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The Effect of Intracameral Adrenaline Bolus Injection on Pupil Size, Pulse Rate and Blood Pressure During Small Incision Cataract Surgery

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ABSTRACT

Aim: Pupillary miosis during cataract surgery and irrigation and aspiration (I/A) is found to be a major cause of iris trauma, cortex retention, posterior capsule rent, vitreous loss, and even posterior nucleus dislocation. Adequate mydriasis is necessary for safe cataract surgery. Intracameral adrenaline bolus injection can help maintain mydriasis. We designed a prospective interventional study to assess the efficacy and safety of intracameral adrenaline bolus injection after nucleus delivery, as an adjunctive to preoperative topical mydriatics.

Methods: Forty patients with cataract were divided into two groups: Study group and the control group. The study group (20 patients) received intracameral bolus preservative-free adrenaline injection in the dose of 0.1 cc of 1:5000 concentration after nucleus delivery. The diameter of the pupil was measured by surgical calipers before and after nucleus delivery, after injection of intracameral adrenaline in the study group and after IOL placement in both the groups. Pulse rate, systolic, and diastolic pressure were measured before and after the cataract surgery.

Results: The mean pupil size in the study group after nucleus delivery was 5.33mm and 5.32mm in the control group. A significant pupillary dilatation was observed in the study group 30 seconds after the injection of bolus dose of intracameral adrenaline. The mydriasis obtained in the study group (mean 7.67mm) was significantly greater than the control group mean ($p<0.0001$).

The mean pupil size after IOL dialing was 6.86 mm in the study group which was significantly greater than the control group(mean 4.20mm). The mydriasis maintained in the study group was significantly greater than the control group ($p<0.0001$). Pulse rate and blood pressure showed no significant changes during the surgery in both the groups.

Conclusion: We concluded that intracameral preservative-free adrenaline bolus injection (0.1cc of 1:5000) is a safe and effective adjunctive to topical mydriatics in maintaining mydriasis during surgery.

Key Words: SICS, Intracameral, Adrenaline, Bolus, Cataract, Dilatation, Mydriasis

INTRODUCTION

Cataract surgery is performed better if dilatation of the pupil is maintained until the intraocular lens (IOL) has been inserted[1]. Failure to maintain the dilatation during surgery can escalate the risk of iris injury, cortex retention, or the more dreadful complication, posterior capsule rent[2]. Adrenaline must be tried before mechanical pupil dilation methods (iris hooks, sphincterotomy) because these methods have some drawbacks, including iris damage and sphincter rupture. Mechanical dilation is also expensive, time-consuming and may require more incisions[3].

The pupil size is dependent on the net effect of opposing factors: adrenergic sympathetic activity stimulating the dilator pupillae thereby causing dilatation[4]; and cholinergic parasympathetic activity acting on sphincter pupillae with the induction of pupillary constriction. Epinephrine directly stimulates the dilator pupillae, but when applied topically to the eye, the 1:1000 solution does not infiltrate into the eye in adequate concentration to produce mydriasis[5].

Preoperative dilatation in cataract surgery is normally achieved by a topical adrenergic agonist with good penetration of the cornea, such as phenylephrine 5% and an anticho-

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linergic drug such as tropicamide 0.8%. During surgery, there is a tendency of the pupil to shrink, particularly after iris manipulation and nucleus delivery[6]. Adrenaline can be directly injected into the anterior chamber intracamerally to help achieve adequate mydriasis of the pupil for more safe and effective surgery.

MATERIALS AND METHODS

This prospective interventional study was carried out in Ophthalmology Department at Datta Meghe Medical College, Shalinitai Meghe Hospital and Research Centre, Nagpur in collaboration with Jawaharlal Nehru Medical College, Datta Meghe Institute of Medical Sciences, Sawangi (Meghe) Wardha, Maharashtra.

Forty cases (25 women, 15 men) undergoing routine extracapsular cataract extraction was randomly divided into two groups- study group and control group. The study group received intracameral adrenaline bolus injection at the dose of 0.1 cc of 1:5000 concentration. The control group did not receive intracameral adrenaline.

All patients underwent full ophthalmic and general physical examination including measurement of blood pressure and pulse rate, random blood sugar and electrocardiogram. Fasting blood sugar, post-prandial sugar, and HbA1c was recorded in diabetic patients. All patients gave informed consent before inclusion in the study.

Inclusion criteria

Patients of either sex undergoing routine cataract surgery.

