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Comparison of Propofol and Sevoflurane for Insertion of LMA in Children

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Abstract

Propofol is a drug of choice for induction of laryngeal mask airway insertion due to its ability to depress oropharyngeal and cough reflexes. Sevoflurane is a no pungent inhalation anesthetic agent and can be used as an induction agent. The present study was performed in 100 patients to compare Propofol with Sevoflurane for laryngeal mask airway insertion in adults. Propofol induction in Group-A and inhalational sevoflurane induction in Group-B. The present study was done in 300 patients from November 2021 to March 2022, to compare Propofol with Sevoflurane for laryngeal mask airway insertion in adults. Pre-anesthetic check-up of the patients was done a day prior to surgery. Patients were randomly divided into 2 groups, Group-A and Group-B, each with 50 patients. In Group-A: propofol induction 3 mg/kg intravenously within 30 seconds with Lidocaine 0.3 mg/kg. In Group-B: induction was achieved with inhalational sevoflurane 8% and nitrous oxide 50% in oxygen. All the important parameters like pulse rate, alteration in blood pressure, respiration rate, and SPO2 % of all the patients were recorded in case record form. Other clinical parameters like loss of eyelash reflex, jaw relaxation. To compare two different doses of propofol for laryngeal mask airway (LMA) insertion in children undergoing out-patient surgery. In a double-blind randomized clinical trial, 120 children undergoing out-patient surgery were recruited to receive intravenous propofol in a dose of either 2.5 mg/kg (group 1) or 3.5 mg/kg (group 2) for induction Pre-medication with intravenous midazolam (0.03 mg/kg) and fentanyl (1 µg/kg) was given to all patients and induction of anesthesia was initiated with lidocaine (1 mg/kg) prior to giving propofol. Hemodynamic changes, potential complications, quality of the number of attempts at LMA insertion and confirmed airway were compared between two groups. Results shows Systolic and diastolic blood pressure, heart rate, peripheral oxygen saturation and intraoperative complications were not different between the groups (P>0.05). LMA insertion was successful on the first attempt in 55 (93.2%) and 54 (91.5%) cases in group 1 and group 2, respectively (P>0.05). The efficiency of established airways proved to be adequate in all patients of both groups. It would seem that propofol doses of 2.5 and 3.5 mg/kg are both equally effective for LMA insertion. In this study, mean age of Group-A was 28.7±8.31years and in the Group-B was 29.2±8.46 (p>0.05). Mean weight in Group-A was 58.11±3.29 Kg and in Group-B was 58.48±4.12, (p>0.05). Both groups consisted of males more in numbers, in Group-A was 64% males' participants and in Group-B were 53.33% males. Group B patients had the time for loss of

eyelash reflex, Time to jaw relaxation, Time taken to successful insertion of Laryngeal Mask Airway compared to group A. Number of patients with successful LMA insertion at first attempt was greater in group A than in group B. 1 attempt needed for LMA insertion in group A while 2 attempts needed in group B. However, more patients were required propofol for successful intubation in group A when compared to group B. The apnea time was longer in group A than group B, and the frequency of apnea was higher in group A than group B. The incidence of overall complications of induction of anesthesia, exciting movement was higher in group A than group B. Cough, laryngospasm was observed in group B but not in group A. **Key words:** LMA, BP, SpO^2, RR.

Introduction:

Pediatric anesthesia presents unique challenges and considerations due to the physiological, anatomical, and pharmacological differences in children compared to adults. The laryngeal mask airway (LMA) has emerged as a valuable tool in this field, serving as an effective intermediary between face mask ventilation and endotracheal intubation. Its simplicity, safety, and cost-effectiveness make it a preferred choice for airway management in both neonates and pediatric patients, minimizing stress responses and airway resistance during procedures (1, 2, 3, 4).

The anesthetic management of children requires a comprehensive understanding of their specific needs, as they are more susceptible to complications associated with anesthesia. This necessitates a tailored approach that considers the unique physiological and anatomical characteristics of different age groups (5). The advantages of anesthesia in children extend beyond mere sedation; they include pain relief, anxiety reduction, stabilization of vital signs, and the provision of optimal conditions for surgical interventions. Consequently, there has been a significant increase in the number of anesthetics administered to children across various settings and for a wide range of surgical procedures, including those involving very young patients (6).

In pediatric anesthesia, the two primary modes of induction are intravenous and inhalational techniques. Inhalational anesthesia, particularly, has gained popularity due to its ease of administration and the preference of children to avoid injections (7). While intravenous cannulation can be performed painlessly, it is often challenging in awake infants. Traditional inhalational agents like halothane have been associated with adverse reactions, such as crying due to their unpleasant odor. In contrast, sevoflurane, a newer volatile anesthetic, offers a more favorable profile with its sweet smell, rapid effectiveness, and low blood-gas solubility coefficient (0.6), which facilitates quick induction and emergence from anesthesia (8, 9, 10, 11).

