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Original Article/นิพนธ์ต้นฉบับ

Comparison of Pupil Dilation between Adrenaline 0.6 microgram/ml and 1.0 microgram/ml in Balance Salt Solution Intracamerally during Phacoemulsification

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Abstract

Objective: To study pupillary dilation in patients using intracameral Adrenaline 0.6 microgram/ml in balance salt solution (BSS) (group A) and adrenaline 1.0 microgram/ml (group B) during phacoemulsification.

Study design: Prospective randomized clinical study.

Method: Study participants are patients underwent phacoemulsification in Trang Hospital by a single surgeon. The patients' age, sex, underlying diseases, cataract type, IOL power, pre- and post-operative visual acuity were collected. The patients were randomized into group A (using adrenaline 0.6 microgram/ml) And group B (using adrenaline 1.0 microgram/ml). Pupil diameters of each patient were measured using caliper under operating microscope 3 times, first at the beginning of the surgery, second at one minute after intracameral adrenaline in BSS irrigation, and third after viscoelastic injection. Standard phacoemulsification was performed and the patients were managed routinely after the operation.

Results: There are 65 patients participated in the study. The average age was 67.8 ± 10.9 years. Fifty four percent of the patients were male. The average pre-adrenaline injection pupil diameters were 5.6 ± 0.8 mm in group A and 6.0 ± 0.9 mm in group B. The average pupil diameters after adrenaline application were 6.6 ± 1.0 mm in group A And 7.1 ± 0.8 mm in group B. The average pupil diameters after viscoelastic injection were 7.3 ± 0.8 mm in group A and 7.7 ± 0.8 mm In group B. The mean visual acuity at one-week post-operation were 20/40 in group A and 20/30 in group B. One person in group A had A post-operative complication (increased intraocular pressure) which responded well after treatment.

Conclusion: Both concentration of adrenaline in BSS applied Intracamerally can increase pupillary dilation and are useful in Phacoemulsification.

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บทคัดย่อ

เปรียบเทียบการขยายรูม่านตา ระหว่างการใช้อะดรีนาลีน ความเข้มข้นที่แตกต่างกัน ในสารละลาย BSS ฉีดเข้าในช่องหน้าตาในระหว่างการผ่าตัดต้อกระจก

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วัตถุประสงค์: เพื่อศึกษาผลในการขยายม่านตา จากการใช้อะดรีนาลีน ความเข้มข้น 0.6 ไมโครกรัมต่อมิลลิลิตร (กลุ่ม A) ในสารละลาย Balance Salt Solution (BSS) เทียบกับอะดรีนาลีน ความเข้มข้น 1.0 ไมโครกรัมต่อมิลลิลิตร (กลุ่ม B) ในการขยายม่านตา โดยฉีดเข้าในช่องหน้าตาในระหว่างการผ่าตัดต้อกระจก โดยใช้คลื่นเสียงความถี่สูง (phacoemulsification)

รูปแบบการศึกษา: เป็นการศึกษาแบบ prospective randomized clinical study

วิธีการ: ผู้เข้าร่วมในการศึกษา เป็นผู้ป่วยที่มาผ่าตัดต้อกระจก ด้วยวิธีการสลายต้อ ด้วยคลื่นความถี่สูงและใส่เลนส์แก้วตาเทียม ในโรงพยาบาลตรัง โดยจักษุแพทย์คนเดียวกัน เก็บข้อมูลอายุ เพศ โรคประจำตัว ชนิดของต้อกระจกกำลังของเลนส์แก้วตาเทียม ค่าความชัดในการมองเห็น (visual acuity) ก่อนและหลังผ่าตัด ทำการสุ่มให้ผู้ป่วยเข้าในกลุ่มทดลอง วัดขนาดของรูม่านตาด้วย caliper ภายใต้กล้องผ่าตัด โดยวัดสามตรั้ง ครั้งแรกตอนเริ่มผ่าตัด ครั้งที่สอง ณ เวลาหนึ่งนาที่หลังใช้ BSS ผสมยาอะดรีนาลีนฉีดล้างในช่องหน้าตา และครั้งที่สามหลังฉีด viscoelastic หลังจากนั้นทำการผ่าตัด phacoemulsification และติดตามผลการผ่าตัด

