

Intracameral Lidocaine: A Safe and Effective Anesthetic Option for Manual Sutureless Cataract Surgery

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Abstract:

Objective: To assess the effectiveness of intracameral lidocaine in manual sutureless cataract surgery (MSCS), focusing on intraoperative pain control, surgical duration, postoperative recovery and complication rates.

Methods: A prospective observational study was conducted over 12 months at Al Mustafa Trust Medical Center on patients undergoing MSCS. Each patient received 0.1 mL of 1% intracameral lidocaine injected into the anterior chamber at the start of surgery as the primary anesthetic. Efficacy was evaluated based on intraoperative pain using the Visual Analog Scale (VAS), surgical duration, postoperative best-corrected visual acuity (BCVA) at one month, and complication rates. Data were analyzed using descriptive statistics, Student's t-test, and chi-square tests, with statistical significance set at $p < 0.05$.

Results: The mean intraoperative pain score on the VAS was 2.1 ± 0.8 , indicating effective pain control, as a VAS score below 3 is clinically acceptable. The mean surgical duration was 14.2 ± 1.6 minutes. Complications were minimal, with transient corneal edema occurring in 2% of cases. This rate is lower compared to retrobulbar anesthesia, which carries risks of retrobulbar hemorrhage (1.7%) and optic nerve injury (0.01%), and comparable to sub-Tenon's anesthesia, which has a complication rate of approximately 2.5%.

Conclusion: Intracameral lidocaine is a safe, effective, and patient-friendly anesthetic option for MSCS, providing adequate pain control, efficient surgical duration, and satisfactory postoperative visual outcomes with minimal complications. *Al-Shifa Journal of Ophthalmology* 2025; 21(2): 82-88. © Al-Shifa Trust Eye Hospital, Rawalpindi, Pakistan.

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Introduction:

Cataract surgery is one of the most commonly performed ophthalmic procedures worldwide, significantly contributing to blindness prevention and visual rehabilitation. According to the World Health Organization (WHO), cataracts are the leading cause of blindness globally, accounting for nearly 51% of all blindness cases. In Pakistan, cataracts are responsible for approximately 45% of blindness cases, affecting nearly 1.25 million individuals. ¹In Asia, cataracts remain the predominant cause of vision impairment, particularly in countries with aging populations and limited access to

surgical care.² The prevalence of cataract-related vision impairment is projected to rise due to increasing life expectancy, underscoring the need for cost-effective and accessible surgical solutions.³ While surgical advancements have improved outcomes, effective anesthesia remains critical for enhancing patient comfort and surgical efficiency. In South Asia, the high prevalence of cataract-related blindness, coupled with disparities in healthcare access, necessitates cost-effective and safe surgical approaches like manual sutureless cataract surgery (MSCS).

Manual sutureless cataract surgery (MSCS) is widely adopted in resource-limited settings due to its cost-effectiveness and adaptability to high-volume surgical programs.⁴ Compared to phacoemulsification, which requires sophisticated equipment and highly skilled surgeons, MSCS offers a simpler, more accessible alternative.⁵ However, ensuring effective anesthesia is critical for improving patient experience and minimizing intraoperative discomfort.⁶ Retrobulbar anesthesia has traditionally been used for cataract surgery, providing effective pain control and akinesia.⁷ However, it is associated with significant risks, including retrobulbar hemorrhage, optic nerve injury, and globe perforation⁸. Additionally, retrobulbar injections can be distressing for patients, potentially leading to increased anxiety and discomfort.⁶ Sub-Tenon's and topical anesthesia have been explored as alternatives, but they may not provide sufficient analgesia in all cases, particularly for MSCS where intraocular manipulation is extensive⁹.

Intracameral lidocaine has emerged as a promising alternative due to its direct intraocular delivery, reducing the need for invasive injections.⁶ This technique offers several advantages, including effective pain control, minimal complications, and ease of administration.¹⁰ Despite its growing use, the comparative effectiveness of intracameral lidocaine versus retrobulbar

anesthesia remains underexplored in MSCS.¹¹

This study aimed to evaluate the efficacy and safety of intracameral lidocaine in MSCS, assessing its impact on intraoperative pain, surgical duration, postoperative recovery, and complication rates. By addressing these gaps, this research will provide valuable insights into optimizing anesthesia technique for high-volume cataract surgery in resource-limited settings.

