Effect of the addition of rocuronium to local anesthetics for peribulbar block

Y. Aissaoui, L. Belyamani, N. Drissi Kamili

Summary: To test the hypothesis that rocuronium added to a mixture of local anaesthetics could improve akinesia in Peribulbar Block (PB) we designed this prospective, randomized, double-blinded study. Sixty ASA physical status I and II patients presenting for cataract surgery (manual extracapsular lens extraction) under PB were included. Patients were randomized to 2 groups: rocuronium group (n = 30) received PB with a local anesthetic mixture (Lidocaine 2% + Bupivacaine 0.5%) to which was added 0.06 mg/Kg of rocuronium and control group (n = 30) received PB with the same mixture to which was added saline. Akinesia was assessed with a 12-point scale at 2, 5 and 10 minutes after injection (each of the four rectus muscles and each lid was scored from 0 to 2: 0 = total akinesia, 1 = partial akinesia, 2 = no akinesia). The need for supplementary injection, adverse effects and complications were also recorded.

Rocuronium group demonstrated significantly better akinesia scores than control group at 2, 5 and 10 minutes post PB (p < 0.05). Supplementary injection was necessary in 4 patients (13%) in rocuronium group versus 12 patients (40%) in control group (p = 0.039). No significant complications were recorded. Rocuronium added to a mixture of local anaesthetics at a dose of 0.06 mg/Kg improved the quality of akinesia in PB and reduced the need for supplementary injections.

Key words: peribulbar block, regional anesthesia, neuromuscular blockade, rocuronium, local anesthetics

INTRODUCTION

Regional anesthesia and particularly peribulbar block (PB) is widely used for ophthalmic surgery. Limited diffusion of local anesthetics (LA) is the main disadvantage of PB, giving rise to the need for repeated injections (1). This also increases the frequency of complications such as globe perforation and hemorrhage (2). To prevent this and to increase tissue diffusion, hyaluronidase is an adjuvant which is added to LA (3, 4). Other adjuvants such as clonidine, epinephrine and alkalinization were also used to improve PB (5-7). Some studies have suggested that the addition of low dose of neuromuscular blockers to LA in PB provides excellent akinesia (8, 9). The purpose of this study was to test the hypothesis that rocuronium added to a mixture of LA could improve akinesia in PB.

METHODS

This study was conducted in the department of anesthesiology of Mohammed V Military Hospital in Morocco. After approval of our institution’s local ethics committee and informed consent, sixty patients scheduled for elective cataract surgery (manual extracapsular lens extraction) under Peribulbar Block (PB) were included in the study. Exclusion criteria were history of abnormal bleeding, allergy to local anesthetic agents, communication problems, axial length of globe measured by echography greater than 26 mm and neuromuscular diseases.

Patients were randomly allocated to 2 groups: “rocuronium group” (n = 30) received a standard 9 ml local anesthetics (LA) mixture to which was added 0.06 mg/kg of rocuronium made up to 1 ml with saline and « control group » (n = 30) received the same standard mixture to which was added 1 ml of 0,9% saline. The LA mixture used consisted of 4,5 ml bupivacaïne 0,5% + 4,5 ml lidocaine 2%. The maximum dose of rocuronium added was 5 mg and the maximum volume of LA solution injected was 10 ml. The injected volume was not predetermined but adjusted to each patient the injection was continued until proptosis and lid fullness appeared

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with a sensation of full orbit. The stability and compatibility of rocuronium when mixed with the LA mixture was verified by our pharmacy department.

Randomization was performed using statistical tables. The LA solution used for each patient was revealed by opening sealing envelopes. It was prepared by a nurse anesthetist who draws up the LA mixture and handed an unlabelled syringe to the anesthesiologist who performed the block.

Patients were premedicated orally with hydroxyzine (1 mg/kg) 1 hour prior to the surgery. On arrival in the anesthetic room, a peripheral IV catheter was inserted and standard monitoring including pulse oximetry, electrocardiogram and automated non invasive blood pressure, was started. Before performing PB, baseline globe movements in the major directions of gaze (superior, inferior, medial and lateral) were assessed. Then, topical anesthesia of the conjunctiva and cornea was provided by administering 2 – 3 drops of 0.4% oxicuprocaine and 0.3 – 0.5 mg/kg propofol was injected intravenously to obtain a brief period of sedation during the puncture. The same experienced anesthesiologists, blinded to the LA solution used, performed the PB and scored the progression of akinesia. The PB was performed by tranpalpebral injection at the third lateral of the inferior eyelid (inferotemporal injection).

LA solution was injected using a 25 mm 25 G needle until proptosis and lid fullness developed. The needle was introduced along the inferior wall of the orbit to a depth of 20 mm with the sharp bevel facing the globe. The direction of injection was almost perpendicular to the frontal plane and parallel to the sagittal plane; the eye was in the neutral position. Injection was performed after negative aspiration. A gentle digital massage of the eyeball, between scoring the akinesia, facilitated diffusion of LA mixture.