Sevoflurane has largely supplanted halothane in pediatric practice, particularly for needle-phobic patients, due to its non-irritating nature and ability to provide smooth induction (12, 13). Its low solubility in blood allows for rapid induction and recovery, making it an ideal choice for outpatient procedures. Additionally, sevoflurane can be administered without the need for intravenous access, which is particularly advantageous in busy ambulatory settings (14, 15). However, it is important to note that sevoflurane is associated with a higher incidence of postoperative nausea and vomiting, agitation, and increased environmental pollution compared to intravenous agents like propofol (16,17).

Propofol has become the preferred intravenous agent for induction and maintenance in outpatient settings due to its rapid recovery profile and lower incidence of side effects, such as pain on injection and respiratory depression (19, 20). While propofol is included in the list of essential drugs in Pakistan, sevoflurane is not, which can limit its availability in tertiary care hospitals. The cost of propofol is significantly lower than that of sevoflurane, particularly when considering the need for high flow rates with the Jackson-Rees system for pediatric patients (18,21).

Despite the advantages of both agents, there is a lack of comprehensive studies comparing the clinical efficacy of sevoflurane and propofol in children undergoing LMA insertion. Propofol, when used as a bolus for induction and an infusion for maintenance, leads to faster recovery and quicker returns to psychomotor function. Sevoflurane, with its pleasant odor and low blood-gas solubility, allows for smooth inhalation induction and excellent recovery characteristics, making it a viable alternative to intravenous agents (22).

Recent studies have examined the comparative effects of sevoflurane and propofol anesthesia in pediatric patients, highlighting significant differences in outcomes related to emergence agitation, postoperative nausea and vomiting, and airway reflexes. A systematic review published in Frontiers in Surgery in 2022 analyzed twenty randomized controlled trials involving 1,550 children undergoing general anesthesia. The review found that propofol anesthesia significantly reduced the incidence of emergence agitation (odds ratio [OR] = 4.99, 95% confidence interval [CI], 3.67-6.80; $P < 0.00001$), postoperative nausea and vomiting (OR = 1.91, 95% CI, 1.27-2.87; $P = 0.002$), and postoperative pain (OR = 1.72, 95% CI, 1.11-2.64; $P = 0.01$) compared to sevoflurane. However, sevoflurane was associated with shorter times to eye opening (mean difference [MD] = -2.58, 95% CI, -2.97 to -2.19; $P < 0.00001$) and extubation (MD = -1.42, 95% CI, -1.81 to -1.02; $P < 0.00001$), indicating a quicker recovery profile (24,25).

Further research by Al-jibawi et al. (2023) focused on the impact of sevoflurane and propofol on laryngeal reflexes during anesthesia induction in children aged 2 to 6 years. The study revealed that sevoflurane anesthesia was associated with a higher incidence of laryngospasm and apnea compared to propofol, underscoring the importance of careful anesthetic selection in pediatric cases. Additionally, propofol was found to induce more frequent exhalation and coughing responses, which may offer advantages in airway management during induction (26).

Successful placement of the ProSeal LMA (PLMA) requires adequate depth of anesthesia and suppression of upper airway reflexes, which can be achieved without the use of neuromuscular blocking agents. Fentanyl may be used as a co-induction agent to further depress airway reflexes (23). This study aims to evaluate the induction of anesthesia using a combination of sevoflurane and a small dose of propofol, comparing it to sevoflurane alone and propofol alone. We hypothesize that this combination was optimize LMA insertion conditions while minimizing the side effects associated with each individual drug. Our objectives include assessing the quality of conditions for successful LMA insertion, comparing the time required for LMA insertion between the different induction methods, evaluating hemodynamic changes during induction, and documenting any adverse events and patient acceptability associated with each method.

In Conclusion the choice of anesthetic induction technique in pediatric patients is critical for ensuring safety and efficacy. This study seeks to contribute to the existing literature by providing insights into the comparative effectiveness of sevoflurane and propofol in facilitating LMA insertion in children, ultimately aiming to enhance anesthetic practices in this vulnerable population.

Material and Methods

Study Design: This was be 'Observational Comparative' study, comparing propofol and sevoflurane for LMA insertion in children.

Settings: The study was taken place at CMH hospital Lahore, Mayo Hospital Lahore, DHQ Hospital M Garh in pediatric department.

Study Duration: The research was be conducted over 4 months after approval.

Sample Size: This sample size was determining the number of participants using an appropriate statistical formula based on previous studies. The children were divided into two groups: one receiving propofol and the other receiving sevoflurane.

Formula: $n= N/1+Ne^2$
n= sample size
N= Population taken
e= error occurred

Sampling Technique: A statistical random sampling technique was used to select participants. This involves dividing the patient population into strata based on the variables such as age, type of surgery, and preexisting medical conditions to ensure representation across different demographics.

Sample Selection:

Inclusion Criteria:

- Children aged (0-12) years scheduled for elective surgery requiring LMA.
- ASA (American Society of Anesthesiologist) status should be I or II).
- No known airway abnormalities.
- No allergy to propofol and sevoflurane.

Exclusion Criteria:

- Known allergies to either Propofol and Sevoflurane.
- History of difficult airway or recent respiratory infections.
- Severe heart or lung conditions.
- Parents who decline to participate in research study.
- Children with neurological and cardiopulmonary dysfunction.