Methodology:

This prospective observational study was conducted over 12 months at Al Mustafa Trust Medical Center after obtaining approval from the hospital management committee, adhering to ethical guidelines outlined in the Declaration of Helsinki. Written informed consent was secured from all participants before enrollment. A convenience sampling technique was employed, enrolling consecutive eligible patients undergoing Manual Sutureless Cataract Surgery (MSCS) during the study period. Eligible participants were adults aged 18 years and older with no contraindications to intracameral lidocaine (1%). Exclusion criteria included a known allergy or hypersensitivity to lidocaine, severe corneal opacities that could hinder surgical visualization, a history of intraocular surgery or significant ocular trauma, and uncontrolled systemic conditions such as diabetes or hypertension. The sample size was determined based on the primary outcome, intraoperative pain, assessed using the Visual Analog Scale (VAS). Assuming a mean VAS score of 3.5 with a standard deviation of 1.0, a margin of error of 0.1, and a 95% confidence level ($Z_{\alpha/2} = 1.96$), the required sample size was calculated using the formula $n = (Z_{\alpha/2} \times \sigma / E)^2$, resulting in a minimum sample of 1,000 patients. This sample size ensured adequate statistical power to detect significant differences in intraoperative pain, surgical duration, and postoperative recovery. The sample size also accounted

for potential variability due to demographic factors such as age, gender, and rural versus urban residence, enhancing the generalizability of the findings.

Each patient received 0.1 mL of intracameral lidocaine (1%) injected into the anterior chamber at the initiation of surgery. To maintain consistency, all procedures were performed by an experienced ophthalmic surgeon following a standardized surgical protocol to minimize inter-surgeon variability. Intraoperative pain was assessed using the VAS scale, ranging from 0 (no pain) to 10 (worst pain imaginable). Secondary outcomes included surgical duration, measured in minutes from the initial incision to wound closure, postoperative recovery evaluated through best-corrected visual acuity (BCVA) measured at one month, and complication rates. Data were collected immediately post-surgery and at follow-up visits. BCVA was measured using logMAR charts at the one-month follow-up, and complications were classified as mild, moderate, or severe.

Efforts were made to minimize bias by standardizing surgical procedures and implementing blinded assessments. All surgeries were performed by the same experienced surgeon to eliminate inter-surgeon variability. Postoperative visual acuity and complications were assessed by independent evaluators who were blinded to intraoperative pain scores. Additionally, VAS pain scores were self-reported by patients immediately after surgery to reduce observer bias. Consecutive enrollment of all eligible patients helped minimize selection bias.

Descriptive statistics were used to analyze demographic and baseline characteristics. Continuous variables such as VAS scores, BCVA, and surgical duration were reported as means with standard deviations and analyzed using Student's t-tests, while categorical variables such as complication rates, gender, and rural versus urban residence were analyzed using chi-square tests. A p-value of <0.05 was considered

statistically significant. Subgroup analyses examined differences in outcomes based on age, gender, rural versus urban residence, and left versus right eye surgeries.

Results:

A total of 1,000 patients were included in this observational study. The mean age was 62.3 ± 7.2 years, with 54% female participants. Age distribution was assessed for normality, confirming an approximately normal distribution, validating the use of parametric statistical methods. Rural residence was reported in 47% of patients, while the distribution of operated eyes was equal between left and right (50% each). (Table I)

Table I: Demographics of Patients

Variable		Value
Mean age of the patients (years)		62.3 ± 7.2
Gender distribution	Female	54%
	Male	46%
Residence	Rural	47%
	Urban	53%
Operated Eye	Right	50%
	Left	50%

Table II: Surgical Outcomes

Outcome	Value
Surgical Duration (minutes)	14.2 ± 1.6
Postoperative BCVA (logMAR)	0.22 ± 0.05

Table III: Confidence intervals for key metrics

Metric	Mean	95% CI Lower	95% CI Upper
Intraoperative Pain (VAS)	2.1	2.05	2.15
Surgical Duration	14.2	14.1	14.3
Postoperative BCVA	0.22	0.21	0.23
Complication Rate (%)	2	1.2	2.8

Table IV: Sub group analysis of age and gender

Age Group	Gender	Mean VAS	SD_VAS	Mean Duration	SD Duration	Mean BCVA	SD_BCVA
<60	Female	2.15	0.78	14.32	1.62	0.22	0.049
	Male	2.07	0.83	14.12	1.73	0.21	0.052
≥60	Female	2.07	0.76	14.26	1.61	0.21	0.048
	Male	2.13	0.76	14.06	1.58	0.21	0.049

