Phacoemulsification without preoperative topical mydricatics: Induction and sustainability of mydrosis with intracameral mydriatic solution

Kedar Nemivant¹, Aabha Bhalerao²

¹Assistant Professor, Department of Ophthalmology, IMSR, Warudi, Badnapur, Jalna, Maharashtra, INDIA.
²Consultant, Aashirvad Hospital, Aurangabad, Maharashtra, INDIA.

Email: aabhabk@yahoo.co.in

Abstract

Aims: Evaluating the role of intracameral solution (0.5% lignocaine and 0.001% epinephrine) in initiating and maintaining the pupillary mydrosis during phacoemulsification. The other aims were to observe the effect of surgical time, nucleolus density and ultrasound time on mydrosis during procedure. Setting and design: The study is a prospective interventional case series. Materials and methods: 30 patients underwent phacoemulsification under topical anaesthesia for visual significant cataract, pupillary dilatation was achieved by intracameral injection of mydriatic solution. Conclusion: Intracameral solution of 0.5% lignocaine and 0.001% epinephrine provides rapid mydrias which is adequate for safe phacoemulsification.

Keywords:

INTRODUCTION

Modern cataract surgery either by phacoemulsification or manual small incision cataract surgery (MSICS), both require good pupillary dilatation, which at present is achieved by repeated administration of mydriatic/cycloplegic and NSAID (non-steroidal anti-inflammatory drug) eye drop. This preparation for surgery has definite disadvantageous like 1 to 1.5 hour holding of patient in preparation room, contamination of the ocular surface, epithelial toxicity due to preservatives in the topical formulas and discomfort due to frequent installation of the drops. Systemic safety of these topical formulae containing beta agonists and prasympatholytics is doubtful as they are known to cause a rise in blood pressure, staxia, dizziness, and dry mouth. Often due to noncompliance of the patient or staff there may be no dilation or poor dilatation leading to delay in start of surgery causing wastage of man hours and resources. Due to these problems there has been an attempt to search for alternatives to this repeated eye drop installation regimen. Various option like single drop installation, Ocular inserts, depot preparation of mydriatic, and intracameral irrigation of mydriatic-cycloplegic drugs have been used with comparable result. Out of these only intracameral irrigation can obviate the need of pre-operative preparation. For this purpose many drugs have been used, namely

- Lignocaine (0.75%-1%) with epinephrine 0.025%
- Lignocaine solution 1%
- Cyclopentolate 0.1% phenylephrine 1.5% and lignocaine 1%

We have not considered using cyclopentolate solution as studies have confirmed that the use of cyclopentolate does not enhance the action provided by intracameral lignocaine. A part form lignocaine, the other component of this intracameral mydriatic solution is sympathomimetic, for which we have two options, namely phenylephrine and epinephrine. The dual effect of epinephrine to contract the dilator musculature by it's...
of pH. This solution was further diluted fourfold by mixing 0.5 ml of this cocktail with 1.5 ml of BSS (Balanced Salt Solution), this achieving the final concentration of lignocaine 5 mg/ml (0.5%) and epinephrine 0.01 mg/ml (0.001%) or 1,100,000. Topical anesthesia was provided by the use of lignocaine jelly 2% (XYlocain Jelly 2% Astra Zeneca India Ltd.) After making the keratome entry, anterior chamber was irrigated with the intracameral mydriatic solution. There was no specific dose of irrigating fluid delivered; the aim was to replace the aqueous with the irrigating fluid. On an average approximately 0.3 to 0.5 ml of this fluid was irrigated into the anterior chamber. After measurement of pupillary dilatation this mydriatic solution was replaced by 2% methycellulose and capsulorhexis was completed. This mydriatic solution was the only mydriatic agent used during the surgery and epinephrine was not added to the irrigating BSS used, during the phacoemulsification procedure. Phacoemulsification using direct chop technique with in the bag implantation of foldable hydrophilic acrylic intra ocular lens (IOL) (RYCF model, Intra Ocular Care Pvt. Ltd. India) using cartridge and injector through 2.8 mm incision was done.

Pupil size Measurement
Surgical caliper having a least count of 0.5 mm was used to measure the horizontal and vertical diameter of the pupil thrice during the surgery. This was done under microscope view with monocular view using only the right eye of the observer, to avoid any parallax error. Measurement of pupil size was done at following stages during the surgery.

1. Before making the incision (undilated pupil size under the microscope illumination).
2. Thirty seconds after instillation of the mydriatic solution in the anterior chamber.
3. At the termination of the surgery after wound hydration and just before removal of the lid speculum.

Statistical Analysis
Statistical software Medcalc ver.11.4.2.0. for windows was used to perform analysis of the observations. Descriptive analysis was done on the age distribution of the subjects. Undilated pupil size, pupil size after mydriatic solution irritation and at the termination of surgery was compared using paired samples student t-test. Influence of the grade of nuclear sclerosis, duration of surgery and ultrasound time on the pupil size was analyzed using spearman correlation coefficient.

