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ENHANCING PEDIATRIC OPHTHALMIC SURGERY OUTCOMES: COMBINING PERIBULBAR BLOCK WITH GENERAL ANAESTHESIA

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Abstract:

Background: Pediatric ophthalmic surgeries often require effective anesthesia techniques to minimize intraoperative complications and ensure patient comfort. This study aimed to evaluate the efficacy of combining peribulbar block (PB) with general anesthesia (GA) compared to GA alone in pediatric patients undergoing ophthalmic surgery.

Materials and Methods: Sixty children aged 4-12 years were randomized into two groups: GA-PB (n=30) and GA (n=30). Data on age distribution, gender, ASA PS grading, incidence of oculocardiac reflex (OCR), complications, weight, intraocular pressure (IOP), heart rate (HR), mean arterial pressure (MAP), and oxygen saturation (SpO2) were collected. Statistical analysis included Pearson's chi-squared test and t-tests.

Results: No significant association was found between age ($\chi^2 = 0.518$, $p = 0.772$), gender ($\chi^2 = 0.000$, $p = 1.000$), or ASA PS grading ($\chi^2 = 0.373$, $p = 0.542$) with groups. OCR incidence was significantly lower in the GA+PB group at 60 minutes ($\chi^2 = 7.295$, $p = 0.011$) and 90 minutes ($\chi^2 = 7.925$, $p = 0.011$). Nausea incidence differed significantly ($\chi^2 = 6.000$, $p = 0.049$) between groups.

Conclusion: Combining PB with GA in pediatric ophthalmic surgeries may reduce OCR incidence and postoperative nausea compared to GA alone, enhancing perioperative management.

Keywords: Pediatric, Ophthalmic Surgery, Peribulbar Block, General Anesthesia, Complications, Anesthesia Techniques.

Introduction:

Ophthalmic surgery in pediatric patients presents unique challenges that necessitate careful consideration of anesthetic techniques to ensure optimal outcomes [1]. Among the various approaches available, the combination of general anesthesia with peribulbar block has gained attention for its potential advantages in providing effective intraoperative anesthesia and postoperative analgesia while minimizing systemic effects [2]. This prospective study seeks to compare the efficacy and safety of general anesthesia with peribulbar block versus general anesthesia without peribulbar block in children undergoing ophthalmic surgery, with a focus on intraoperative hemodynamic changes, analgesic requirements, duration of postoperative analgesia, incidence of oculocardiac reflex, and postoperative nausea and vomiting.

The importance of choosing the most suitable anesthetic technique for pediatric ophthalmic surgery cannot be overstated. Unlike adult patients, children have unique physiological characteristics and may exhibit heightened responses to stressors such as pain and anxiety. Consequently, strategies that address both intraoperative comfort and postoperative pain management are essential for optimizing surgical outcomes and promoting patient well-being [3].

General anesthesia has long been the cornerstone of pediatric ophthalmic surgery, providing deep sedation and muscle relaxation to facilitate surgical procedures. However, the use of systemic agents such as opioids and volatile anesthetics carries inherent risks, including respiratory depression, hemodynamic instability, and delayed emergence from anesthesia. In contrast, regional anesthesia techniques such as peribulbar block offer the advantage of targeted analgesia with reduced systemic absorption, potentially minimizing the need for systemic opioids and their associated side effects [4]. Peribulbar block involves the injection of local anesthetic agents into the retrobulbar or peribulbar space surrounding the globe, thereby providing sensory blockade to the eye and surrounding structures [5]. By selectively blocking the sensory nerves innervating the eye, peribulbar block can complement general anesthesia by reducing intraoperative nociception and providing prolonged postoperative analgesia. Furthermore, the avoidance of direct ocular manipulation during block placement minimizes the risk of globe perforation and other ocular complications [6].

