RESEARCH PAPER

Evaluation of Intravenous Versus Inhalational Anesthetic Techniques in Pediatric Surgery: A Cross-Sectional Study

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Abstract

Background: Pediatric anesthesia requires safe and effective anesthetic techniques that provide hemodynamic stability, rapid recovery, and minimal postoperative complications. Intravenous and inhalational anesthetic techniques are commonly used in pediatric surgical practice, and their comparative effectiveness remains an important area of clinical evaluation.

Aim: To evaluate and compare intravenous and inhalational anesthetic techniques in pediatric patients undergoing surgical procedures.

Materials and Methods: This cross-sectional study was conducted in the Department of Anaesthesia at a tertiary care teaching hospital attached to Meenakshi Medical College, Kanchipuram. A total of 60 pediatric patients aged between 1 and 12 years undergoing elective surgical procedures were included in the study. Patients were divided into two groups: Group I (n = 30) received intravenous anesthesia and Group II (n = 30) received inhalational anesthesia. Various perioperative parameters including hemodynamic variables, duration of anesthesia, recovery time, and postoperative complications were recorded. Statistical analysis was performed using appropriate statistical tests, and a p value < 0.05 was considered statistically significant.

Results: The mean heart rate and systolic blood pressure were significantly lower in the intravenous anesthesia group (98.4 ± 10.2 beats/min and 96.2 ± 8.4 mmHg) compared with the inhalational anesthesia group (104.6 ± 11.5 beats/min and 101.8 ± 9.1 mmHg) ($p = 0.03$ and $p = 0.02$ respectively). The mean recovery time was significantly shorter in the intravenous anesthesia group (11.4 ± 3.6 minutes) compared with the inhalational anesthesia group (15.8 ± 4.1 minutes) ($p = 0.001$). Postoperative nausea and vomiting were observed more frequently in the inhalational anesthesia group, although the difference was not statistically significant.

Conclusion: Both intravenous and inhalational anesthetic techniques are effective for pediatric surgical procedures; however, intravenous anesthesia may provide better hemodynamic stability and faster postoperative recovery.

Keywords: Pediatric anesthesia, Intravenous, Inhalational Anesthetic, techniques

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Introduction

Pediatric anesthesia presents unique challenges due to the physiological and pharmacological differences between children and adults. Safe and effective anesthetic management is essential in pediatric surgical procedures to ensure hemodynamic stability, adequate analgesia, rapid recovery, and minimal postoperative complications. Among the commonly used anesthetic techniques in pediatric surgery are intravenous anesthesia and inhalational anesthesia. Both techniques are widely utilized in clinical practice, and the choice of anesthetic method often depends on patient characteristics, surgical requirements, and anesthesiologist preference [1].

Intravenous anesthetic techniques, commonly using agents such as propofol, ketamine, and opioids, provide rapid induction and predictable recovery profiles. Intravenous anesthesia allows precise control of anesthetic depth and is often associated with smoother recovery and reduced incidence of postoperative nausea and vomiting. In pediatric anesthesia, propofol-based anesthesia has gained popularity due to its rapid onset, short duration of action, and favorable recovery characteristics [2].

Inhalational anesthesia, on the other hand, remains one of the most commonly used techniques in pediatric practice. Volatile anesthetic agents such as sevoflurane and desflurane are frequently used because they allow non-invasive induction and provide good control over anesthetic depth. Inhalational induction is particularly advantageous in children who may have difficulty with intravenous cannulation before anesthesia induction.

Sevoflurane is widely preferred in pediatric anesthesia due to its rapid onset, low airway irritation, and favorable hemodynamic profile [3].

Despite the widespread use of both intravenous and inhalational anesthetic techniques, there are ongoing discussions regarding their comparative effectiveness in pediatric surgical patients. Factors such as hemodynamic stability, recovery time, postoperative complications, and patient comfort are important considerations when selecting the appropriate anesthetic technique. Studies have suggested that intravenous anesthesia may provide improved recovery profiles and reduced postoperative complications, whereas inhalational anesthesia offers easier induction and greater flexibility in anesthetic management [4–6].

Evaluating the outcomes associated with different anesthetic techniques is important for improving perioperative care in pediatric patients. Understanding the advantages and limitations of intravenous and inhalational anesthesia can assist clinicians in selecting the most appropriate anesthetic technique based on individual patient characteristics and surgical requirements. Additionally, such evaluations contribute to the development of evidence-based anesthetic protocols in pediatric surgical practice [7].

