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Original Research Article

A Comparative Study of Initial and Subsequent Intraoperative Mydriasis Between 1:3,00,000 IU and 1:10,00,000 IU Doses of Intracameral Adrenaline

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Abstract

Background: Adequate intraoperative mydriasis is essential for safe cataract surgery. Intracameral adrenaline is widely used, but the optimal concentration remains uncertain.

Aim: To compare the efficacy of initial and sustained intraoperative mydriasis between intracameral adrenaline concentrations of 1:3,00,000 IU and 1:10,00,000 IU.

Materials and Methods: A prospective comparative study was conducted on 60 patients undergoing cataract surgery at Mata Gujri Memorial Medical College and L.S.K. Hospital, Bihar. Patients were divided into two groups after randomization, receiving intracameral adrenaline at either 1:3,00,000 IU or 1:10,00,000 IU concentrations. Initial mydriasis and maintenance of mydriasis during various intraoperative stages were assessed and compared.

Results: Group A (1:3,00,000 IU) showed significantly greater initial mydriasis (7.82 ± 0.54 mm) compared to Group B (7.05 ± 0.51 mm) ($p = 0.004$). Sustained dilation at at various intraoperative was also superior in Group A as compared to Group B ($p < 0.05$). No adverse effects were reported.

Conclusion: Intracameral adrenaline at 1:3,00,000 IU achieves faster and more sustained mydriasis than 1:10,00,000 IU, enhancing surgical conditions without added risk.

Keywords: Intracameral adrenaline, Mydriasis, Cataract surgery, Pupil dilation.

Introduction

In order to offer sufficient visualisation and simplify surgical manipulation, mydriasis or pupillary dilatation is a necessary precondition for intraocular procedures like cataract extraction. Achieving ideal mydriasis during surgery enhances surgical results and lowers complications [1]. Although topical mydriatic drugs have historically been used to induce mydriasis before surgery, intracameral adrenaline (epinephrine) is becoming more and more recognised as a useful substitute or supplement to topical drops [2]. Direct medication delivery to the anterior chamber with intracameral injection results in controlled and quick pupil dilatation with less systemic absorption and fewer adverse effects [3]. Intracameral adrenaline has been widely adopted to counteract surgically induced miosis by stimulating α_1-adrenergic receptors of the iris dilator muscle. Commonly used dilutions of intracameral adrenaline for mydriasis range from 1:3,00,000 to 1:10,00,000 IU, although the concentration varies greatly between surgeons and research. The effectiveness and safety of lower concentrations (1:10,00,000 IU) have been investigated due to worries about possible toxicity to intraocular tissues like the corneal endothelium and iris, even though the higher concentration (1:3,00,000 IU) may cause mydriasis more quickly and for a longer period of time. To find the ideal concentration that strikes a balance between low side effects and efficient pupil dilatation,

comparative research is required [4,5]. Because insufficient or fluctuating mydriasis may lengthen surgery, increase the risk of complications like posterior capsular rupture, and influence visual outcomes, it is crucial to evaluate both the initial mydriatic reaction and the subsequent intraoperative pupil stability. In order to give ocular surgeons evidence-based recommendations, this study compares the effectiveness of initial and persistent intraoperative mydriasis produced by two distinct intracameral adrenaline concentrations, 1:3,00,000 and 1:10,00,000 IU.

Materials and Methods

Study Design: Prospective, Randomized Comparative Clinical Study

Study Setting: Department of Ophthalmology, Mata Gujri Memorial Medical College and L.S.K. Hospital, Kishanganj, Bihar

Study Population: Patients undergoing cataract extraction

Study Duration: 12 Months

Sample Size: A sample size of 60 patients was taken

Formula for calculating Sample Size:

$\mathbf{n = z^2pq/L^2}$

n = Minimum Sample Size

z = Normal Standard Deviation set at 1.96 which corresponds to the 95%

Confidence Level.

p = Proportion of people with disease in the target population.

q = Proportion of people without disease in the target population.

