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Original Research

The Impact of General Anesthesia vs. Regional Anesthesia on Intraocular Pressure During Glaucoma Surgery

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ABSTRACT:
Aim: This study aimed to compare the impact of general anesthesia (GA) versus regional anesthesia (RA) on intraocular pressure (IOP) during glaucoma surgery. **Materials and Methods:** A prospective, randomized, controlled clinical trial was conducted on 100 patients with primary open-angle glaucoma or primary angle-closure glaucoma. Patients were randomly assigned to the GA (n = 50) or RA (n = 50) group. IOP was measured preoperatively, intraoperatively, and postoperatively using a Goldmann applanation tonometer. Both groups underwent standard glaucoma surgeries, including trabeculectomy or tube shunt surgery. **Results:** Both groups had similar demographic characteristics and baseline IOP values. The GA group showed a significant increase in IOP intraoperatively (27.1 ± 3.6 mmHg) compared to the RA group (25.6 ± 3.2 mmHg). Postoperatively, both groups demonstrated a reduction in IOP, with no significant difference between them. The GA group had longer anesthesia duration compared to the RA group (70.3 ± 11.3 vs. 30.2 ± 7.8 minutes). Postoperative discomfort, including pain, nausea, and vomiting, was slightly higher in the GA group, though the differences were not statistically significant. **Conclusion:** Both GA and RA are effective for controlling IOP during glaucoma surgery. While GA led to a higher increase in IOP intraoperatively, both anesthesia techniques provided similar postoperative IOP reduction. Regional anesthesia had the advantage of more stable IOP during surgery and a shorter anesthesia duration.
Keywords: General anesthesia, Regionalanesthesia, Intraocular pressure, Glaucoma surgery, Anesthesia duration

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INTRODUCTION

Glaucoma surgery is a critical procedure aimed at reducing intraocular pressure (IOP), a primary risk factor for glaucomatous optic neuropathy. The management of IOP during such surgeries is paramount, as elevated IOP can exacerbate the progression of the disease, potentially leading to irreversible vision loss. Anesthesia plays a crucial role in these surgical procedures, not only in providing patient comfort but also in influencing physiological parameters such as IOP, which can significantly impact the surgical outcome. The choice of anesthesia, particularly general anesthesia (GA) versus regional anesthesia (RA), can affect various hemodynamic variables, including IOP, which is of great importance in the context of glaucoma surgery.[1]

General anesthesia, which induces a state of unconsciousness and muscle relaxation, is commonly employed in a wide variety of surgical procedures. This form of anesthesia involves the administration of drugs that affect the central nervous system, resulting in loss of consciousness, amnesia, and analgesia. General anesthesia often includes the use of endotracheal intubation or laryngeal mask airways to secure the airway, and a combination of intravenous and inhalational anesthetic agents is used to maintain the anesthetized state. One of the well-recognized concerns with general anesthesia, particularly in the context of ophthalmic surgery, is its potential to cause fluctuations in IOP. The physiological mechanisms underlying these fluctuations are multifactorial, including changes in respiratory dynamics, blood pressure, and systemic vascular tone. These alterations may not only have an immediate impact on IOP but can also potentially influence the long-term

prognosis of the surgical intervention, especially in patients with glaucoma.[2]

On the other hand, regional anesthesia, which includes both peribulbar and retrobulbar blocks, is commonly used in glaucoma surgeries. This type of anesthesia involves the administration of local anesthetics near the optic nerve or extraocular muscles to block sensation in the eye and surrounding structures. Unlike general anesthesia, regional anesthesia does not affect consciousness, and the patient remains awake or lightly sedated during the procedure. This method has gained popularity in ophthalmic surgery due to its ability to provide effective pain relief while avoiding the systemic effects of general anesthesia. In addition, regional anesthesia may offer specific advantages in terms of more stable hemodynamic control and reduced fluctuations in IOP during surgery. However, regional anesthesia itself is not devoid of risks. Complications such as retrobulbar hemorrhage or ocular motility disturbances can occur, and the impact of regional anesthesia on IOP remains an area of ongoing investigation.[3]

The relationship between anesthesia and IOP is particularly important in the context of glaucoma, where precise control of IOP is essential to preventing optic nerve damage. In glaucoma patients, the optic nerve is more susceptible to damage from elevated IOP due to impaired blood flow and reduced ability of the eye to compensate for changes in IOP. Therefore, understanding the impact of different anesthetic techniques on IOP during glaucoma surgery is critical to ensuring optimal outcomes for patients.[4]

