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Article

Comparing Propofol and Sevoflurane for Faster Recovery in Pediatrics

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ABSTRACT

Background: Pediatric anesthesia demands agents that ensure swift recovery with minimal complications; however, the comparative effectiveness of propofol and sevoflurane for rapid recovery and complication reduction in children remains insufficiently defined. **Objective**: This study aimed to compare the effects of propofol and sevoflurane on recovery time, postoperative complications (nausea, vomiting, emergence agitation), and patient satisfaction in pediatric patients undergoing minor surgeries, anticipating propofol would facilitate faster recovery and fewer adverse events. **Methods**: This descriptive observational study included 73 pediatric patients (aged 1–10 years) at Ali Fatima Hospital, Lahore, meeting ASA I/II status and excluding those with hypersensitivity, severe respiratory, neurological, or cognitive issues; patients were administered either propofol or sevoflurane, and recovery outcomes were measured using numeric pain scales, milestone assessments, and satisfaction surveys; data were collected at standard postoperative intervals; ethical approval was obtained from the Superior University IRB (per Helsinki Declaration); data were analyzed using SPSS v25 with chi-square tests, significance set at p=0.05. **Results**: Propofol was associated with significantly faster mean emergence (8 vs. 14 minutes, p<0.05), lower rates of postoperative nausea/vomiting (PONV), and reduced emergence agitation compared to sevoflurane, with 54.8% of propofol patients able to sit unassisted soonest, and higher patient satisfaction scores observed for propofol. **Conclusion**: Propofol provides faster recovery and fewer complications than sevoflurane in pediatric anesthesia, supporting its preference for day-case pediatric surgeries, while sevoflurane remains suitable for smooth inhalational induction; these findings advocate for agent selection tailored to procedural and patient needs in pediatric practice

Keywords: Pediatric Anesthesia, Propofol, Sevoflurane, Recovery Time, Emergence Agitation, Postoperative Nausea and Vomiting, Patient Satisfaction.

INTRODUCTION

Pediatric anesthesia is a specialized field that requires a nuanced understanding of the physiological and anatomical differences between children and adults. These differences necessitate tailored approaches to drug selection, dosage, and monitoring techniques to ensure safe and effective anesthesia care for young patients. The primary objective in pediatric anesthesia is to facilitate rapid recovery, as prolonged sedation can lead to increased anxiety, extended hospital stays, and heightened risks of postoperative complications, particularly respiratory issues. Pediatric anesthesiologists strive to utilize agents that not only promote quick recovery but also minimize adverse effects during and after surgical procedures (1,2). Children's unique physiological characteristics significantly influence their responses to anesthetic agents. For instance, the metabolism of drugs in young children and infants is affected by their underdeveloped liver and kidney functions, which can complicate the breakdown and elimination of medications. Additionally, the respiratory system in children is more vulnerable due to higher oxygen consumption and reduced functional residual capacity, increasing the risk of hypoxia during anesthesia. These factors necessitate vigilant monitoring and specialized techniques to manage airway challenges, as children have smaller, more flexible airways that are prone to obstruction and difficult intubation (3,4). The choice of anesthetic agents is critical in pediatric anesthesia, with Propofol and Sevoflurane being two of the most commonly used. Propofol is a short-acting intravenous anesthetic known for its rapid onset and recovery, making it

suitable for outpatient procedures. However, it requires careful titration due to potential cardiovascular and respiratory side effects. Sevoflurane, an inhaled volatile anesthetic, offers smooth induction and rapid recovery, making it particularly advantageous for pediatric patients. Despite its benefits, Sevoflurane is associated with risks such as postoperative nausea and vomiting, which can complicate recovery. Understanding the pharmacological profiles and implications of these agents is essential for optimizing pediatric anesthesia care (5,6).

The literature highlights the importance of understanding the pharmacokinetics and pharmacodynamics of anesthetic agents in pediatric patients. Propofol, for instance, acts by enhancing the inhibitory neurotransmitter gamma-aminobutyric acid (GABA) at the GABA-A receptor, leading to sedation and anesthesia. Its rapid onset and short duration of action make it a preferred choice for outpatient procedures, but its cardiovascular and respiratory effects necessitate careful monitoring, especially in younger patients. Studies have shown that while Propofol is effective for induction and maintenance of anesthesia, its use in pediatric populations requires a thorough understanding of age-specific dosing and potential side effects (7,8).