ผลการศึกษา: ผู้ป่วยเข้าในการศึกษา 65 ราย อายุเฉลี่ย 67.8 ± 10.9 ปี เพศชาย 53.8% ขนาดของรูม่านตาเฉลี่ยก่อนฉีดยาอะดรีนาลีน กลุ่ม A 5.6 ± 0.8 มม. กลุ่ม B 6.0 ± 0.9 มม. หลังฉีดอะดรีนาลีน กลุ่ม A 6.6 ± 1.0 มม.กลุ่ม B 7.1 ± 0.8 มม.และหลังฉีดสารหนืด กลุ่ม A 7.3 ± 0.8 มม. กลุ่ม B 7.7 ± 0.8 มม. ค่าเฉลี่ยสายตาของผู้ป่วยหลังผ่าตัดหนึ่งสัปดาห์ ของกลุ่ม A คือ Snellen 20/40 ของกลุ่ม B คือ Snellen 20/30 เกิดภาวะแทรกซ้อนเป็นความดันลูกตาสูงหลังผ่าตัด หนึ่งรายในผู้ป่วยกลุ่ม A หลังได้รับยารักษาพยาบาลหนึ่งคืน ผู้ป่วยก็กลับสู่ภาวะปกติ

สรุป: สารละลายอาดรีนาลีนใน BSS ทั้งสองความเข้มข้น สามารถขยายรูม่านตาเพิ่มถึงขนาดที่สามารถผ่าตัดต้อกระจกด้วยวิธีสลายต้อด้วยคลื่นความถี่สูงและใส่เลนส์เลนส์แก้วตาเทียม ได้อย่างปลอดภัย

Introduction

Phacoemulsification and aspiration, and extracapsular cataract extraction are performed more easily if mydriasis can be maintained until the intraocular lens has been inserted.[1] If the pupil diameter becomes less than 7.0 mm, surgery becomes more difficult.[2] It is important to maintain optimal adrenaline concentration in the irrigating solution, especially for diabetic eyes where constriction of the pupil during ophthalmic surgery is more pronounced[3]. The maintenance of mydriasis during the entire procedure is therefore crucial. This can be achieved with the use of phenylephrine and tropicamide ophthalmic solutions before surgery. However, most drugs are administered before surgery and flushed out

of the eye by the intraocular irrigation solution[4]. In this regard, intraocular irrigation with 1.0 µg/ml adrenaline provides a significant benefit in maintaining mydriasis during surgery[5]. Some surgeons in Scandinavian however use 0.6 µg/ml adrenaline in the BSS.[6]. Adrenaline directly stimulates the dilator pupillae, but when applied to the conjunctiva, the 1:1000 solution (1.0 mg/ml) does not penetrate into the normal eye in sufficient quantities to have an obvious mydriatic effect[7]. Early experience with intraocular adrenaline resulted in a few cases of severe corneal decompensation following the use of 1:1000 concentration[8], but not 1:5000[9]. The local safety of lower concentrations of adrenaline has since been demonstrated by histological studies of the endothelium in cats[10] and rabbits,[11] and by clinical examination in humans.[12,13] One advantage of using intraocular continuous irrigation with adrenaline as opposed to a bolus, is that it continues to be exposed to the eye while the stimulus to miosis persists. Furthermore, there was no correlation between the flow rate of the irrigating solution and the rate of miosis when Irrigation solutions containing adrenaline were used.[14] A study also showed that intraocular irrigation with adrenaline kept the pupil well dilated and did not have adverse effect on the patient's pulse rate or blood pressure[5]. Therefore, intraocular irrigation with 1.0 µg/ml adrenaline is widely used to maintain pupil dilation during surgery.[5,6,15] Adrenaline is rapidly decomposed by oxidizing agents in aqueous solution. This process is increased by the presence of oxygen or transition metal ions, and by exposure to light, to alkaline PH, or to increase in temperature.[16,17] If ophthalmologists fail to maintain patient mydriasis during surgery from an adrenaline concentration decrease with time, the surgeon's impaired visualization through the small pupil may increase the risk of damage to the iris, and may cause incomplete clearance of soft lens matter: or more importantly, could result in the rupture of the posterior capsule[5]. As in the time of the 10%phenylephrine eye drops shortage. I researched the 1.0 µg/ml adrenaline in BSS. and the 0.6 µg/ml. adrenaline in BSS. to see whether both solutions could increase the dilation of the pupils after topical dilation with 1% tropicamide eye drops or not: and see which solution is better for this purpose and their results.