Intraocular pressure is regulated by a delicate balance between the production and outflow of aqueous humor, and it is influenced by a variety of systemic and ocular factors. General anesthesia has been shown to induce various physiological changes that may directly or indirectly affect IOP. For instance, changes in systemic blood pressure, respiratory rate, and central venous pressure during GA can influence the production and drainage of aqueous humor, leading to alterations in IOP. Additionally, the use of certain anesthetic agents, such as volatile anesthetics, has been associated with increased IOP, while other agents, such as opioids or barbiturates, may have a lowering effect. The interaction between anesthetic agents and autonomic control of the eye's vasculature can also contribute to fluctuations in IOP during surgery.[5]

In contrast, regional anesthesia, by targeting specific ocular and periorbital structures, may have a more localized effect on IOP. By avoiding the systemic effects of general anesthesia, regional anesthesia may allow for more stable IOP management during surgery. The anesthetic agents used in regional anesthesia, typically local anesthetics like lidocaine or bupivacaine, work by blocking the transmission of pain signals and reducing the need for systemic analgesics. This can result in a more controlled hemodynamic environment, potentially leading to less variation in IOP throughout the procedure.[6]

Despite the potential advantages of regional anesthesia, the impact of both general and regional anesthesia on IOP remains a subject of debate and research. While several studies have investigated the effects of anesthesia on IOP during cataract surgery, there is limited research focusing specifically on glaucoma surgery. The choice of anesthesia may depend on a variety of factors, including patient preferences, underlying medical conditions, and the specific type of glaucoma surgery being performed. Furthermore, variations in technique and the types of anesthetic agents used can lead to differing outcomes, making it crucial to examine the existing literature to better understand the comparative effects of general and regional anesthesia on IOP during glaucoma surgery.

MATERIALS AND METHODS

This was a prospective, randomized, controlled clinical trial conducted to assess the impact of general anesthesia (GA) versus regional anesthesia (RA) on intraocular pressure (IOP) during glaucoma surgery. The study was approved by the institutional review board and adhered to the Declaration of Helsinki. Informed consent was obtained from all participants prior to enrollment.A total of 100 patients with primary open-angle glaucoma or primary angle-closure glaucoma, scheduled for glaucoma surgery (trabeculectomy or tube shunt surgery), were included in the study. Patients were aged between 40 -80 years and were excluded if they had any history of eye trauma, other ocular conditions (e.g., retinal diseases), or significant systemic illnesses that could interfere with the anesthesia procedures.

Randomization

Patients were randomly assigned into two groups: the General Anesthesia (GA) group (n = 50) and the Regional Anesthesia (RA) group (n = 50). Randomization was achieved using a computer-generated random number table.

Anesthesia Protocol

- **General Anesthesia (GA):** Patients in the GA group received standard general anesthesia with propofol for induction, fentanyl for analgesia, and sevoflurane for maintenance. Muscle relaxation was achieved with rocuronium, and airway management was accomplished with an endotracheal tube.
- **Regional Anesthesia (RA):** Patients in the RA group underwent retrobulbar block or peribulbar block, performed under sterile conditions by an experienced anesthesiologist. The local anesthetic mixture consisted of 2% lidocaine and 0.75% bupivacaine with epinephrine (1:200,000). The blocks were performed preoperatively, and no additional sedation was used during surgery.

Intraocular Pressure Measurement

Intraocular pressure (IOP) was measured using a Goldmann applanation tonometer at three key time points during the study. The first measurement was taken preoperatively, immediately before the administration of anesthesia. The second measurement was taken intraoperatively at the beginning of the surgical procedure, before the creation of a trabeculectomy flap or the insertion of the glaucoma drainage device. The final IOP measurement was recorded postoperatively, immediately after the completion of surgery, prior to the patient being moved to the recovery room. A single trained observer conducted all IOP measurements to minimize variability, and the tonometer was calibrated daily to ensure accurate readings. Consistency in the measurement technique was maintained for all patients to reduce potential errors.

Surgical procedures were performed by the same experienced surgeon for all patients. For those in the general anesthesia (GA) group, the surgery was carried out under general anesthesia, while the regional anesthesia (RA) group received regional anesthesia following the appropriate block. Both groups underwent standard glaucoma surgeries, including trabeculectomy or glaucoma drainage device insertion, depending on their individual needs.

Demographic data, including patient age, gender, and baseline IOP, were collected preoperatively. Intraoperative variables, such as the duration of the surgery and anesthesia, were recorded, along with any complications that arose during the procedure. The primary outcome measure was the change in IOP at each time point, while secondary outcomes included postoperative pain, nausea, vomiting, and any adverse events associated with anesthesia.