Therefore, the present study was undertaken to evaluate and compare intravenous and inhalational anesthetic techniques in pediatric surgery with respect to perioperative parameters, recovery characteristics, and postoperative outcomes [8].

Materials and Methods

This cross-sectional study was conducted in the Department of Anaesthesia at a tertiary care teaching hospital attached to Meenakshi Medical College, Kanchipuram, Tamil Nadu. The study aimed to evaluate and compare the effectiveness of intravenous and inhalational anesthetic techniques in pediatric patients undergoing surgical procedures.

A total of 60 pediatric patients scheduled for elective surgical procedures under anesthesia were included in the study. Patients aged between 1 and 12 years and classified as American Society of Anesthesiologists (ASA) physical status I or II were eligible for inclusion. Patients with severe systemic illness, congenital cardiac disease, respiratory disorders, or those undergoing emergency surgeries were excluded from the study.

A detailed preoperative assessment was performed for all patients, including medical history, clinical examination, and necessary laboratory investigations. Standard intraoperative monitoring such as electrocardiography, non-invasive blood pressure, pulse oximetry, and respiratory rate monitoring was applied for all patients during surgery.

The patients were divided into two groups based on the anesthetic technique used. Group I (n = 30) received intravenous anesthesia, commonly using agents such as propofol along with short-acting opioids for induction and maintenance of anesthesia. Group II (n = 30) received inhalational anesthesia, primarily using volatile anesthetic agents such as sevoflurane for induction and maintenance.

Various intraoperative and postoperative parameters were recorded for comparison between the two groups. These included hemodynamic parameters (heart rate and blood pressure), duration of anesthesia, recovery time, incidence of postoperative nausea and vomiting, airway complications, and overall recovery profile.

All collected data were entered into Microsoft Excel and analyzed using SPSS statistical software. Descriptive statistics such as mean, standard deviation, frequency, and percentage were used to summarize the data. The association between anesthetic technique and perioperative outcomes was evaluated using appropriate statistical tests such as the Chi-square test and independent t-test. A p value less than 0.05 was considered statistically significant.

Table 1: Demographic Characteristics of Study Participants (n = 60)

Variable	Intravenous Anaesthesia (n = 30)	Inhalational Anaesthesia (n = 30)	p value
Mean age (years)	6.2 ± 2.8	6.5 ± 3.1	0.71
Male	18 (60%)	17 (56.7%)	0.79
Female	12 (40%)	13 (43.3%)	

The mean age and gender distribution were comparable between both groups. There was no statistically significant difference in demographic characteristics ($p > 0.05$).

Table 2: Type of Surgical Procedures

Type of Surgery	Frequency (%)
General surgery	24 (40%)
ENT surgery	18 (30%)
Orthopedic surgery	12 (20%)
Urological surgery	6 (10%)

General surgical procedures constituted the largest proportion (40%) among the pediatric surgeries

performed. ENT surgeries were the second most common procedures (30%).

Table 3: Intraoperative Hemodynamic Parameters

Parameter	Intravenous Anaesthesia	Inhalational Anaesthesia	p value
Mean heart rate (beats/min)	98.4 ± 10.2	104.6 ± 11.5	0.03
Mean systolic BP (mmHg)	96.2 ± 8.4	101.8 ± 9.1	0.02

Children receiving intravenous anesthesia showed slightly lower heart rate and systolic blood pressure. The difference was statistically significant, indicating better hemodynamic stability ($p < 0.05$).

Table 4: Duration of Anaesthesia

Parameter	Intravenous Anaesthesia	Inhalational Anaesthesia	p value
Mean duration (minutes)	52.6 ± 14.2	54.8 ± 15.6	0.58

The duration of anesthesia was similar in both groups. No statistically significant difference was observed ($p > 0.05$).

Table 5: Recovery Time

Parameter	Intravenous Anaesthesia	Inhalational Anaesthesia	p value
Mean recovery time (minutes)	11.4 ± 3.6	15.8 ± 4.1	0.001

Recovery time was significantly shorter in the intravenous anesthesia group. This indicates faster postoperative recovery compared with inhalational anesthesia ($p = 0.001$).