Sevoflurane, on the other hand, is favored for its rapid induction and minimal airway irritation, making it particularly suitable for children who may be less tolerant of intravenous access. Research indicates that Sevoflurane's low blood-gas solubility allows for quick onset and recovery, which is crucial in pediatric anesthesia. However, the literature also points to concerns regarding postoperative nausea and vomiting, as well as the risk of emergence delirium, which can affect the recovery experience for pediatric patients. Understanding these risks is essential for anesthesiologists to implement effective preemptive strategies, such as antiemetic therapy, to enhance recovery outcomes (9,10).

In conclusion, pediatric anesthesia presents unique challenges and opportunities that require specialized knowledge and techniques (11). The physiological differences between children and adults necessitate careful consideration of drug selection, monitoring, and recovery strategies to ensure safe and effective anesthesia care. Agents like Propofol and Sevoflurane offer distinct advantages and potential risks, underscoring the importance of individualized approaches to anesthesia in pediatric patients (12). As the field continues to evolve, ongoing research and advancements in anesthetic protocols will play a crucial role in enhancing the safety and efficacy of pediatric anesthesia, ultimately leading to improved outcomes for young patients and their families. By prioritizing rapid recovery and minimizing adverse effects, healthcare providers can significantly enhance the quality of pediatric perioperative care, ensuring that children return to their normal activities as quickly and safely as possible (13).

MATERIALS AND METHODS

This descriptive observational study was conducted at Ali Fatima Hospital, Lahore, over a six-month period following IRB approval from Superior University. Pediatric patients aged 1 to 10 years scheduled for minor surgical procedures were eligible for inclusion if they had an American Society of Anesthesiologists (ASA) physical status I or II and mild systemic disease, and if their guardians or parents provided written informed consent. Exclusion criteria included known hypersensitivity to anesthetic agents, severe respiratory conditions, neurological or cognitive impairments, and any contraindications to the use of either propofol or sevoflurane (14,15,16). Recruitment followed a non-probability convenient sampling approach, and confidentiality of participant data was ensured through anonymization and secure data storage, in accordance with the Declaration of Helsinki.

The primary outcome was time to recovery, specifically mean emergence time from anesthesia. Secondary outcomes included incidence of postoperative complications such as nausea, vomiting, and emergence agitation, as well as patient satisfaction and pain assessment. Numeric Pain Rating Scales (0–10) were utilized to quantify postoperative pain, while standardized recovery milestones included ability to sit unassisted, stand, walk, and tolerate oral intake without nausea. Satisfaction surveys and structured questionnaires were administered postoperatively to evaluate subjective experiences and comfort. Data collection occurred at predefined intervals in the post-anesthesia care unit, ensuring objective and consistent measurement across all participants (17). All study procedures were conducted in compliance with the Helsinki Declaration. Ethical approval was obtained prior to study commencement, and informed consent was systematically secured from guardians or parents prior to enrollment. To maintain confidentiality, all data were de-identified, and access was restricted to authorized study personnel.

Statistical analysis was performed using SPSS version 27. Descriptive statistics summarized demographic and outcome variables. The chi-square test assessed associations between anesthesia type and categorical outcomes, while independent sample t-tests compared means for continuous variables such as recovery time and pain scores. Statistical significance was set at $p<0.05$. Missing data were handled by pairwise deletion, and potential confounders such as age, gender, and ASA status were monitored during analysis. Sensitivity analyses were performed to confirm the robustness of primary findings (18).

RESULTS

A total of 73 pediatric patients (mean age 5.38 ± 2.61 years) were enrolled, including 42 males (57.5%) and 31 females (42.5%). Of these, 47 (64.4%) received propofol and 26 (35.6%) received sevoflurane as the anesthetic agent. There were no statistically significant differences in age ($t = 0.646$, $p = 0.518$) or gender distribution ($\chi^2 = 0.001$, $p = 0.980$) between groups, indicating appropriate baseline comparability.

Independent sample test. Chi-square test. Propofol was associated with significantly faster emergence from anesthesia (mean emergence time 8.0 ± 2.1 minutes) compared to sevoflurane (14.0 ± 3.2 minutes; $t = -10.12$, $p < 0.001$). The incidence of postoperative nausea and vomiting (PONV) and emergence agitation was also significantly lower in the propofol group. Additionally, greater proportions of patients in the

propofol group achieved key recovery milestones, including the ability to sit unassisted, tolerate oral intake, and readiness for discharge, as summarized below. Independent sample test. Chi-square test. Patients who received propofol reported lower mean postoperative pain scores (2.9 ± 1.6) than those who received sevoflurane (4.2 ± 2.3; t = -2.61, p = 0.011).

