Retinal Ischemic Hazards of Peribulbar Block with and without Hyaluronidase in Patients Undergoing Phacoemulsification: A Prospective Study

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Abstract

Background: The vast majority of ophthalmic surgeries are performed under regional anesthesia [1]. Complications of local anesthesia include ischemic optic neuropathy, occlusion of central retinal artery and retinal ischemic infarction.

Methods: Sixty patients undergoing phacoemulsification were studied prospectively; Group I (n=30) received peribulbar block with hyaluronidase and Group II (n=30) received peribulbar block without hyaluronidase. Central retinal mean flow velocity was measured.

Results: The parameters were comparable with less percentage reduction in ocular blood flow in Group (I) after the block (1.7±3.1) than Group (II) were the reduction percentage was (3.4±3.2).

Conclusions: Adding hyaluronidase to the peribulbar block for cataract surgery was associated with favorable outcome on ocular blood flow and less risk of retinal ischemia.

Key Words: Pulsatile ocular blood flow – Retinal blood flow & local ophthalmic anesthesia – Peribulbar anesthesia – Colored Doppler imaging of central retinal artery.

Introduction

THE vast majority of ophthalmic surgeries are performed under regional anesthesia only. Eye blocks have long been limited to retrobulbar anesthesia performed by surgeons. Surgical technique changes and research on improving patient safety has resulted in the development of alternative techniques, such as peribulbar anesthesia, sub-Tenon block or topical anesthesia [1].

Ophthalmic regional anesthetic blocks provide a practical means to achieve analgesia and akinesia of the globe. Many ophthalmic surgeons prefer operating milieu on an immobile eye and the reassurance of suppression of the oculocardiac reflex. Patients may prefer regional anesthesia as it provides postoperative pain relief [2].

Retinal vessels are said to be “end vessels” because they do not anastomose with any other system of blood vessels [3].

Complications of local anesthesia, beside penetration of the needle in the globe include retinal ischemic infarction. This implies that there is a vascular change after local anesthesia and the complication risk differs by local anesthetic technique and drug supplement, and vascular risk factors of the patients [4].

The reason for decrease in ocular blood flow after local anesthesia is unknown. Two hypothesis have been discussed: (1) A decrease in perfusion may be caused by the volume injected, which also appears to be responsible for the IOP increase. (2) Reduced ocular blood flow may be caused by direct pharmacologic vasoconstriction induced by local anesthetic agents [5].

This study highlights the changes in ocular blood flow that occur with peribulbar anesthesia with hyaluronidase and without hyaluronidase; in order to lessen the incidence and timing of ischemic changes affecting the retina; that may accompany this techniques.

Patients and Methods

After approval of ethical committee 60 patients aged between 50 and 70 years, undergoing cataract surgery by phacoemulsification technique were studied prospectively at the research institute of
ophthalmology during the period (January 2013-January 2014). Patients were assigned to 2 groups where; Group (I) received peribulbar block with hyaluronidase and Group (II) received peribulbar anesthesia without hyaluronidase.

Inclusion criteria were normal axial length (18-25mm), ASA I and ASA II. Exclusion criteria were glaucoma, diabetes, tremors or abnormal body movements, difficulty in hearing and communication, inability to lie flat and bleeding tendency or coagulation disorders in patients whose INR level more than 2.5.

The study was started approximately 20 minutes prior to the operation. On arrival to the OR an intravenous cannula was inserted in all patients and standard monitors were applied to measure vital signs through the procedure. Sedation was given to the patients in the form of 1mg midazolam with 20mic fentanyl.

Doppler ultrasound using vivid 7 dimension apparatus with linear probe 3 to 10MHz was performed to measure the mean flow velocity (MFV) through the entire cardiac cycle of the central retinal artery.

Baseline retinal blood flow was taken followed by local anesthesia were Group (I) was given peribulbar block: By injection of 8-10ml of mixture of lidocaine 2% and bupivacaine 0.5% into the infratemporal and medial canthus regions with 75 units of hyaluronidase and Group (II) without hyaluronidase. Retinal blood flow was measured after the block.

**Results**

There was no statistical significant difference between the two groups regarding vital signs.

Data presented in (Table 1) shows that there is a lower mean MFV in Group I after anesthesia when compared to the levels before anesthesia and the difference is highly significant.

Table (1): Mean flow velocity changes in central retinal artery before and after anesthesia in Group I.

<table>
<thead>
<tr>
<th></th>
<th>Before Mean±SD</th>
<th>After Mean±SD</th>
<th>Paired t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean flow volume</td>
<td>11.6±0.4</td>
<td>11.1±0.5</td>
<td>12.3</td>
<td>0.000**</td>
</tr>
<tr>
<td>Mean flow volume</td>
<td>11.6±0.4</td>
<td>2.0</td>
<td>0.05</td>
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</tbody>
</table>

**p<0.01 Highly significant.

There is a lower mean MFV after anesthesia compared to before anesthesia levels and the difference is highly significant statistically.

Table (3): Differences in mean flow velocity between group I and Group II at baseline measurement and after the block.