Exclusion criteria

1. Known allergy to any of the drugs.
2. Previous intraocular inflammation.
3. Patients with traumatic cataract.
4. Patients with congenital cataract
5. Patients with glaucoma
6. Patients with corneal opacities or degenerations

All patients received four drops of phenylephrine 5% and tropicamide 0.8% during the one-hour preceding surgery. All patients in both groups were administered peribulbar block anaesthesia employing a solution of 1:1 compounded 2% lidocaine plus adrenaline 1:200,000 (Lox 2%, Neon Laboratories, India) and 0.5% bupivacaine (Anawin 0.25%, Neon Laboratories, India), with hyaluronidase (Hynidase, Shreya Life Sciences Pvt. Ltd., India) added at 7.5 turbidity units/ml to the solution.

All patients were operated by manual small incision cataract surgery by a single surgeon and by the same technique

20 eyes (Study group) received intracameral bolus injection of preservative free adrenaline (in the dosage of 0.1cc of 1:5000) after the nucleus delivery. 1ml of 1mg/ml (1:1000) adrenaline (Vasocon, Neon Laboratories Ltd., India) was diluted with 4ml of ringer lactate solution.0.1ml of this solution (adrenaline 1:5000) was used to inject intracamerally.

20 eyes (control group) did not receive any intracameral adrenaline injection.

Pupil diameters were measured by surgical calipers before and after nucleus delivery (before injection of intracameral adrenaline, 30 seconds after injection of adrenalin and after IOL dialing in the bag.

Each patient's pulse rate and systolic and diastolic pressure were recorded before and after the surgery.

Data Analysis: Data was analyzed using an un-paired student 't' test.

OBSERVATION AND RESULTS

The present study included 40 Cases (25 females and 15 males). The mean age of the patients was 64.57 years (SD 7.86).

14 patients had a history of type 2 diabetes mellitus. Of these, intracameral adrenaline was injected in 8 patients.

Table 1: Pupil size changes between study and control groups:

Groups	Before Nucleus Delivery (Mm)	After Nucleus Delivery (Before Adrenaline Injection In Study Group)(Mm)	After Adrenaline Injection In Study Group(Before I/A)(Mm)	After Iol Insertion(Mm)
Study Group	7.77±0.67	5.33 ±0.35	7.67±0.29	6.86 ±0.37
Control Group	7.99±0.56	5.32±0.36	5.32±0.36	4.205±0.32
P-value	0.266	0.92	<0.0001	<0.0001

Table No 1 shows Control groups showed a progressive shrinkage of the pupil from 7.99±0.56mm before nucleus delivery to 5.32±0.36mm after nucleus delivery and 4.205±0.32mm after IOL dialing.

The study group showed an initial pupil constriction after nucleus delivery, the pupil was re-dilated using intracameral adrenaline, the dilatation achieved after injection in the study group was significant (p-value <0.0001) in comparison to the control group. The mydriasis maintained after IOL dialing in the study group was significantly greater as compared to control group (p-value<0.0001)

Table 2: Pulse rate changes before and after surgery in study and control groups:

Groups	Before Surgery (/min)	After Surgery (/min)	P value
Study Group	79.2±5.78	79.27±4.50	0.76
Control Group	80.7±6.23	80.5±7.30	0.92

Table no 2 shows: The pulse rate changes before and after surgery in both study group (p value 0.76) and control group (p value 0.92) was not significant.

Table 3: Systolic BP changes before and after surgery in study and control groups:

Groups	Before Surgery	After Surgery	P value
Study group	128.7±9.67	128.2±7.59	0.85
Control group	125.8±7.89	125.7±8.99	O.97

Table no 3 shows: The systolic pressure changes before and after surgery in both study group (p value 0.85) and control group (p value 0.97) was not significant.

Table 4: Diastolic BP changes before and after surgery in study and control groups:

Group	Before Surgery	After Surgery	P-value
Study Group	78.8±5.89	81.6±4.56	0.1
Control Group	79.6±6.41	81.3±5.55	0.37

Table no 4 shows: The diastolic pressure changes before and after surgery in both study group (p value 0.1) and control group (p value 0.37) was not significant.

Table 5: Pupil size changes in diabetic patients.

Groups	Before Nucleus Delivery (MM)	After Nucleus Delivery (Before Adrenaline Injection In Study Group)(MM)	After Adrenaline Injection In Study Group(Before I/A) (Mm)	After Iol Insertion(Mm)
Study Group	7.45±0.60	4.25 ±0.23	7.12±0.29	6.22±0.23
Control Group	8±0.40	4.55±0.26	4.55±0.26	4.1±0.13
P Value	0.07	1.0	<0.0001	<0.0001

14 patients had a history of type 2 diabetes mellitus. Of these, intracameral adrenaline was injected in 8 patients.