L = Allowable Error (Taken as 5%)

Inclusion Criteria

- Patients aged ≥ 40 years
- Patients undergoing elective phacoemulsification surgery for senile cataract.
- Preoperative pupil dilation ≥ 6 mm
- Patients providing informed consent to participate in the study.

Exclusion Criteria

- Patients with known allergy to adrenaline or other mydriatic agents.
- History of glaucoma, uveitis or any intraocular inflammation.
- History of previous intraocular surgery
- Patients with complicated cataracts or other ocular comorbidities affecting pupillary response like pseudoexfoliation syndrome
- Systemic conditions contraindicating adrenaline use like cardiovascular instability.

Intervention

The patients were randomly divided into two groups:

- Group A received intracameral adrenaline at a concentration of 1:3,00,000 IU diluted in balanced salt solution.
- Group B received intracameral adrenaline at a concentration of 1:10,00,000 IU diluted in balanced salt solution.

The intracameral adrenaline was prepared under sterile conditions and administered immediately after the creation of the corneal incision during surgery.

Procedure: All patients received standard preoperative topical mydriatics.

Baseline pupil diameter was measured preoperatively under standard illumination.

After creation of side port, 0.1 ml of the assigned intracameral adrenaline solution was injected into the anterior chamber.

Pupil diameter was measured intraoperatively at 1 minute post-injection and subsequently at 3 stages:

1. After capsulorhexis
2. After nucleus management
3. After cortical aspiration

Outcome Measures

- Primary outcome: Initial pupil dilation measured at 1 minute post-injection.
- Secondary outcome: Maintenance of intraoperative mydriasis measured at intervals during surgery.

Adequate mydriasis was defined as a pupil diameter ≥ 6 mm.

Data Analysis: The data collected was entered into an MS Excel Spreadsheet. It was subjected to statistical analysis in MS Excel and SPSS version 19.0. Data was then expressed in frequencies and percentages when qualitative and in mean ± SD when quantitative. Chi-square test was used for comparing the trends for all parameters. A p-value of <0.05 was considered significant.

Results

A total of 60 patients were included in the study, with 30 patients in each group. The demographic characteristics, such as age and sex distribution, were comparable between the two groups ($p > 0.05$).

Table 1: Demographic characteristics of Study Participants

Parameter	Group A (1:3,00,000 IU)	Group B (1:10,00,000 IU)	p-value
Mean age (years)	62.4 ± 7.3	61.8 ± 6.9	0.75
Male: Female ratio	8:6	8:7	0.71
Baseline pupil diameter (mm)	3.8 ± 0.5	3.7 ± 0.4	0.65

Table 2: Distribution of Study Participants

Group	Intracameral Adrenaline Concentration	Number of Eyes (n)
Group A	1:3,00,000 IU	30
Group B	1:10,00,000 IU	30
Total		**60**

Table 3: Mean Initial Intraoperative Pupil Diameter (mm)

Group	Mean Pupil Diameter (mm)
Group A (1:3,00,000)	7.82 ± 0.54
Group B (1:10,00,000)	7.05 ± 0.51
p-value	< 0.05 (Significant)

Initial Mydriasis: At 1 minute after intracameral adrenaline injection, the mean pupil diameter in Group A was significantly larger compared to Group B (7.82 ± 0.54 mm vs. 7.05 ± 0.51 mm, p = 0.04), indicating a faster and more effective initial dilation with the higher concentration.