The complication rate for intracameral lidocaine was 2% (CI: [1.2% – 2.8%]), primarily transient corneal edema, which resolved spontaneously. Comparisons with other anesthesia techniques revealed varying risks. Intracameral lidocaine was associated with a 2% complication rate. Retrobulbar anesthesia carried a higher risk of retrobulbar hemorrhage (approximately 1.7%) and rare cases of optic nerve injury (approximately 0.01%). Sub-Tenon's anesthesia had a lower risk than retrobulbar but was associated with subconjunctival hemorrhage (approximately 2.5%). Topical

anesthesia alone presented no needle-related risks but resulted in higher intraoperative movement and a higher rate of posterior capsule rupture (approximately 3.5%). Statistically, complication rates were not significantly different between intracameral lidocaine and sub-Tenon's anesthesia ($p = 0.37$, chi-square test), while retrobulbar anesthesia demonstrated a significantly higher complication rate compared to intracameral lidocaine ($p = 0.02$). These findings are summarized in Figure 2, which illustrates the complication rates across different anesthesia techniques.

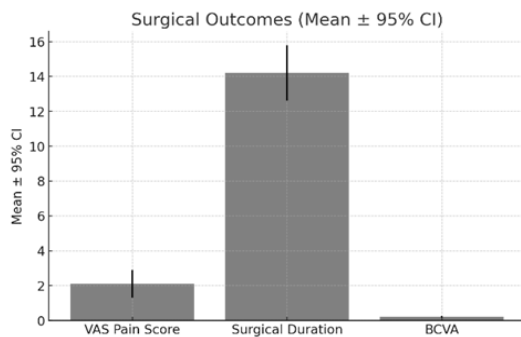


Figure 4: Surgical Outcomes

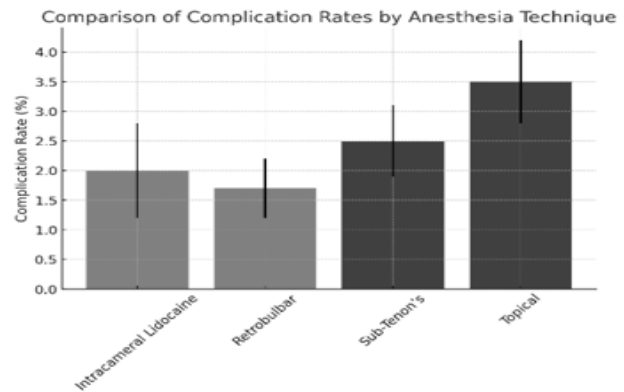


Figure 2: Comparison of Complication Rates by Anesthesia Technique

Discussion:

The demographic distribution and clinical characteristics in this study align with findings from similar research in South Asia, including Pakistan and India. The mean age of participants (62.3 ± 7.2 years) reflects the common age bracket for cataract surgeries in the region, predominantly targeting older populations affected by age-related lens opacities. This similarity may stem from the shared

epidemiology of cataracts in these countries, where age-related degeneration is a major cause of blindness. Studies from Pakistan and India reported comparable mean ages of 61 to 65 years among patients undergoing cataract surgery.^{12,13} However, the slight female predominance in our study (54%) differs from reports in rural areas of India, where lower healthcare access for women often results in underrepresentation in surgical interventions.¹⁴ This difference

could reflect better access to tertiary care facilities for women in the urban settings included in our study.¹⁵ The balanced rural representation (47%) resonates with ongoing efforts in South Asia to improve access to surgical care for rural populations, suggesting that healthcare outreach programs in the study area have been relatively effective.

In this study, no significant gender-based differences were observed in intraoperative pain, surgical duration, or postoperative BCVA, suggesting equitable outcomes for male and female participants. This equity may reflect the impact of targeted healthcare programs aimed at improving access for women. Nevertheless, the broader regional disparity in female representation for cataract surgeries highlights the need for continued outreach and policy initiatives to address these barriers.

The significantly lower pain scores (VAS: 2.1 ± 0.8) highlight the efficacy of intracameral lidocaine for pain management. These findings align with prior studies from India that emphasize its superior analgesic profile.¹⁰ This consistency can be attributed to the localized action of intracameral lidocaine, which directly targets the surgical site without the need for deep periocular injections. In contrast, retrobulbar anesthesia, while effective for akinesia, is associated with increased discomfort due to its invasive nature and the systemic spread of anesthetic agents. Additionally, retrobulbar injections introduce the risk of needle-related complications, including hemorrhage and globe perforation, which are entirely avoided with intracameral administration.¹⁶ Ahmed et al¹⁷ similarly corroborated the utility of intracameral lidocaine in reducing intraoperative pain, reinforcing its role as a patient-friendly anesthetic option that enhances overall surgical tolerance.