Statistical Analysis

Data were analyzed using SPSS software (version 16.0). Descriptive statistics were used to summarize patient demographics and intraoperative data. Continuous variables were compared between the two groups using independent t-tests, and categorical variables were compared using chi-square tests. A p-value of < 0.05 was considered statistically significant. Changes in IOP from baseline to intraoperative and postoperative measurements were analyzed using paired t-tests within each group and independent t-tests between the groups.

RESULTS

Demographic Characteristics of Patients (Table 1)

The demographic characteristics of the patients in the study were balanced between the two groups. The average age of patients in the General Anesthesia (GA) group was 65.2 ± 8.4 years, while the Regional Anesthesia (RA) group had a slightly younger mean age of 64.8 ± 7.9 years, with an overall mean age of 65.0 ± 8.1 years. The gender distribution was similar between both groups, with 52% male and 48% female in the GA group, and 56% male and 44% female in the RA group. The baseline intraocular pressure (IOP) was also similar between the two groups, with the GA group having a mean IOP of 25.3 ± 3.2 mmHg and the RA group having a mean IOP of 24.9 ± 3.0 mmHg. The total baseline IOP across all 100 patients was 25.1 ± 3.1 mmHg.

Intraocular Pressure (IOP) Measurements (Table 2)

Table 2 shows the IOP measurements taken at three key time points: preoperative, intraoperative, and postoperative. The GA group had a preoperative IOP of 25.3 ± 3.2 mmHg, which was slightly higher than the RA group's preoperative IOP of 24.9 ± 3.0 mmHg. During the intraoperative period, the GA group experienced a significant increase in IOP, reaching 27.1 ± 3.6 mmHg, while the RA group had a more moderate increase to 25.6 ± 3.2 mmHg. Postoperatively, both groups showed a reduction in IOP, with the GA group's IOP decreasing to 22.4 ± 3.1 mmHg and the RA group's IOP decreasing to 21.7 ± 3.0 mmHg. Overall, these measurements suggest that while both groups showed a reduction in IOP postoperatively, the GA group experienced a higher increase in IOP intraoperatively.

Changes in Intraocular Pressure (IOP) at Different Time Points (Table 3)

Table 3 shows the changes in IOP between the preoperative, intraoperative, and postoperative time points. The GA group showed a significant increase in IOP from preoperative to intraoperative measurements, with an average increase of +1.8 ± 1.2 mmHg, while the RA group experienced a smaller increase of +0.7 ± 1.0 mmHg. The difference between the two groups in terms of intraoperative IOP change was statistically significant ($p < 0.01$). However, from preoperative to postoperative measurements, both groups showed a decrease in IOP, with the GA group decreasing by -2.9 ± 2.3 mmHg and the RA group decreasing by -3.2 ± 2.5 mmHg. The difference between the two groups in postoperative IOP change was not statistically significant ($p = 0.42$).

Intraoperative Variables (Table 4)

In Table 4, the intraoperative variables of surgical and anesthesia duration were compared between the two groups. The average surgical duration was very similar between the two groups, with the GA group having an average of 65.4 ± 10.2 minutes and the RA group having an average of 64.1 ± 9.8 minutes, and this difference was not statistically significant ($p = 0.45$). However, the anesthesia duration was significantly longer for the GA group, with an average duration of 70.3 ± 11.3 minutes, compared to 30.2 ± 7.8 minutes for the RA group ($p < 0.01$). This difference reflects the additional time required for the

administration and maintenance of general anesthesia compared to regional anesthesia.

Postoperative Outcomes (Table 5)
Table 5 presents the postoperative outcomes for both groups. The Visual Analog Scale (VAS) for postoperative pain was slightly higher in the GA group, with a mean of 3.1 ± 1.5, compared to the RA group's mean of 2.8 ± 1.2. However, this difference was not statistically significant (p = 0.32). The incidence of postoperative nausea was higher in the GA group, with 30% of patients reporting nausea, compared to 16% in the RA group, though this difference was not statistically significant (p = 0.18). Similarly, the incidence of postoperative vomiting was slightly higher in the GA group (14%) compared to the RA group (8%), but this difference was not statistically significant (p = 0.47).

Adverse Events (Table 6)
Table 6 outlines the occurrence of adverse events in both groups. Hypotension was observed in 8% of the GA group and 4% of the RA group, with no statistically significant difference between the two groups (p = 0.38). Bradycardia was slightly more common in the GA group (6%) compared to the RA group (2%), but again, this difference was not statistically significant (p = 0.23). Corneal abrasions, a potential complication from the anesthetic technique or surgical procedure, occurred in 4% of the GA group and 2% of the RA group, with no statistically significant difference (p = 0.53).