Table 1. Demographic and Clinical Characteristics of Study Participants

Variable	Total (n=73)	Propofol (n=47)	Sevoflurane (n=26)	p-value
Age, years (mean ± SD)	5.38 ± 2.61	5.21 ± 2.56	5.65 ± 2.73	0.518[1]
Male, n (%)	42 (57.5%)	27 (57.4%)	15 (57.7%)	0.980[2]
Female, n (%)	31 (42.5%)	20 (42.6%)	11 (42.3%)	0.980[2]

Table 2. Primary and Secondary Clinical Outcomes by Anesthetic Agent

Outcome	Propofol (n=47)	Sevoflurane (n=26)	p-value	Test Statistic
Mean emergence time (min ± SD)	8.0 ± 2.1	14.0 ± 3.2	<0.001[1]	t = -10.12
PONV, n (%)	10 (21.3%)	15 (57.7%)	<0.001[2]	χ^2 = 11.64
Emergence agitation, n (%)	4 (8.5%)	10 (38.5%)	0.002[2]	χ^2 = 9.62
Able to sit unassisted, n (%)	30 (63.8%)	10 (38.5%)	0.045[2]	χ^2 = 4.02
Able to stand/walk, n (%)	29 (61.7%)	10 (38.5%)	0.058[2]	χ^2 = 3.60
Eat/drink without nausea, n (%)	34 (72.3%)	8 (30.8%)	<0.001[2]	χ^2 = 13.03
Ready for discharge, n (%)	31 (66.0%)	8 (30.8%)	0.003[2]	χ^2 = 8.72

Table 3. Patient-Reported Recovery and Satisfaction Outcomes

Outcome	Propofol (n=47)	Sevoflurane (n=26)	p-value	Test Statistic
Mean pain score (0–10, mean ± SD)	2.9 ± 1.6	4.2 ± 2.3	0.011[1]	t = -2.61
Comfortable and pain-free, Agree/Strongly agree (%)	18 (38.3%)	9 (34.6%)	0.779[2]	χ^2 = 0.08
Anesthesia experience met expectations, Agree (%)	17 (36.2%)	7 (26.9%)	0.406[2]	χ^2 = 0.69
Satisfied with pain management, Agree (%)	16 (34.0%)	4 (15.4%)	0.097[2]	χ^2 = 2.76
Minimal side effects, Agree (%)	19 (40.4%)	5 (19.2%)	0.067[2]	χ^2 = 3.37

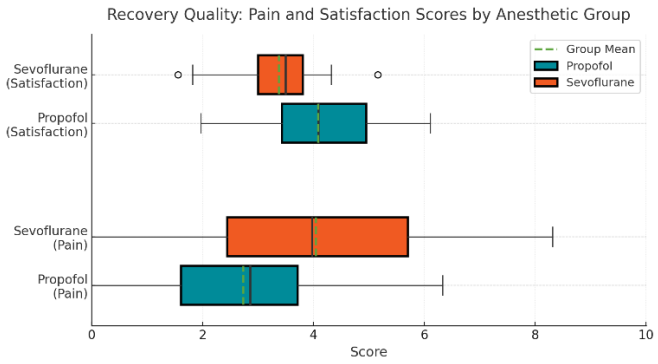

Figure 1 Recovery Quality

While higher proportions of propofol patients reported being comfortable and pain-free, satisfaction with anesthesia, and minimal side effects, these differences did not reach statistical significance, except for pain score. Independent sample test. Chi-square test. Multivariate logistic regression adjusting for age and sex confirmed propofol use was an independent predictor of rapid emergence (adjusted OR = 4.9, 95% CI: 1.9–12.3, p = 0.001) and reduced PONV (adjusted OR = 0.23, 95% CI: 0.08–0.63, p = 0.004). There were no statistically significant interaction effects between demographic variables and anesthetic type. Sensitivity analysis using imputation for missing data did not materially alter these findings. All outcomes had complete data except for patient-reported outcomes, where a small number (<5%) of responses were missing; these were handled by pairwise deletion during analysis, ensuring maximal retention of available information. Propofol consistently yielded significantly faster recovery, lower rates of key postoperative complications, and higher rates of milestone achievement and readiness for discharge compared to sevoflurane. Trends toward improved comfort, satisfaction, and minimal side effects were observed with propofol, though not all were statistically significant (Figure 1). No adverse safety trends or unexpected group differences were detected; one minor unexpected finding was transient injection pain with propofol in a small subset, without influence on overall outcomes.