Despite its potential benefits, the use of peribulbar block in pediatric patients has been a subject of debate due to concerns regarding patient cooperation, needle phobia, and the risk of local anesthetic toxicity. However, recent advancements in pediatric regional anesthesia techniques, coupled with improved understanding of pediatric anatomy and physiology, have renewed interest in incorporating peribulbar block into the anesthetic management of pediatric ophthalmic surgery [7].

This study aims to contribute to the existing literature by providing empirical evidence regarding the comparative effectiveness of general anesthesia with peribulbar block versus general anesthesia alone in pediatric ophthalmic surgery. By systematically evaluating key outcomes such as intraoperative hemodynamic stability, analgesic requirements, duration of postoperative analgesia, incidence of oculocardiac reflex, and postoperative nausea and vomiting, we seek to elucidate the potential advantages and limitations of each approach.

The choice of anesthetic technique in pediatric ophthalmic surgery requires careful consideration of various factors, including patient age, surgical complexity, and comorbidities [8]. Through rigorous investigation and comparative analysis, this study aims to inform clinical practice and enhance the quality of care provided to pediatric patients undergoing ophthalmic procedures. By elucidating the relative merits of general anesthesia with peribulbar block versus general anesthesia alone, we hope to facilitate evidence-based decision-making and ultimately improve patient outcomes in this vulnerable population.

Materials and Methods:

Study Setting: The study followed a prospective randomized comparative design. All patients were allocated into two groups: Group GA-PB (General Anesthesia + Peribulbar Block) and Group GA (General Anesthesia). The study was conducted at Madras Medical College, Chennai, Tamil Nadu, India.

Study Participants: Inclusion criteria included children aged between 4-12 years, of both sexes (male/female), with ASA PS Grading I or II, weighing between 10-50 kg, requiring eye surgery on either side (Right/Left), and with a duration of the procedure lasting between 30-60 minutes were included. Exclusion criteria encompassed patients with active ocular infections, undergoing Antiglaucoma treatment, having a single eye, allergic to Amide type of local anesthetic, with known Cardiac disease, and with ASA PS III or IV were excluded.

Sample Size: The study population consisted of 60 children, with 30 allocated to each group (GA-PB and GA). Participants meeting the inclusion criteria were selected consecutively from the pool of patients scheduled for ophthalmic surgery during the study period.

Study Methodology: Patients satisfying the inclusion criteria were randomly assigned to either Group GA or Group GA-PB using a computer-generated randomization sequence.
Patients were premedicated with Inj. Glycopyrrolate 10 mcg/kg and Inj. Fentanyl 1mcg/kg intravenously before induction. Preoperative teaching of the Visual Analog Scale (VAS) was conducted two hours prior to surgery.
Anesthesia was induced with Inj. Propofol 2mg/kg after ensuring adequate mask ventilation. Inj. Atracurium 0.5mg/kg was administered for muscle relaxation, followed by endotracheal intubation. Anesthesia was maintained with oxygen, nitrous oxide, and Sevoflurane to achieve a total MAC of 1.

Study Tools: The study utilized various tools including blood investigations, monitors, cannula, drugs for peribulbar block, I.V. fluids, syringes, anesthesia workstation, emergency drugs, and airway equipment.

Statistical Analysis: Data analysis was performed using IBM SPSS version 27. Descriptive statistics summarized demographic and clinical characteristics, while inferential statistics such as t-tests or chi-square tests were used to compare outcomes between the two groups.

Ethical Issues: The study adhered to ethical principles outlined in the Declaration of Helsinki. Patient confidentiality was maintained, and informed consent was obtained from all participants or their legal guardians before enrollment.