Table 1: Demographic Characteristics of Patients

Characteristic	GA Group (n = 50)	RA Group (n = 50)	Total (n = 100)
Age (mean ± SD)	65.2 ± 8.4	64.8 ± 7.9	65.0 ± 8.1
Gender			
Male (%)	26 (52%)	28 (56%)	54 (54%)
Female (%)	24 (48%)	22 (44%)	46 (46%)
Baseline IOP (mean ± SD)	25.3 ± 3.2	24.9 ± 3.0	25.1 ± 3.1

Table 2: Intraocular Pressure (IOP) Measurements

Time Point	GA Group (n = 50)	RA Group (n = 50)
Preoperative IOP (mmHg)	25.3 ± 3.2	24.9 ± 3.0
Intraoperative IOP (mmHg)	27.1 ± 3.6	25.6 ± 3.2
Postoperative IOP (mmHg)	22.4 ± 3.1	21.7 ± 3.0

Table 3: Changes in Intraocular Pressure (IOP) at Different Time Points

Time Point	GA Group (n = 50)	RA Group (n = 50)	p-value
Preoperative to Intraoperative	+1.8 ± 1.2	+0.7 ± 1.0	< 0.01
Preoperative to Postoperative	-2.9 ± 2.3	-3.2 ± 2.5	0.42

Table 4: Intraoperative Variables

Variable	GA Group (n = 50)	RA Group (n = 50)	p-value
Surgical Duration (min)	65.4 ± 10.2	64.1 ± 9.8	0.45
Anesthesia Duration (min)	70.3 ± 11.3	30.2 ± 7.8	< 0.01

Table 5: Postoperative Outcomes

Outcome	GA Group (n = 50)	RA Group (n = 50)	p-value
Postoperative Pain (VAS)	3.1 ± 1.5	2.8 ± 1.2	0.32
Postoperative Nausea (%)	15 (30%)	8 (16%)	0.18
Postoperative Vomiting (%)	7 (14%)	4 (8%)	0.47

Table 6: Adverse Events

Adverse Event	GA Group (n = 50)	RA Group (n = 50)	p-value
Hypotension (%)	4 (8%)	2 (4%)	0.38
Bradycardia (%)	3 (6%)	1 (2%)	0.23
Corneal abrasion (%)	2 (4%)	1 (2%)	0.53

DISCUSSION

The demographic characteristics of the patients in this study were well-balanced between the two anesthesia groups, which is crucial for minimizing bias when comparing outcomes. The average age in both groups was close, and there was no significant difference in gender distribution. This aligns with the findings of Santos et al. (2015), who reported similar age and gender distributions in their study, ensuring that the results of IOP measurements and outcomes were not confounded by these factors.[7] Additionally, baseline intraocular pressures were comparable between the

two groups, suggesting that the initial severity of glaucoma did not influence the outcomes, which is in agreement with the study by Jones et al. (2014), who also found no significant differences in baseline IOP values between groups undergoing different anesthesia techniques .[8]

The IOP measurements during the study revealed a significant increase in IOP in the GA group compared to the RA group during the intraoperative period. The GA group exhibited an increase of 1.8 ± 1.2 mmHg, while the RA group had a smaller increase of 0.7 ± 1.0 mmHg, which was statistically significant. This is consistent with the work of Zhang et al. (2015), who reported that general anesthesia often leads to a rise in IOP due to factors such as increased venous pressure, muscle relaxation, and changes in body positioning.[9] The more moderate increase in IOP in the RA group supports the findings of Park et al. (2013), who also observed a smaller rise in IOP during surgeries performed under regional anesthesia. This suggests that regional anesthesia may be advantageous in terms of maintaining more stable IOP during surgery.[10]

Despite the intraoperative differences, both anesthesia groups showed a reduction in IOP postoperatively. The GA group showed a decrease of -2.9 ± 2.3 mmHg, and the RA group showed a slightly greater decrease of -3.2 ± 2.5 mmHg, but this difference was not statistically significant. These findings are similar to those reported by Kim et al. (2014), who found that although anesthesia type can influence intraoperative IOP fluctuations, both methods lead to a comparable reduction in postoperative IOP.[11] This indicates that the surgical procedure itself is the primary factor influencing postoperative IOP, rather than the anesthesia technique used.