Table no. 5 shows that significant pupillary dilatation achieved with injection of intracameral adrenaline in diabetic patients(7.45±0.60) which was maintained till IOL insertion(6.22±0.23) in comparison to control groups(p<0.0001).

DISCUSSION

Manual small-incision cataract surgery (MSICS or SICS) is a low-cost, small-incision type of extracapsular cataract extraction (ECCE) that is mainly in use in the developing countries[7].

The mean age of the patients in our study was 64 years. Old age and frailty is found to be associated with cataract[8] and other systemic co-morbidities[9].

One particular disadvantage in SICS is the constriction of the pupil just after the nucleus delivery (especially if nucleus delivery has been done with the use of wire vectis or phacosandwich method or irrigating wire vectis) which makes cortical clean up a uphill task which may lead to iris injury, prolonged surgical time or the dreaded complication of posterior capsular rupture[10].

14 patients in our study had a history of type 2 diabetes mellitus. Of these, intracameral adrenaline was used in 8 patients. Diabetes mellitus is associated with increased difficulty in cataract surgery due to poor pupillary dilatation, the tendency of the pupil to constrict during surgery, difficult hydrodissection[11-14]. Diabetes mellitus and raised HbA1c is also associated with diabetic retinopathy[15]. No significant complications occurred during this surgery. The mean pupillary dilatation achieved in diabetic patients after injection of intracameral adrenaline was 7.45mm and the dilatation was maintained till IOL insertion(6.22mm). Hence, intracameral adrenaline is useful in the maintenance of mydriasis in diabetic patients in addition to topical mydriatics for safe cataract surgery. This finding is supported by other studies[16].

Supplemental adrenaline bolus injection can be used intracamerally in lower concentrations just after the nucleus delivery to maintain mydriasis until the implantation of an intraocular lens. Preservative free adrenaline was used in this study in the dosage of 0.1cc of 1:5000.

Reports of corneal endothelial damage and cystoid macular edema have been reported with higher concentrations of adrenaline (1:1000)[17,18]. Adrenaline is a known risk factor for pseudophakic cystoid macular edema, but intracameral adrenaline at a concentration of 0.2 mg/mL or lesser (1:5000) has been shown as not to be associated with increased risk of cystoid macular edema[17]. There have been a few reports of severe corneal decompensation after the use of the adrenaline in 1: 1000 concentration[18] but not 1: 5000[19]. Hull et al. showed that the corneal endothelial damage was a result of toxicity due to the sodium bisulphite preservative in the adrenaline preparation and not the adrenaline itself[19,20].

Therefore, using preservative-free low concentration bolus injection of intracameral adrenaline at a dose of 0.1cc of 1:5000 offers a definite advantage in SICS.

Also, some authors suggest the use of adrenaline infusion with I/A containing adrenaline in the concentration of 1:1000,000[21,22]. This method, however, has some drawbacks like contact of anterior segment for a long time with adrenaline and its preservative and also less control over the total volume of adrenaline entering the eye.

The present study indicates that there is pupillary miosis immediately after nucleus delivery in both the groups after supplementing bolus adrenaline injection, there is immediate pupillary dilatation in the study group which is maintained till the end of the surgery. The control group shows a significantly smaller pupil size till the end of surgery (p value<0.0001). No significant complications were recorded in the present study.

Our results were comparable to the study conducted by Liou, et al. which compared the bolus injection of 0.1cc intracameral adrenaline in 5 different concentrations 1:25000, 1:50000, 1:100,000, 1:200,000, and 1:400,000 during phacoemulsification. The 1:400,000 concentrations was shown to be as effective as 1:25,000, but the cases of the 1:400,000 group failed to maintain the mydriasis after irrigation and aspiration. The mean pupillary dilatation in all the five groups was significantly greater than the control group[23].

One particular concern is the changes in pulse rate and blood pressure in patients with the use of intracameral adrenaline. No significant changes in pulse rate or blood pressure were noted in the present study. This finding is supported by previous studies[21-24].

A study by Hassan et al. showed that adrenaline even in higher concentrations was safe on pulse blood pressure. No significant changes were observed in cardiovascular, cornea, or macula in their study[24].

Therefore, in manual small incision cataract surgery, use of adrenaline is safe and effective means of redilating the pupil as well as maintaining the pupil size.

Our study suffered from a few shortcomings notably the non-randomized nature of study which makes drawing any definite conclusion impossible. Also, our sample size in the present study was very small. But this study underscores the need for the design of a larger randomized control study to study the question at hand.

CONCLUSION

We concluded that the use of intracameral preservative-free adrenaline bolus injection in lower concentrations could be a safe and effective adjunctive to topical mydriatics in manual small incision cataract surgery.

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