia (score 2) was not achieved. These patients were excluded and statistical analysis was performed on 60 other patients who achieved complete akinesia. Regarding age, sex, weight, and duration of the surgery, there were no significant differences between the case and control groups (Table 2). However, there was a significant difference between the case and control groups

regarding the time onset and duration of akinesia. The onset time of complete block was  $4.7 \pm 1.1$  minutes in the case group and  $6.9 \pm 0.96$  minutes in the control group. This difference was statistically significant ( $P < 0.001$ ). Duration of akinesia was  $104.07 \pm 17.6$  minutes in the case group and  $87.1 \pm 16.2$  minutes in the control group which was significant ( $P < 0.001$ ). There was no specific complication in both case and control groups. No patient needed supplemental anesthetic agent injection.

Table 2

Comparison of the two treatment groups regarding age, sex, weight duration of surgery, time to onset of akinesia and duration of akinesia.

	Case	Control	Significance
Age (yr)	63.37	62.97	0.8
Sex (F/M)	2218/	2416/	0.37
Weight (kg)	$68.7 \pm 9.9$	$72.2 \pm 11.1$	0.1
Duration of surgery (min)	$20.4 \pm 5.09$	$21.1 \pm 6.1$	0.5
Time to onset of akinesia (min)	$4.7 \pm 1.1$	$6.9 \pm 0.96$	$<0.001$
Duration of akinesia (min)	$104 \pm 17.6$	$87.1 \pm 16.2$	$<0.001$

## Discussion

There is debate over whether the peribulbar approach provides more effective and safer anesthesia for cataract surgery than retrobulbar block. In the retrobulbar approach, a needle is inserted into the intraconal space, a space behind the eye formed by the extraocular muscles that contains the major nerves of the eye and its adnexa. Therefore, it may be associated with potentially serious ocular damages such as scleral perforation, stimulation of the oculocardiac reflex and injection of anesthetic agent into the perioptic meningeal space. However, this route may have the advantage of rapid onset of analgesia and akinesia with the use of relatively smaller volumes of anaesthetic agent<sup>1,9</sup>.

The most popular peribulbar anesthetic technique involves dual injections above and below the globe. In the inferior site the needle is inserted for a distance of 25 mm at a point between the lateral third and medial two thirds of the lower orbital margin and four ml of

anesthetic solution is injected outside the muscle cone at the level of globe equator. In the case of upper side, the needle is introduced through the upper lid at about 2 mm medial and inferior to the supraorbital notch and 3 ml of anesthetic solution are deposited<sup>10</sup>. In addition to conjunctival edema often seen, a higher initial IOP is accompanied because of higher volume of anesthetic agent<sup>11</sup>.

The need for additional injection is higher with peribulbar block in comparison with retrobulbar block<sup>1</sup>. In order to augment the effect of local anesthetics, Küçü kyavuz et al.<sup>5</sup> and Reah et al.<sup>6</sup> studied the effect of neuromuscular blockers on the peribulbar block. Küçü kyavuz et al.<sup>5</sup> reported the effect of 8 mL of a lidocaine-bupivacaine mixture, plus 0.5 mL (5 mg) atracurium was better than the 8 mL of the same local anesthetic mixture plus 0.5 mL 0.9% NaCl. Time to the onset of akinesia in minutes was  $10 \pm 3$  in the atracurium and  $7 \pm 2$  in the control one. The duration of akinesia in minutes was the same in both groups ( $192 \pm 99$  versus  $194 \pm 53$ ) which was not statistically significant ( $p > 0.05$ ). Moreover, no side effects related to peribulbar block or drugs were observed in any patient.

Reah et al.<sup>6</sup> compared the effect of 5 ml of 2% Lignocaine with 1:200000 adrenaline, 5 ml 0.75 bupivacaine and 150 IU hyaluronidase with either 0.9% saline 0.25, or vecuronium bromide 0.25 ml. They concluded that the addition of vecuronium at a dose of 0.5 mg to the local anesthetic mixture improves the quality of akinesia. Although Reah et al.<sup>6</sup> and Küçü kyavuz et al.<sup>5</sup> studied the effect of neuromuscular blocking agents in peribulbar block, reporting that the addition of neuromuscular blocking agents to the local anesthetic mixture improves the quality of akinesia, our study is the first to use low-dose atracurium in retrobulbar block.

In this study, the onset of complete block was more rapid in the atracurium group compared with the control group. This finding is in concordance with that of the two mentioned studies. But, the total amounts of local anesthetic agent in both of these studies were more than those of our study. However, the need for additional injection is higher with peribulbar block in comparison with retrobulbar block<sup>1</sup>.

Nowadays, topical anesthesia is the more popular

technique for ophthalmic anesthesia. This contributes to a controversy about the optimal technique for cataract surgery. Though topical anesthesia reduces the risk of complications related to needle and systemic toxicity, yet it has the potential disadvantages of incomplete akinesia<sup>12</sup>. Induction of complete akinesia is an ideal situation for the beginner surgeons, because complete akinesia is not achievable by topical anesthesia.

A major concern in retrobulbar block is the potential for central spreading and inadvertent intrathecal injection. The possibility of central spread is a rare occurrence; Nicoll et al.<sup>13</sup> reported the incidence of 0.27%. In our study there was no case of central spread of medication which seems to be related to taking into account the predetermined precautions in retrobulbar injection.

The additional effect of low-dose nondepolarizing neuromuscular blocking agents to the local anesthetic solution in improving the quality of anesthesia and provision of motor block during intravenous regional

anesthesia technique has been proved. Though the mechanism is still unclear, the hypothesis is that the neuromuscular blockers probably interfere with muscle spindle activity. The motor unit, the number of muscle fibers innervated by a single motor neuron, is the characteristic features of intraorbital muscles which makes the extra ocular muscles most sensitive to the effect of neuromuscular blocking agents<sup>6</sup>.

Our study demonstrated that atracurium had a local action on the extraocular muscles. It shortened the onset time of retrobulbar block, prolonged the duration of retrobulbar block, and provided excellent surgical conditions without known complications. Shortening the onset time of akinesia leads to saving of the time and cost of operating room. Moreover, increasing the duration of akinesia could enable the surgeon to do other ophthalmic operations which last longer than a routine phacoemulsification surgery. Further studies are required to confirm the local effect of atracurium on akinesia of the globe.

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