Results:
Among the 60 children enrolled in the study, 16 (26.7%) were aged 3-5 years, 34 (56.7%) were aged 6-10 years, and 10 (16.7%) were above 10 years old. The mean age of the participants was 8 ± 3 years. Out of the 60 children, 20 (33.3%) were female, and 40 (66.7%) were male. The Pearson's chi-squared test revealed no statistically significant association between age and groups ($\chi^2 = 0.518$, $p = 0.772$). The Pearson's chi-squared test indicated no statistically significant association between gender and groups ($\chi^2 = 0.000$, $p = 1.000$). Similarly, the Pearson's chi-squared test revealed no statistically significant association between ASA PS and groups ($\chi^2 = 0.373$, $p = 0.542$).
The incidence of oculocardiac reflex (OCR) was compared between two groups: GA (General Anesthesia) and GA+PB (General Anesthesia + Peribulbar Block) at different time intervals (0, 30, 60, and 90 minutes). The results show that at 0 minutes, OCR was absent in 96.7% of patients in both groups. At subsequent intervals, OCR remained absent in the majority of patients, with percentages ranging from 90.0% to 76.7% in the GA group and 100.0% in the GA+PB group. However, at 60 and 90 minutes, a statistically significant difference was observed ($\chi^2 = 7.295$, $p = 0.011$; $\chi^2 = 7.925$, $p = 0.011$ respectively), with a higher incidence of OCR present in the GA group compared to the GA+PB group.
The complications examined include nausea and vomiting. Nausea was reported in 20.0% of patients in the GA group and 6.7% in the GA+PB group, with a significant difference observed ($\chi^2 = 6.000$, $p = 0.049$). Vomiting was reported in 10.0% of patients in the GA group, while no cases were reported

in the GA+PB group. The majority of patients did not experience any complications, with 70.0% in the GA group and 93.3% in the GA+PB group reporting no complications.

Table 1: Weight and intraocular pressure among the study participants.

Variable	Groups	N	Mean	SD	t-value	P-value
Weight/kgs	GA	30	22.27	6.158	0.610	0.544
	GA + PB	30	21.27	6.533		
IOP (Pre)	GA	30	11.63	1.066	1.060	0.293
	GA + PB	30	11.33	1.124		
Intra OP	GA	30	13.53	1.106	1.059	0.294
	GA + PB	30	13.20	1.324		

Table 1 presents the comparison of weight and intraocular pressure (IOP) between two groups: GA (General Anesthesia) and GA+PB (General Anesthesia + Peribulbar Block). For weight, the mean ± SD for the GA group was 22.27 ± 6.158 kg, and for the GA+PB group was 21.27 ± 6.533 kg. There was no significant difference between the groups ($t(58) = 0.610$, $p = 0.544$). Regarding IOP, the mean ± SD for preoperative IOP was 11.63 ± 1.066 mmHg for the GA group and 11.33 ± 1.124 mmHg for the GA+PB group, with no significant difference observed ($t(58) = 1.060$, $p = 0.293$). Similarly, for intraoperative IOP, the mean ± SD was 13.53 ± 1.106 mmHg for the GA group and 13.20 ± 1.324 mmHg for the GA+PB group, with no significant difference found ($t(58) = 1.059$, $p = 0.294$).

Table 2 compares the heart rate (HR) between the GA and GA+PB groups at various time intervals. Significant differences were observed at all time points (0, 10, 20, 30, 45, 60, 75, and 90 minutes). At 0 minutes, the mean HR was 118.1 bpm for the GA group and 111.6 bpm for the GA+PB group ($t(58) = 2.253$, $p = 0.028$). The significant differences persisted at subsequent time intervals, with p-values ranging from $p = 0.0005$ to $p = 0.004$.

Table 2: Comparison of heart rate among the study participants.

HR	Groups	N	Mean	SD	t-value	P-value
0 Mins	GA	30	118.1	10.0	2.253	0.028*
	GA + PB	30	111.6	12.0		
10 Mins	GA	30	123.4	9.6	5.395	0.0005*
	GA + PB	30	110.1	9.6		
20 Mins	GA	30	120.5	7.9	3.254	0.002*
	GA + PB	30	112.1	11.8		
30 Mins	GA	30	119.8	8.6	4.123	0.0005*
	GA + PB	30	110.4	9.1		
45 Mins	GA	30	123.9	8.7	4.826	0.0005*
	GA + PB	30	113.5	7.9		
60 Mins	GA	30	117.5	9.6	2.974	0.004*
	GA + PB	30	110.3	9.3		
75 Mins	GA	30	123.5	9.4	5.522	0.0005*
	GA + PB	30	110.1	9.4		
90 Mins	GA	30	122.7	7.0	5.669	0.0005*
	GA + PB	30	110.3	9.2		

*Significant P value.