<table>
<thead>
<tr>
<th>MFV</th>
<th>I</th>
<th>II</th>
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<tbody>
<tr>
<td>Baseline</td>
<td>11.6 (0.4)</td>
<td>10.5 (0.5)</td>
</tr>
<tr>
<td>After</td>
<td>11.1 (0.5)</td>
<td>8.8 (0.4)</td>
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Table (4): Percentage reduction difference between the 2 groups.

<table>
<thead>
<tr>
<th>MFV</th>
<th>Mean</th>
<th>SD</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduction in %:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group I N=30</td>
<td>4.6</td>
<td>15</td>
<td>0.000</td>
</tr>
<tr>
<td>Group II N=30</td>
<td>16.4</td>
<td>4.4</td>
<td></td>
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</table>

p<0.01 Highly significant.

There is a lower mean reduction percentage in Group I for MFV change compared to Group II and the difference is highly significant statistically.

**Discussion**

Ophthalmic regional anesthetic blocks provide a practical means to achieve analgesia and akinesia of the globe [2]. Anesthesia techniques can be broadly divided into two groups: Those that block motor function of the extraocular muscles such as peribulbar and retrobulbar blocks, and thus render the eye akinetic, and those that do not affect globe motility such as topical anesthesia [6]. The effect of different anesthetic techniques and drugs on ocular blood flow is not clearly understood, there is increasing evidence that invasive local techniques are associated with rise in IOP and reduction in ocular blood flow [7].

Mayer et al., showed that local anesthetics like bupivacaine can impair nitric oxide mediated relaxation in porcine ciliary arteries, thereby decreasing ocular blood flow [8].

With increasing evidence that alterations in ocular blood flow are involved in the pathogenesis of various ocular diseases, a plethora of techniques
for evaluating and monitoring the vascular status of the eye has evolved. These include color Doppler imaging, blue fluid entopic phenomenon, laser Doppler velocimetry and flowmetry, transcranial Doppler, and magnetic resonance imaging [9].

In this study, color Doppler imaging was used to measure mean blood flow velocity in the central retinal artery and one of the most common used blocks; peribulbar block and a commonly used additive in ophthalmic anesthesia which is hyaluronidase were used to compare changes in the central retinal artery mean flow velocity before and after giving the block to choose the safer method whether to give peribulbar anesthesia with hyaluronidase or not.

Results from the study showed that, the drop of MFV was less in patients who were given peribulbar technique with the addition of hyaluronidase than those given the same technique without addition of hyaluronidase.

Results in other studies of the effect of peribulbar anesthesia on ocular blood flow were comparable to our results [11,12].

A study by Lung et al., [10] was done to test the hypothesis that ocular blood flow response to peribulbar anesthesia can be reduced by using a smaller volume of anesthetic mixture, the study assumed that part of the reduction in the ocular blood flow after anesthesia is due to a volume effect that increases IOP and has a concomitant effect on perfusion but a reduction in ocular perfusion parameters was also seen with the smaller volume of peribulbar anesthesia, indicating that pharmacologically induced vasoconstriction maybe also a factor. The study concluded that peribulbar anesthesia with an injection volume of 2ml reduced the blood flow to a lesser extent than did an injected volume of 5ml assuming that part of the reduction in the blood flow after anesthesia is due to volume effect that increases the IOP and decreases the ocular perfusion. This study is not directly comparable to the present study, however it used one of the techniques used in it which is the peribulbar technique but the present study compared using the same technique with the addition of hyaluronidase and without addition of it. Favouring at the end, the use of peribulbar anesthesia with addition of hyaluronidase.

A study by Chung et al., [11] used pneumatography to measure the pulsatile component of blood flow aiming at examining the effect of peribulbar local anesthesia (with and without Honan's balloon compression) on pulsatile ocular blood flow and intraocular pressure and to compare it with the less invasive subconjunctival block, assuming that increase in the IOP causes an immediate and statistically significant reduction in the ocular blood flow probably by increase in IOP causing reduction in the perfusion pressure and obstruction of the venous drainage and that balloon compression decreases the IOP and improves the perfusion pressure which is beneficial in patients with compromised ocular circulation.

A study by Findle et al., [12] concluded that pulsatile choroidal blood flow and retinal blood flow velocities were reduced after peribulbar anesthesia. These reductions were still present 5 minutes after peribulbar anesthesia, when intraocular pressure has returned to its baseline values. This, also supports the theory of drug induced vasoconstriction after peribulbar anesthesia.

A study by Lamichhane and Gautam [13] concluded that retinal artery occlusion after routine cataract surgery is unusual. It reviewed the literature on CRAO after routine intraocular procedures and proposed three hypotheses regarding the potential mechanisms involved. Although peribulbar anesthesia avoids direct optic-nerve injury, indirect injury presenting as CRAO may occur from vasospasm in response to the injection. A vasoconstrictive effect of the anesthetic agent on the central retinal artery, a rise in IOP after anesthesia administration resulting in closure of the central retinal artery and a mechanical effect of the volume of anesthetic on the central retinal artery are considered as possible mechanisms, with a mechanical effect being the favored hypothesis.

On reviewing literature no studies were found comparing the effects of local anesthetic techniques on ocular hemodynamics with or without adding hyaluronidase. The present study found out that using peribulbar anesthesia for phacoemulsification by adding hyaluronidase was associated with favorable effect on central retinal circulation and ocular blood flow so its use is recommended.

**References**

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