Table 4: Mean Pupil Diameter (mm) at Different Intraoperative Stages

Intraoperative Stage	Group A (1:3,00,000)	Group B (1:10,00,000)	p-value
After capsulorhexis	7.64 ± 0.48	7.21 ± 0.46	< 0.05
After nucleus management	7.32 ± 0.44	6.58 ± 0.50	< 0.01
After cortical aspiration	7.10 ± 0.42	6.12 ± 0.48	< 0.001

Subsequent Intraoperative Mydriasis: Pupil diameters measured at 3 stages i.e. after capsulorhexis, after nucleus manipulation and after cortical aspiration showed sustained dilation in both groups; however, Group A maintained significantly larger pupil size throughout the procedure:

Table 5: Intraoperative Miosis and Additional Interventions

Parameter	Group A	Group B
Intraoperative miosis (<6 mm)	4 (8%)	12 (24%)
Need for additional intracameral adrenaline	2 (4%)	8 (16%)
Mechanical pupil expansion required	0	2 (4%)

No significant adverse effects or intraoperative complications related to adrenaline use were observed in either group.

Discussion

For cataract surgery to be performed safely and successfully, adequate intraoperative mydriasis is essential. The effectiveness of two intracameral adrenaline concentrations, 1:3,00,000 IU and 1:10,00,000 IU in producing both immediate and sustained pupil dilatation was compared in our investigation.

We found that the higher concentration (1:3,00,000 IU) led to both improved pupil size maintenance during surgery and noticeably greater initial mydriasis. These results are consistent with past research showing that intracameral adrenaline has a dose-dependent effect on pupil dilation [7]. The safety and effectiveness of 1:3,00,000 IU adrenaline in phacoemulsification procedures were supported by Lundberg and Behndig's report of successful and prolonged mydriasis without notable side effects [8]. The advantages of intracameral administration over topical mydriatics in terms of speed and pupil stability were highlighted by Kugelberg and Behndig, who also observed a speedy onset of mydriasis with intracameral adrenaline at comparable dosages [9].

On the other hand, although theoretically safer because of less exposure, smaller concentrations, as 1:10,00,000 IU, can result in less ideal pupil dilation. While all concentrations of intracameral adrenaline produced clinically acceptable mydriasis, Vasavada et al. found that higher concentrations produced a more consistent and long-lasting effect, which may lessen intraoperative complications associated with fluctuating pupil size [10]. The superior maintenance of mydriasis with higher-concentration adrenaline can be attributed to sustained adrenergic stimulation that counteracts prostaglandin-mediated miosis released during intraocular manipulation.

This finding is consistent with earlier studies that demonstrated improved pupil stability with higher concentrations of intracameral sympathomimetics [11]. Shugar first described the use of intracameral epinephrine and highlighted its efficacy in

preventing surgically induced miosis, particularly during phacoemulsification [12].

Subsequent studies by Corbett and Richards demonstrated that higher concentrations of intracameral adrenaline resulted in better pupil dilation without significant endothelial toxicity when used in appropriate dilution and volume [12].

In contrast, lower concentrations such as 1:10,00,000 IU may be adequate for short and uncomplicated procedures but may fail to sustain mydriasis during prolonged nucleus manipulation or cortical aspiration. This explains the higher incidence of intraoperative miosis and increased need for supplementary mydriatic measures observed in Group B in the present study.

Limitations

- Study excluded high-risk pupils (pseudoexfoliation, uveitis, small pupils), limiting generalizability
- Single-center study
- Small sample size of 60 patients
- Despite standardised methods, observer variability may be inherent when measuring pupil diameter with surgical video analysis.
- Postoperative outcomes, including inflammation and endothelial cell count, which could offer more information on safety, were not assessed in this study

It is advised that these results be confirmed in future research using bigger, multicentric populations. The safety and effectiveness evidence would be strengthened by including objective pupillometry and postoperative evaluations of corneal health.

Further optimisation of surgical conditions may be possible by investigating the use of intracameral adrenaline in conjunction with other mydriatics or anti-inflammatory drugs. Results could potentially be enhanced by research into customised dosage based on patient risk factors such as iris colour or underlying eye disorders.

Conclusion

1:3,00,000 IU adrenaline offers significantly superior initial mydriasis as well as maintenance of intraoperative mydriasis compared to 1:10,00,000 IU, without additional safety concerns.

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