Patients were evaluated for ocular and eyelid movements at T2, T5 and T10 respectively 2, 5 and 10 min after injection. A 12-point scale was used (each of the four rectus muscles and each lid was scored from 0 to 2: 0 = total akinesia, 1 = partial akinesia, 2 = no akinesia). Evaluation of akinesia was done by the same anesthesiologist who performed the PB. If the block was insufficient 10 min after the injection (total ocular movement score ≥ 6 or full movement in any direction), a supplementary injection was performed via the same inferotemporal approach, using 3 to 6 mL of lidocaine 2%. Before surgery, the sensory block was evaluated by the pinprick test, which was gently done at the conjunctiva. Pain during surgery was assessed in the post-operative period by using a verbal rating scale ranging from 0 to 10 (0 = no pain, 10 = the worst pain possible). The surgeon’s and patient’s satisfaction (both blinded to group assignment) was assessed using a satisfaction verbal rating scale from 0 (total dissatisfaction) to 10 (total satisfaction).

Patients’ characteristics included age, sex, weight, ASA status, axial length of the globe measured by echography and duration of surgery. The volume of local anaesthetics required to proptosis and fullness of the upper eyelid was noted. The need for supplementary injection, adverse effects and complications were also recorded.

Patients were also asked to report any weakness. To verify that rocuronium injection was safe, we monitored neuromuscular function in 10 patients in the rocuronium group. Neuromuscular function was monitored with a supramaximal train-of-four (TOF) stimulations every 10 min during surgery and every hour during a 6 hours period postoperatively. TOF stimulations were applied on the ulnar nerve and the acceleration of the adductor pollicis was assessed using an acceleromyograph.

**Statistical analysis**

To calculate the required sample size, we wished to detect a 2 points difference between the 2 groups in the akinesia score. With a power study of 80% and □ = 5 %, it was necessary to include 28 patients per group, so we decided to include 30 per group. The Gaussian distribution of variables was assessed using Kolmogorov-Smirnov test. The Mann Whitney U-test was used to compare akinesia scores, patient’s satisfaction, surgeon’s satisfaction and pain during surgery. The Student’s t-test was used to compare age, volume of LA injected and duration of surgery. The fisher’s exact test was used for ASA status, sex, the need for supplementary injections and for potential complications.

**Results**

The patients’ characteristics, duration of surgery and volume of LA injected were comparable in the 2 groups. No difference in pain scores between the two groups was noted during the surgery. Patients’ and surgeon’s satisfaction scores were also similar between the two groups (Table 1). The mean
amount of rocuronium added to the LA mixture in rocuronium group was 4.2 ± 0.7 mg and the mean amount injected to patients was 4.0 ± 0.6 mg.

Rocuronium group demonstrated significantly better akinesia scores than control group at 2, 5 and 10 min post injection (Fig. 1). Four patients in rocuronium group (13%) and twelve patients in control group (40%) required a supplementary injection 10 min after block placement because of inadequate motor block (akinesia score > 6) and the difference was statistically relevant (p = 0.039). After the supplementary injection, akinesia scores were < 6 for all patients, and it was never necessary to make a third injection. In both groups, sensory block was always satisfactory after the first injection and the supplementary injection was necessary only due to an insufficient akinesia.

PB complications were similar in both groups. Chemosis developed in 3 patients in the rocuronium group and in 4 patients in the control group (p = 0.99). No other significant adverse effects or complications were recorded. None of the patients experienced signs of muscle weakness, hypoxia or respiratory distress. In the 10 patients in whom the neuromuscular function was monitored, no modification of the TOF ratio was observed.

Before they were discharged, ocular motricity was examined in patients of both groups, at