Materials and Methods

This is a prospective randomize clinical study by collecting data from 65 patients who underwent cataract surgery by phacoemulsification and intraocular lens implantation. Excluding; patients who have diabetes with proliferative diabetes retinopathy, advanced glaucoma or those who used pilocarpine eye drops, patients who have been uveitis, patients who have previous ocular surgery, or ocular trauma, patients who have congenital ocular abnormality, patients who have only one eye, patients who have corneal abnormality. The author collected these patients from august to October 2019. The patients were divided into two groups; group A 32 persons (using adrenaline 0.6 microgram/ml), and group B 33 persons And group B (using adrenaline 1.0 microgram/ml). All patients underwent cataract surgery by the same surgeon. Every patient

knows their disease, how to surgery, and has informed consented on the day of admission to hospital. The following details of the patients were recorded as; name, age, gender, hospital number, underlying diseases, diagnosis and type of cataract, the power of intraocular lens of each one. On the morning of day of surgery, all patients had 1% tropicamide eye drops 6 times in ten minutes interval. When beginning the surgery after subconjungtival lidocaine injection. We measured the diameter of the pupil for the first time by a caliper under the operating microscope. Then we made a side port with a 21 gauge needle then we fill the anterior chamber with 0.075% trypan blue dye to dye the anterior capsule. Following that we made a 2.8 mm main port with a slit knife. We then irrigated the anterior chamber with a water bulb for one minute. In group A, we used 0.6µg/ml of adrenaline in BSS solution for the irrigating solution. In group B, we used 1µg/ml of adrenaline in BSS solution for the irrigating solution, to wash out the trypan blue dye, and to dilate the pupil more. Then we measured the diameter of the pupil for second time with a caliper under the microscope. After that we filled the anterior chamber with a cohesive viscoelastic device, to maintain the anterior chamber and to increase the dilation of the pupil.[18,19,20] Then we measured the diameter of the pupil for the third time. We then did the 5mm diameter continuous curvilinear capsulorhesis follow by hydrodisection. Then we did the intracapsular phacoemulsification followed with cortex aspiration and polished the posterior capsule. The anterior chamber and capsular bag was filled with the viscoelastic device again and the foldable intraocular len was implanted. We then cleaned up the viscoelastic device, then the corneal hydration was done, and formed the anterior chamber with BSS.

Result

The result of group A were 32 patients: 19males and 13 females. The youngest patient was 40 years old, and the oldest patient was 88 years Old. The average age was 67.3 ± 12.0 years old. The diabetes patients were 8 people. The average IOL power was 21.0 ± 2.0 diopters. The average diameter of the pupils after 1%tropicamind eye drops was 5.6±0.8 mm, the average dimeter of the pupils after irrigation with 0.6µg/ml of adrenaline in BSS solution was 6.6 ± 1.0 mm. The average diameter of the pupils after filling the anterior chamber with cohesive viscoelastic device was 7.3 ± 0.8 mm., the average surgical time was 20.5 ± 3.3 minutes. The phaco power was 12.1 ± 4.5%. the phaco time was 30 seconds. The first week post operation uncorrected VA was Logmar0.30±0.2 or Snell VA was 20/40. There was one case of post-operative increase IOP. Presented with left ocular pain with severe headache. An eye exam found corneal edema with deep anterior chamber and with iris trauma. The disease responded well with diamox one tablet every six hours 20% manitol 250 ml intravenously in 45 minutes. together with predforte eye drops every two hours.

The result of group B were 33 patients: 16 males and 17 females. the youngest patient was 48 years old. The oldest patient was 87 years old. The average age of the patients was 68 ± 9.9 years old. The average power of IOL was

Table 1 The baseline data of the two groups.