RESULTS
Thirty eyes of thirty patients completed the study; there were no dropouts due to surgical complications. There were no dropouts due to surgical complications. There

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were no dropouts due to surgical complications. There were 15 male patients. The age distribution of subjects was normal (D Agostino-Pearson test P=0.37) with average age being 64.3 years (Range 40.75 SD±8.8). The average pupil size without any mydriasis under the microscope illumination was 2.1 mm (Range 5.9 mm SD±1.12) at 30 seconds time after anterior chamber irrigation with the mydriatic solution. This change was statistically significant with P<0.0001 (paired samples student t-test). When compared to a test value of 7 mm (pupillary dilatation required for comfortable and safe Phacoemulsification) using one sample student t-test, was no statically significant difference (P=0.5). At the end of surgery the average pupillary diameter was 7.0 mm (Range 3.5-9 mm SD ± 0.20). Thus, pupillary mydriasis was not only maintained throughout the surgery but rather there was an increase (0.10 mm average difference) in the size of the pupil at the end of surgery. Though this difference was statistically insignificant (paired student t-test, P=0.24). The pupillary dilatation achieved by the use of intracameral mydriatic solution was adequate for the entire surgical procedure which took 13 min on average (Range 9-18 min SD ± 1.6). There was a weak positive correlation between the pupil size and the surgical duration, which was statistically insignificant (Spearman correlation coefficient 0.13, P=0.46). Nucleus density and pupillary dilatation at the end of the procedure had weak positive correlation which was statistically insignificant (Spearman correlation coefficient 0.09, P=0.60) Fig.1. Ultrasound time had weak positive correlation to final pupillary dilatation at the end of surgery, which was statistically insignificant (Spearman correlation coefficient 0.02, P=0.91) Fig.2. Thus the pupillary dilatation achieved by the use of intracameral mydriatic solution was unaffected by the duration of surgery, grade of nucleus and ultrasound time.

**DISCUSSION**

Adequate pupillary dilatation and maintenance of mydriasis is important for an uncomplicated phacoemulsification. The efficacy of mydriatic solution composed of lignocaine (0.75%-1%) with epinephrine 0.025% in inducing and maintaining pupillary mydriasis during phacoemulsification has been demonstrated earlier. One percent intracameral lignocaine has been demonstrated to be safe for corneal endothelium, but as this toxicity is concentration related, Thus it can be safely presumed that using a lower concentration which can provide, effective anesthesia and mydriasis would be enhancing its’ safety. In our study we have demonstrated that using 0.5% lignocaine in intracameral solution can provide adequate mydriatic effect comparable to a similar study. There are conflicting reports in literature the coreneal endothelial toxicity of epinephrine. Experimental and clinical reports claiming safety of epinephrine solutions with concentrations ranging form 1mg/ml to 0.01 mg/ml are there, and on the other hand there are studies and cases reports caling endothelial toxicity of epinephrine at similar concentrations. We further analyzed these antagonistic reports and found the going by the present evidence endothelial toxicity is related to the buffer capacity of the epinephrine solution, which is in turn is controlled by the concentration of the antioxidant (sodium bisulfite) as well as by the vehicle formulation and a low pH value. Thus epinephrine solution toxicity to endothelium is the by product of formulations, rather than the molecule itself. So, either an endothelial friendly formulation or maximum dilution of available formulation (which is corneal endothelium compatible with regard to concentration and pH) appear to be the possible answers for safe use of intracameral epinephrine. Thus, use of lower concentration of lignocaine and epinephrine can enhance the safety by reducing the toxicity to intraocular structures apart from retaining all the advantages offered by intracameral mydriatic solution. Combination of epinephrine with lignocaine as an intracameral irrigation solution has many advantages apart from providing anesthesia and pupillary dilatation, as it provides better duration of action and more efficacy, aids in hemostasis, and markedly reduces or eliminates risk for IFIS (Intraoperative Iris Syne-drome) in eyes with risk factors such as exposure alpha Bickers and Tamsulosin. We found that the pupillary dilutional in our study was comparable to the findings in a study done by William et al, using similar (but more concentrated) intracameral mydriatic solution. In that study the average pupillary dilution achieved using their higher concentration intracameral mydriatic solution was 7.1 mm ± 0.7 against our average pupillary dilution of 6.9 mm ± 0.11. This indicates a slight increase in the diameter during the surgical procedure in both studies. As the surgical time, nucleus density and ultrasound time increase for any given surgical machine, the cause damage to tissues and which in turn could release of prostaglandins leading to pupillary miosis. Topical NSAIDs (Non-Steroidal Anti-inflammatory Drugs) are used as preoperative medication routinely to prevent this pupillary constriction. In this study we have not used any preoperative NSAID, and yet the pupillary dilatation was maintained. This is an important requirement for safe removal of lens matter and is well catered by our technique of mydriasis. There are few limitation of this study, particularly, the lack of control arm (receiving conventional preoperative topical

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mydriatic regimen). However the study intended to demonstrate feasibility of this method of mydriasis with lower concentration formulation rather than demonstrate comparison to various mydriatic regimens in practice. The study demonstrates that the intracameral solution alone, containing lower concentration of lignocaine and epinephrine provides rapid mydriasis which is adequate for safe phacoemulsification with intraocular lens implantation and this mydriasis is maintained throughout the procedure.

REFERENCES


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