Table 6: Postoperative Complications

Complication	Intravenous Anaesthesia	Inhalational Anaesthesia	p value
Nausea and vomiting	3 (10%)	8 (26.7%)	0.09
Airway irritation	1 (3.3%)	5 (16.7%)	0.08
No complications	26 (86.7%)	17 (56.6%)	

Postoperative complications were observed more frequently in the inhalational anesthesia group. However, the difference was not statistically significant ($p > 0.05$).

Discussion

The present study evaluated the effectiveness of intravenous and inhalational anesthetic techniques in pediatric surgical patients by comparing perioperative parameters, recovery characteristics, and postoperative complications. The findings demonstrated that both anesthetic techniques were effective; however, intravenous anesthesia showed certain advantages in terms of hemodynamic stability and faster recovery.

In the present study, intraoperative hemodynamic parameters such as heart rate and systolic blood pressure were lower in the intravenous anesthesia group (98.4 ± 10.2 beats/min and 96.2 ± 8.4 mmHg) compared with the inhalational anesthesia group (104.6 ± 11.5 beats/min and 101.8 ± 9.1 mmHg). The difference between the two groups was statistically significant ($p = 0.03$ for heart rate and $p = 0.02$ for systolic blood pressure), indicating better hemodynamic stability with intravenous anesthesia. Similar findings were reported by Lerman J [9], who noted that intravenous anesthetic techniques may provide improved cardiovascular stability during pediatric surgical procedures.

Postoperative nausea and vomiting were observed more frequently in the inhalational anesthesia group (26.7%) compared with the intravenous anesthesia group (10%). However, the difference was not statistically significant ($p = 0.09$). These findings are consistent with the guidelines reported by Gan TJ et al [10], which indicate that inhalational anesthetics are commonly associated with a higher incidence of postoperative nausea and vomiting.

The present study also demonstrated that recovery time was significantly shorter in patients receiving intravenous anesthesia (11.4 ± 3.6 minutes) compared with those receiving inhalational anesthesia (15.8 ± 4.1 minutes). The difference between the two groups was highly statistically significant ($p = 0.001$). Comparable findings were reported by Lee JH et al [15], who observed that propofol-based intravenous anesthesia resulted in faster recovery profiles compared with sevoflurane anesthesia in pediatric patients.

Intravenous anesthetic agents such as propofol are widely used in pediatric anesthesia due to their rapid onset and short duration of action. Hansen TG [12] reported that propofol infusion provides smooth induction and faster recovery in children undergoing surgical procedures. In addition, enhanced recovery pathways emphasize the use of anesthetic techniques that facilitate early recovery and reduce postoperative complications. Kaye AD et al [13] highlighted that optimized anesthetic management significantly

improves recovery outcomes in pediatric surgical patients ($p < 0.05$).

Ambulatory anesthesia guidelines also recommend anesthetic techniques that promote rapid recovery and early discharge. Chung F et al [14] reported that fast-track anesthetic approaches significantly improve perioperative efficiency and recovery outcomes ($p < 0.05$). Similarly, Gupta A et al [18] demonstrated that improved anesthetic techniques contribute to enhanced recovery profiles and reduced postoperative complications ($p < 0.01$).

Although adverse events are uncommon in pediatric anesthesia, proper monitoring remains essential. Cravero JP et al [16] reported that the incidence of complications during pediatric sedation and anesthesia is relatively low when appropriate monitoring protocols are followed. Furthermore, Davidson AJ [11] emphasized the importance of careful anesthetic management in children to minimize potential neurological risks.

Overall, the findings of the present study indicate that both intravenous and inhalational anesthetic techniques are effective in pediatric surgical procedures. However, intravenous anesthesia demonstrated better hemodynamic stability and significantly faster recovery ($p = 0.001$), suggesting that it may provide advantages in pediatric anesthesia practice.

Conclusion

The present study demonstrated that both intravenous and inhalational anesthetic techniques are effective for pediatric surgical procedures. However, intravenous anesthesia showed certain advantages, including better intraoperative hemodynamic stability and faster postoperative recovery compared with inhalational anesthesia. The recovery time was significantly shorter in the intravenous anesthesia group (11.4 ± 3.6 minutes) compared with the inhalational anesthesia group (15.8 ± 4.1 minutes), and this difference was statistically significant ($p = 0.001$). Although postoperative complications such as nausea and vomiting were more frequent in the inhalational anesthesia group, the difference was not statistically significant. Overall, intravenous anesthesia may provide improved recovery outcomes and better perioperative stability in pediatric patients undergoing surgical procedures.

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