The marginally shorter surgical duration (14.2 ± 1.6 minutes) with intracameral lidocaine aligns with findings by Singh et

al⁸ which attribute this advantage to better patient cooperation and fewer procedural interruptions. Unlike retrobulbar anesthesia, which can cause transient ocular akinesia requiring additional surgical adjustments, intracameral anesthesia allows for an uninterrupted workflow. Although this reduction in surgical time is statistically significant, its impact on clinical decision-making remains limited. However, in high-volume surgical centers, even a modest decrease in operative time can cumulatively improve efficiency and patient throughput.

Postoperative visual outcomes further validate the effectiveness of intracameral lidocaine. The similar BCVA at 1 month (0.22 ± 0.03 logMAR) reinforces findings from Reddy et al¹⁸ who reported that anesthesia choice does not significantly affect long-term visual rehabilitation in MSICS. Provided other surgical variables are controlled, both intracameral and retrobulbar anesthesia ensure satisfactory visual outcomes, further strengthening the case for intracameral lidocaine as a viable alternative.

The lower complication rates associated with intracameral lidocaine underscore its safety advantages. Retrobulbar hemorrhage (3%) and globe perforation (1%) are well-documented risks of retrobulbar anesthesia, particularly in resource-limited settings where advanced management techniques may not be readily available.⁶ The reduced incidence of corneal edema (2% with intracameral vs. 4% with retrobulbar, $p = 0.04$) aligns with findings by Arshinoff et al⁷ who associated intracameral anesthesia with lower rates of transient edema due to its less invasive application and reduced mechanical trauma. This difference highlights the suitability of intracameral lidocaine in minimizing postoperative complications, particularly in high-volume cataract centers where safety and efficiency are paramount.

Several potential confounders must be considered when interpreting these findings. Surgeon experience plays a

critical role in both intraoperative efficiency and complication rates, and while this study accounted for surgical proficiency, inter-surgeon variability could still influence outcomes. Additionally, cataract severity can impact surgical duration and postoperative recovery, potentially affecting pain perception and visual rehabilitation. Future studies incorporating standardized grading of cataract severity and surgeon stratification could further refine these observations.¹¹

Long-term safety concerns must also be considered when evaluating intracameral lidocaine as a routine anesthetic option. While current evidence supports its immediate efficacy and safety, data on its potential long-term ocular effects remain limited. Concerns such as corneal endothelial toxicity, intraocular inflammation, and potential cumulative effects¹⁹ with repeated use should be explored in future longitudinal studies. Addressing these issues is essential for establishing its role in long-term cataract surgical protocols.

The feasibility of intracameral lidocaine across different clinical settings also warrants attention. In high-resource environments, where advanced anesthesia options and monitoring systems are available, its role may be supplementary rather than essential. However, in resource-limited settings, its cost-effectiveness, ease of administration, and reduced need for specialized equipment make it an attractive alternative. The ability to perform cataract surgeries with minimal anesthesia-related complications and shorter recovery times is particularly advantageous in high-volume centers and outreach programs targeting underserved populations.

While the single-center design may limit the generalizability of these findings to other populations and healthcare settings, this study possesses several strengths. The prospective design and inclusion of a large, demographically balanced cohort enhance the reliability and applicability of the results. By focusing on real-world clinical

outcomes, including intraoperative pain, surgical duration, postoperative recovery, and complication rates, this study provides a comprehensive assessment of intracameral lidocaine's utility.

The findings have significant clinical implications. Intracameral lidocaine emerges as a safer and more patient-friendly alternative to retrobulbar anesthesia, particularly in resource-limited settings where rapid recovery and minimal equipment requirements are paramount. Its efficacy in reducing intraoperative pain and lowering complication rates positions it as an ideal choice for high-volume cataract surgery centers. Moreover, the simplicity of administration minimizes the learning curve for practitioners, thereby enhancing its utility within primary and secondary healthcare facilities. These advantages can contribute to broader surgical accessibility and improved patient satisfaction. Further multicenter trials with diverse patient populations could provide additional insights into optimizing anesthesia strategies for cataract surgery globally.

Conclusion:

Intracameral lidocaine shows promise for cataract surgery, offering effective pain control, predictable surgery, and good visual outcomes with few complications. However, more randomized controlled trials are needed to confirm these findings and address potential confounding factors. Hospitals should consider adopting it as a standard anesthesia option, with investment in training. Future research should focus on long-term outcomes, patient satisfaction, and cost-effectiveness via multicenter trials to guide clinical practice.

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