In terms of intraoperative variables, the surgical duration was comparable between the two groups, with no statistically significant difference, aligning with the findings of Li et al. (2013), who also reported no significant differences in surgery time between patients receiving general or regional anesthesia .[12] However, anesthesia duration was significantly longer in the GA group, which is consistent with the results of Shifman et al. (2014), who noted that general anesthesia generally requires more time for induction, maintenance, and recovery than regional anesthesia. This increased anesthesia duration in the GA group may be a contributing factor to the higher intraoperative IOP increase observed in this study.[13]

Postoperative outcomes, such as pain, nausea, and vomiting, were slightly higher in the GA group, although these differences were not statistically significant. These findings are consistent with those of Tran et al. (2015), who also found that general anesthesia was associated with higher levels of postoperative discomfort, including nausea and vomiting, compared to regional anesthesia . The higher rates of postoperative nausea and vomiting in the GA group could be attributed to the residual effects of the anesthetic agents used during general anesthesia, which are known to contribute to these symptoms.[14]

CONCLUSION

In conclusion, both general anesthesia (GA) and regional anesthesia (RA) are effective in managing intraocular pressure (IOP) during glaucoma surgery. While GA was associated with a greater increase in IOP intraoperatively, both anesthesia techniques resulted in a comparable reduction in IOP postoperatively. Surgical duration was similar between the groups, but anesthesia duration was longer in the GA group. Postoperative discomfort, including pain, nausea, and vomiting, was slightly higher in the GA group, although differences were not statistically significant. Overall, both anesthesia methods are safe and effective, with regional anesthesia offering the advantage of more stable IOP during surgery.

REFERENCES

1. Gündüz K, Arslan F, Özkurt Y. The effects of general anesthesia and retrobulbar block on intraocular pressure during cataract surgery. J Cataract Refract Surg. 2004;30(1):148-52. doi: 10.1016/j.jcrs.2003.08.031.
2. Khandelwal S, Rajan A. Effect of general anesthesia versus regional anesthesia on intraocular pressure during cataract surgery. J Anesth. 2007;21(3):348-51. doi: 10.1007/s00540-007-0492-0.
3. Lee HM, Kim HK. Comparison of the effects of general anesthesia and retrobulbar anesthesia on intraocular pressure during glaucoma surgery. Korean J Ophthalmol. 2011;25(3):184-8. doi: 10.3341/kjo.2011.25.3.184.
4. Alam MI, Jehangir A. A comparative study of general anesthesia and regional anesthesia on intraocular pressure in glaucoma surgery. J Clin Diagn Res. 2013;7(9):1916-9. doi: 10.7860/JCDR/2013/5761.3390.
5. Saito T, Yokoyama T. Influence of general anesthesia versus regional anesthesia on intraocular pressure during glaucoma surgery: A randomized controlled trial. Br J Anaesth. 2012;109(5):797-803. doi: 10.1093/bja/aes281.
6. Arif KH, Chawla H. Effect of anesthetic technique on intraocular pressure in patients undergoing glaucoma surgery: A prospective study. J Clin Anesth. 2015;27(5):425-30. doi: 10.1016/j.jclinane.2015.02.022.
7. Santos AB, Rangel DB, Oliveira F. The impact of demographic characteristics on glaucoma surgery outcomes under different anesthesia types. *Journal of Ophthalmology*. 2015;62(2):101-106.
8. Jones MS, Patel DV, Zhang M. Baseline intraocular pressure comparisons in anesthesia types during glaucoma surgery. *British Journal of Ophthalmology*. 2014;98(4):531-536.
9. Zhang Y, Lee Y, Chen T. Intraocular pressure fluctuations during general anesthesia in ophthalmic surgeries. *Ophthalmic Research*. 2015;49(6):254-260.
10. Park S, Lee J, Chang J. Regional anesthesia and its effects on intraocular pressure during glaucoma surgery. *Journal of Clinical Anesthesia*. 2013;25(1):34-39.

11. Kim M, Lee S, Choi S. Postoperative intraocular pressure reduction following glaucoma surgery under general and regional anesthesia. *Ophthalmology Research*. 2014;43(3):216-220.
12. Li X, Zhang J, Wang L. Surgical time and anesthesia duration in glaucoma surgeries: A comparison of general and regional anesthesia. *Journal of Glaucoma Surgery*. 2013;14(1):75-80.
13. Shifman D, Dothan Y, Carmon L. Anesthesia duration and its effect on glaucoma surgery outcomes. *Ophthalmic Anesthesia*. 2014;15(5):240-245.
14. Tran NV, Tran SH, Rosenthal F. Postoperative nausea and vomiting after general and regional anesthesia in glaucoma surgery. *Ophthalmic Anesthesia*. 2015;13(3):155-160.