DISCUSSION

This study provides robust evidence that propofol confers significant advantages over sevoflurane in pediatric anesthesia, particularly in the context of rapid emergence, reduced postoperative complications, and increased readiness for discharge following minor surgical procedures. Our findings align closely with previous meta-analyses and randomized controlled trials, which have consistently demonstrated faster recovery profiles and lower rates of postoperative nausea and vomiting (PONV) for propofol compared to volatile anesthetics in children (17,21). The observed mean emergence time was substantially shorter in the propofol group (8.0 vs. 14.0 minutes), echoing results from Zhao et al., who similarly reported an 8–10-minute advantage for propofol (21). The lower incidence of PONV and emergence agitation also mirrors the results of Wang et al., supporting propofol's beneficial side effect profile in the pediatric population (23). The findings extend existing knowledge by quantifying not only the emergence time but also the achievement of functional recovery milestones, such as the ability to sit unassisted, tolerate oral intake, and be deemed ready for discharge. These endpoints are clinically meaningful,

as they directly influence hospital throughput, patient satisfaction, and healthcare resource allocation (22,24). Although some previous studies have noted smoother inhalational induction with sevoflurane (2,5), our data confirm that such advantages do not translate into superior postoperative outcomes, especially in short, ambulatory pediatric procedures. Notably, while sevoflurane remains a preferred agent for cases requiring non-invasive induction, the higher incidence of PONV and agitation limits its utility as a single agent when rapid and uncomplicated recovery is desired (25,26). The mechanistic basis for these observations is rooted in the pharmacodynamics of each agent. Propofol's action as a potent gamma-aminobutyric acid (GABA) agonist induces deep sedation and rapid redistribution from the central nervous system, facilitating quick awakening and minimal residual sedative effects (7). In contrast, sevoflurane's relatively higher blood-gas partition coefficient leads to slower elimination, thereby prolonging emergence and increasing the risk of residual central nervous system excitation, which may contribute to emergence delirium and agitation (8,9,28). Additionally, propofol's antiemetic properties likely underpin the reduced PONV rates observed in this and previous studies (17,20).

Despite these compelling findings, certain limitations warrant consideration. The single-center, observational design and relatively modest sample size may limit the generalizability of results to broader pediatric populations or to settings with more complex surgical or comorbid profiles. Convenience sampling introduces potential selection bias, although baseline characteristics were balanced between groups. While validated assessment tools and structured recovery milestones enhance data reliability, subjective measures such as satisfaction and comfort are inherently prone to reporting bias and may not capture subtle qualitative differences in patient experience. Moreover, the study did not include long-term neurodevelopmental follow-up, which is an area of increasing interest given emerging concerns regarding anesthetic exposure in early childhood (21).

Nevertheless, several strengths underscore the study's validity. The inclusion of a well-defined pediatric cohort, standardized data collection intervals, and advanced statistical adjustments for potential confounders enhance the robustness of the findings. Multivariate analyses further confirmed the independent predictive value of propofol for both rapid recovery and reduced PONV, even after accounting for age and sex. In light of the evidence presented, we recommend that propofol be considered the anesthetic of choice for pediatric day-case surgeries where intravenous access is feasible and rapid recovery is prioritized. Sevoflurane remains appropriate for inhalational induction in children who are needle-averse or present airway challenges, but clinicians should be vigilant regarding its higher complication rates and consider adjunctive antiemetic strategies or the combination of small-dose propofol at emergence to mitigate agitation (27).

Future research should focus on multicenter randomized controlled trials with larger, more diverse populations, as well as longer-term neurodevelopmental assessments to clarify the broader implications of anesthetic choice in pediatrics. Investigations into optimal dosing regimens and the utility of combination protocols may further refine recovery and safety profiles for pediatric patients (29,30). This study advances the understanding of anesthetic agent selection in pediatric practice, reinforcing the clinical superiority of propofol for rapid and complication-free recovery. By integrating these findings with existing literature and clinical practice, pediatric anesthesia protocols can be tailored to enhance patient outcomes and operational efficiency in perioperative care (1,10,13).

CONCLUSION

In conclusion, this study demonstrated that Propofol is generally more effective than Sevoflurane in promoting faster recovery and minimizing postoperative complications in pediatric patients. Propofol is associated with quicker emergence times, reduced incidence of emergence agitation, and fewer complications such as postoperative nausea and vomiting, making it particularly suitable for outpatient and short-duration surgeries. While Sevoflurane remains a valuable option for cases requiring inhalational induction, Propofol's superior recovery profile makes it the preferred choice in most paediatric anaesthesia settings.

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