Table 3 presents the comparison of mean arterial pressure (MAP) between the GA and GA+PB groups at different time points. Significant differences in MAP were observed at all time intervals (0, 10, 20, 30, 45, 60, 75, and 90 minutes). At 0 minutes, the mean MAP was 87.47 mmHg for the GA group and 75.80 mmHg for the GA+PB group ($t(58) = 8.602$, $p = 0.0005$). Similar significant differences were observed at subsequent time points, with p-values ranging from $p = 0.0005$ to $p = 0.0005$. Table 4 compares the oxygen saturation (SpO2) between the GA and GA+PB groups at different time

intervals. No significant differences were observed at any time point (0, 10, 20, 30, 45, 60, 75, and 90 minutes), with p-values all greater than 0.05.

Table 3: Comparison of mean arterial pressure (MAP) among the study participants.

MAP	Groups	N	Mean	SD	t-value	p-value
0 Mins	GA	30	87.47	4.470	8.602	0.0005*
	GA + PB	30	75.80	5.933		
10 Mins	GA	30	87.13	4.023	17.992	0.0005*
	GA + PB	30	70.60	3.024		
20 Mins	GA	30	88.33	4.122	18.773	0.0005*
	GA + PB	30	70.53	3.159		
30 Mins	GA	30	87.17	4.843	15.576	0.0005*
	GA + PB	30	70.17	3.505		
45 Mins	GA	30	86.97	4.709	17.298	0.0005*
	GA + PB	30	69.47	2.921		
60 Mins	GA	30	88.10	4.475	19.649	0.0005*
	GA + PB	30	69.23	2.763		
75 Mins	GA	30	86.37	5.143	15.082	0.0005*
	GA + PB	30	70.30	2.756		
90 Mins	GA	30	88.03	4.437	19.038	0.0005*
	GA + PB	30	70.07	2.651		

*Significant P value

Table 4: Comparison of SpO2 among the study participants.

SpO2	Groups	N	Mean	SD	t-value	p-value
0 Mins	GA	30	99.3	0.8	0.466	0.643
	GA + PB	30	99.2	0.8		
10 Mins	GA	30	99.3	0.8	0.644	0.522
	GA + PB	30	99.1	0.8		
20 Mins	GA	30	99.3	0.7	1.352	0.182
	GA + PB	30	99.0	0.8		
30 Mins	GA	30	99.2	0.8	1.340	0.186
	GA + PB	30	98.9	0.9		
45 Mins	GA	30	99.2	0.8	0.613	0.542
	GA + PB	30	99.0	0.9		
60 Mins	GA	30	99.2	0.8	2.271	0.027*
	GA + PB	30	98.8	0.8		
75 Mins	GA	30	99.1	0.9	0.451	0.653
	GA + PB	30	99.0	0.8		
90 Mins	GA	30	98.9	1.0	0.138	0.891
	GA + PB	30	98.9	0.9		

*Significant P value

Discussion:

The findings of this study shed light on several critical aspects of pediatric anesthesia management, particularly concerning the use of general anesthesia (GA) alone versus GA combined with peribulbar block (GA+PB) in children undergoing ophthalmic surgeries.

The age distribution observed in our study population reflects the typical demographic profile of pediatric patients undergoing ophthalmic procedures. The predominance of children aged 6-10 years

aligns with previous research, indicating a higher prevalence of ocular conditions requiring surgical intervention in this age group [9, 10]. Similarly, the gender distribution, with a higher proportion of males, mirrors patterns observed in pediatric surgical populations, although the underlying reasons warrant further investigation [11].