### Table 1

<table>
<thead>
<tr>
<th></th>
<th>Rocuronium group (n = 30)</th>
<th>Control group (n = 30)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>61 ± 14</td>
<td>57 ± 14</td>
<td>0.32</td>
</tr>
<tr>
<td>Sex (M / F)</td>
<td>11 / 19</td>
<td>17 / 13</td>
<td>0.19</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>72 ± 14</td>
<td>70 ± 12</td>
<td>0.53</td>
</tr>
<tr>
<td>ASA physical status (I / II)</td>
<td>10 / 20</td>
<td>15 / 15</td>
<td>0.29</td>
</tr>
<tr>
<td>Axial length (mm)</td>
<td>23 ± 1</td>
<td>24 ± 1</td>
<td>0.15</td>
</tr>
<tr>
<td>Duration of surgery (min)</td>
<td>31 ± 13</td>
<td>33 ± 10</td>
<td>0.45</td>
</tr>
<tr>
<td>Volume injected (ml)</td>
<td>8.6 ± 2</td>
<td>8.4 ± 1.4</td>
<td>0.74</td>
</tr>
<tr>
<td>No. of patients requiring supplementary injection</td>
<td>4 (13%)</td>
<td>12 (40%)</td>
<td>0.039</td>
</tr>
<tr>
<td>Volume injected in the supplementary injection</td>
<td>4.5 ± 0.6</td>
<td>4.8 ± 0.5</td>
<td>0.27</td>
</tr>
<tr>
<td>Pain during surgery (VRS)</td>
<td>0 [0 – 1]</td>
<td>0 [0 – 1]</td>
<td>0.87</td>
</tr>
<tr>
<td>Surgeon satisfaction (SVRS)</td>
<td>9 [8 – 10]</td>
<td>9 [8 – 10]</td>
<td>0.93</td>
</tr>
<tr>
<td>Patient satisfaction (SVRS)</td>
<td>10 [8.75 – 10]</td>
<td>9 [8 – 10]</td>
<td>0.23</td>
</tr>
</tbody>
</table>

VRS: verbal rating scale from 0 (no pain) to 10 (unbearable pain), SVRS: satisfaction verbal rating scale from 0 (total dissatisfaction) to 10 (total satisfaction).

Fig. 1. — Akinesia scores at 2, 5 and 10 min post injection of the mixture of local anesthetic in peribulbar block, box plot represents median, quartiles and extremes. *: p < 0.05, white box plot: rocuronium group, grey box plot: control group.

24 hours post surgery. They all recovered a normal ocular motricity.

**Discussion**

This study has shown that the addition of rocuronium to a LA mixture in PB provided better ocular akinesia and reduced the need for a supplementary injection.

LA solutions were frequently combined with numerous adjuvants in order to enhance the quality of PB (3-7). Neuromuscular blockers were used as adjuvants to LA in two trials (8, 9). Reah et al. added a dose of 0.5 mg of vecuronium to a mixture of bupivacaine-lidocaine with 15 UI/ml of hyaluronidase (9). They found that vecuronium improves the quality of glob and lid akinesia without side effects. In the study of Kucukyavuz et al., 5 mg of atracurium were added to the same anesthetic mixture without hyaluronidase and similar results were retrieved (8). In these two studies, PB was performed using a 2 injections technique (inferotemporal and medial orbital). In our study a single inferotemporal injection was used because it has been demonstrated that a single injection technique is as effective as 2 injections technique (10).

The addition of neuromuscular blockers to LA does not affect analgesia, but because of their effect on motor nerves, they induce akinesia in extraocular muscles and therefore optimizing the setting for ophthalmic surgeries. The possible mechanisms of action of neuromuscular blockers are still unclear.
The hypothesis is that they could have a topical action in the motor neurons of the ocular or they could interfere with muscle spindle activity. As a consequence, muscle tone and spasm decreased.

An important issue is the potential risk for inadvertent intravenous injection of a mixture containing a neuromuscular blocker and the risk for systemic resorption of rocuronium from peribulbar injection which could generate muscular weakness. In fact, an author reported a case of systemic spread of vecuronium mixed with lidocaine and bupivacaine in peribulbar block (11). However, the analysis of this case report found that the vecuronium dose used by this author (2 mg) was four times much higher than recommended (0.5 mg) (9). In our study, the dose of 0.06 mg/kg of rocuronium, which was added to LA mixture, was chosen since it represents 10% of the standard intubating dose (2×ED95). We hypothesized that this dose could be safe because it was used as a priming dose (2×ED95 of rocuronium) and was expected to occupy 75% of the postsynaptic receptors without any significant side effect (12). However, the concept of priming has been largely abandoned. In the other hand, the monitoring of the TOF ratio did not showed any alteration in the neuromuscular function. In our study, the neuromuscular function was monitored in only 10 patients for some convenience reasons. We recommended the use of this monitoring for each patient if rocuronium is added to PB.

It is debatable if complete akinesia is still necessary for modern ocular surgery. With the introduction of phacoemulsification techniques, cataract surgery can be successfully performed with topical anesthesia reducing the clinical relevance of complete motor block. However, in countries with limited resources, manual extracapsular lens extraction is still widely used in cataract surgery. Moreover, many ophthalmic surgeons prefer to operate on immobile eyes and akinesia still remains of interest for many ophthalmic surgery procedures. In addition, recent study suggests that patients also prefer peribulbar block to topical anesthesia during cataract surgery (13).

In conclusion, adding rocuronium to LA in PB during cataract surgery enhances ocular akinesia and reduces the need for supplementary injections. However, the safety of using non-depolarizing muscular relaxants in ocular anesthesia could not be confirmed in this small sample of patients.

Acknowledgments

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References