	Group A	Group B
Number of patients	32	33
Sex	Male 19, Female 13	Male 16, Female 17
Average age	67.3 ± 12.0	68 ± 9.9
Diabetes patients	8	8
The average IOL power	21.0 ± 2.0	19.2 ± 3.9
The average diameter of the pupil after tropicamide eye drops	5.6 ± 0.8 mm.	6.0 ± 0.9 mm.
The average diameter of the pupil after irrigation with the adrenaline in BSS.	6.6 ± 1.0 mm.	7.1 ± 0.8 mm.
The average diameter of the pupil after fill the anterior chamber with the viscoelastic device	7.3 ± 0.8 mm.	7.7 ± 0.8 mm.
Phaco power	12.1 ± 4.5%	11 ± 3.5%
Phaco time	30 seconds	24 seconds
Surgical time	20.5 ± 3.3 minutes	20.4 ± 2.8 minutes
Post-operative first day complication	Increase IOP one case	0
First week post-0perative uncorrected VA	Logmar 0.30 ± 0.2 Snellen 20/40	Logmar 0.20 ± 0.1 Snellen 20/30

19.2 ± 3.9 diopters. The diabetes patients were 8 people. The average diameter of the pupils after 1%Tropicamide eye drops was 6.0 ± 0.9 mm. The average diameter of the pupils after irrigation with 1μg/ml of adrenaline in BSS solution was 7.1 ± 0.8 mm. The average diameter of the pupils after filling the anterior chamber with cohesive viscoelastic device was 7.7 ± 0.8 mm. The average surgical time was 20.4 ± 2.8 minutes. The phaco power was 11 ± 3.5%. The phaco time was 24 seconds. The first week post operation uncorrected VA was Logmar 0.20±0.1 or Snellen VA was 20/30. There were no post-operative serious complications in this group.

Discussion

This is a prospective randomized clinical study. The basic data of the two groups are similar. In terms of the number of patients, the average age, the number of diabetes patients, the average IOL power. After patients' pupil are dilation with 1% tropicamide eye drops. The diameter of the pupil in both groups are not appropriate for the cataract surgery with IOL implantation. (5.6±0.8 mm. in diameter of group A, 6.0±0.9 mm. in diameter of group B) It was difficult to do the cataract surgery.[1,2] So, we dilate more the pupils in both groups with 0.6μg/ml of adrenaline in BSS in group A and with 1 μg/ml of adrenaline in BSS in group B. The result are 6.6 ± 1.0mm in diameter in group A, and 7.1 ± 0.8 mm in diameter in group B. The diameter in group B looks larger

than the group A. However, there is no statistically significant. (Mann-Whitney Test), At the moment, just group B looks like it can have the safe cataract surgery.[1,2.] When we fill the anterior chamber with viscoelastic device,[18,19,20.] the results show both groups have the pupil diameter larger than 7 mm in diameter (7.3 ± 0.8 mm in group A, 7.7 ± 0.8mm in group B), so both groups can have the safe cataract surgery with IOL implantation.[1,2.] We maintain the mydriasis during the entire procedure. In group A 0.6µg/ml adrenaline in BSS was used.[6] In group B 1µg/ml adrenaline in BSS solution was used.[5.] Both groups have similar surgical parameters and surgical outcomes. Such as; phaco power 12.1 ± 4.5% vs 11 ± 3.5%, phaco time, 30 seconds vs 24 seconds, surgical time, 20.5 ± 3.3 minutes vs 20.4 ± 2.8 minutes, first week post- operative visual acuity, Logmar0.30 vs 0.20, or Snellen, 20/40 vs 20/30, respectively. A study showed that, if ophthalmologists fail to maintain patient mydriasis during surgery, the surgeon's impaired visualization through the small pupil may increase the risk of damage to the iris, may cause incomplete clearance of soft lens matter, or could result in the rupture of the posterior capsule[5.] There is one case in group A who has small pupil due to old age and diabetes problem, and has miosis during the surgery. the surgery is difficult, and has damage to the iris. Six hours post-operation, the patient had developed ocular pain and severe headache. An eye exam found corneal edema, deep anterior chamber and tense eye. Diagnosis is Post-operative increase ocular pressure due to iris damage and may retain viscoelastic device. The treatment is diamox one tablet every six hours, 20% mannitol 250 ml intravenously, predforte one drop every two hours. The symptoms and sign improved on next morning.

Conclusions

In the time of 10% phenylephrine eye drops shortage, we can use both 0.6 µg/ml Or 1µg/ml adrenaline in BSS solution to dilate the pupil more. These two concentrations of adrenaline in BSS solution are safe, easy, and have similar results and good surgical performance. In phacoemulsification And intraocular lens implantation surgery.

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