The absence of significant associations between age, gender, and group allocation suggests that demographic factors may not influence the choice of anesthesia technique in pediatric ophthalmic surgeries. However, it is essential to consider individual patient characteristics and comorbidities when selecting the most appropriate anesthesia regimen, as these factors may impact perioperative outcomes [12].

The incidence of oculocardiac reflex (OCR) is a crucial parameter to monitor during pediatric ophthalmic surgeries, given its potential to cause bradycardia and hemodynamic instability. Our study revealed a higher incidence of OCR in the GA group compared to the GA+PB group at 60 and 90 minutes postoperatively, indicating a potential protective effect of peribulbar block against OCR. This finding is consistent with previous literature suggesting that regional anesthesia techniques, such as peribulbar block, may attenuate the autonomic reflex responses associated with ocular manipulation during surgery [13].

The lower incidence of OCR in the GA+PB group could be attributed to the local anesthetic effect of peribulbar block, which provides targeted analgesia and sensory blockade, thereby reducing afferent nociceptive input from the eye. Additionally, the sympathetic blockade induced by peribulbar anesthesia may contribute to minimizing reflex bradycardia by dampening the autonomic response to ocular stimulation [14]. These mechanistic insights underscore the potential clinical benefits of incorporating regional anesthesia techniques into pediatric ophthalmic anesthesia protocols to enhance perioperative safety and optimize patient comfort [14].

The observed differences in complications between the GA and GA+PB groups warrant careful consideration. While the overall incidence of complications was relatively low in both groups, the lower rates of nausea and vomiting in the GA+PB group highlight the potential advantages of multimodal analgesia strategies in mitigating perioperative adverse events. The superior antiemetic effect of peribulbar block may be attributed to its opioid-sparing and analgesic properties, which reduce the need for systemic opioids and their associated side effects [15].

The significant differences in heart rate (HR) and mean arterial pressure (MAP) between the GA and GA+PB groups at various time intervals emphasize the hemodynamic stability conferred by peribulbar block during pediatric ophthalmic surgeries. The blunted sympathetic response and attenuated stress hormone release associated with regional anesthesia may contribute to maintaining stable cardiovascular parameters and preventing perioperative hemodynamic fluctuations. These findings corroborate the growing body of evidence supporting the role of regional anesthesia techniques in enhancing perioperative hemodynamic stability and improving surgical outcomes in pediatric patients [16].

Despite the promising results of our study, several limitations warrant acknowledgment. The retrospective nature of the data analysis and the relatively small sample size may limit the generalizability of our findings. Additionally, the lack of long-term follow-up data precludes assessment of the sustained effects of peribulbar block on postoperative outcomes, including pain management, recovery times, and patient satisfaction.

Future research endeavors should focus on prospective, randomized controlled trials with larger sample sizes to validate the findings of our study and elucidate the optimal anesthesia regimen for pediatric ophthalmic surgeries. Longitudinal studies examining the impact of peribulbar block on long-term neurodevelopmental outcomes, ocular motility, and visual acuity in pediatric patients are warranted to comprehensively evaluate the safety and efficacy of regional anesthesia techniques in this population.

This study provides valuable insights into the comparative effectiveness of general anesthesia alone versus general anesthesia combined with peribulbar block in pediatric ophthalmic surgeries. The findings suggest that peribulbar block may offer advantages in reducing the incidence of oculocardiac reflex, minimizing perioperative complications, and maintaining hemodynamic stability. By incorporating regional anesthesia techniques into anesthesia protocols for pediatric ophthalmic procedures, clinicians can optimize perioperative care and improve patient outcomes.

Conclusion:
The study results suggest that combining peribulbar block with general anesthesia in pediatric ophthalmic surgeries may mitigate the incidence of oculocardiac reflex, reduce perioperative complications such as nausea and vomiting, and promote hemodynamic stability. By integrating regional anesthesia techniques into anesthesia protocols for pediatric patients can enhance perioperative safety and optimize surgical outcomes.

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