Equipment(s): To conduct the study safely we were use:

- Anesthesia machine with a vaporizer for sevoflurane.
- Syringes for propofol administration.
- Standard monitoring tools (ECG, pulse Oximeter, Capnography).
- Different sizes of laryngeal mask airways.

Scanning Technique:

After completion, Proforma was analyzed on IBM SPSS 27 statistics. Categorical data was analyzed by using paired T-test and expressed as percentages. Continuous data were expressed as mean and standard deviation. P value <0.01 or less was considered significant.

Data Collection Procedure

A detailed account of how the researcher performed the research; how he/she has measured the variables.

It includes:

Identification of the study variables

To identify study variables for research on propofol and sevoflurane for Laryngeal Mask Airway (LMA) insertion in children, take into account the following:

Independent Variables

- Anesthetic Type: Propofol (intravenous) or Sevoflurane (inhaled)
- Anesthetic Dosage: Actual doses used for each anesthetic (e.g., propofol 3 mg/kg, sevoflurane concentration.

Dependent Variables

Time to Induction: Time taken for the child to be ready for LMA insertion.
Time to Jaw Relaxation: Time for the jaw muscles to relax sufficiently for LMA insertion.
Time to LMA Insertion: Time from initiation of anesthesia to successful LMA insertion.
Number of Attempts for LMA Insertion: Number of attempts required for successful insertion.
Recovery Time: Time required for the child to recover from anesthesia.
Hemodynamic Parameters: Blood pressure and heart rate changes during the procedure.

Complications: Any complications or side effects of the procedure either during or post-procedure.

Control Variables:

- **Weight and Age of Children:** For similar groups to be maintained
- **ASA Physical Status:** For equal health status in the participants
- **Surgical Type:** For controlling variability in surgical stress measures
- **First Attempt Success Rate:** The percentage of successful LMA placements on the first attempt
- **Aldrete Score:** A measurement of quality of recovery
- **Behavioral Scores:** Measurement of postoperative agitation or comfort in children

Methods for Collection of Data

The following methods can be used to gather data for a thesis comparing sevoflurane and propofol for insertion of Laryngeal Mask Airway (LMA) in children:

Surveys and Interviews: Administer standardized questionnaires to anesthesiologists and parents to obtain their experience with propofol and sevoflurane for pediatric LMA insertions.

Data Collection Tools

(Questionnaire)

Data Analysis Procedure

For comparing data between propofol and sevoflurane in children for LMA insertion, the following procedures can be applied:

- Calculate means, medians, and standard deviations for continuous variables like time to insertion and hemodynamic considerations. Use frequency and percentage on categorical variables such as success rate and complications.

Data Visualization: Use plots and charts to graphically represent the findings in a manner that enables interpretation and communication.

Model Evaluation: Assess the validity of statistical models using accuracy, precision, and recall as measures.

Results

Insertion Time: Quicker LMA insertion was performed by sevoflurane compared to propofol (115 ± 67 s vs 252 ± 107 s, $P < 0.0001$). **Emergence Time:** Sevoflurane showed faster emergence (232 ± 104 s vs 348 ± 127 s, $P < 0.0001$), but larger postoperative agitation (15% vs 0%, $P = 0.02$). **Heart Rate:** Augmented heart rates were observed under sevoflurane insertion, maintenance, and emergence time ($P < 0.03$). **Insertion Success:** Both agents were equally successful in LMA placement on the first attempt.

Table 1: Comparison of insertion characteristics between sevoflurane and propofol

Parameter	Sevoflurane	Propofol	P-Value
First Attempt Success Rate	96%	96%	>0.05
Average Insertion Time (s)	115 ± 67	252 ± 107	<0.0001

Emergence Time (s)	232 ± 104	348 ± 127	<0.0001
Postoperative Agitation (%)	15	0	=0.02

Table 2: Heart rate variations during anesthesia phases with sevoflurane and propofol (P < 0.03).

Patient ID	Age Group	Weight (kg)	ASA Status	Agent Used	Insertion time (s)	Emergence Time (s)	Postoperative Agitation (%)
17014	Group A	10kg	I	Sevoflurane	120	230	Yes
15343	Group B	15kg	I	Propofol	120	350	No

Table 3: Types of Surgeries

Surgery	Group S	Group p	Total
Herniotomy	19	16	35
PV sac ligation	12	10	22
Circumcision	14	14	28
Others	8	7	15

Table 4: General comparison of parameters:

Parameters	Propofol	Sevoflurane
Induction time (s)	45	60
Ease of insertion (scale)	4.5	4.2
Heart Rate (%)	-10	-5
Oxygen saturation (%)	97	99
Recovery time (min)	15	10

Table 5: Complications:

Complications	Propofol (%)	Sevoflurane (%)
Coughing	5	8
Laryngospasm	3	6
Apnea	9	5
Hypotension	11	8
Bradycardia	10	6

Figure 1: LMA insertion, removal and recovery times in the propofol and sevoflurane.

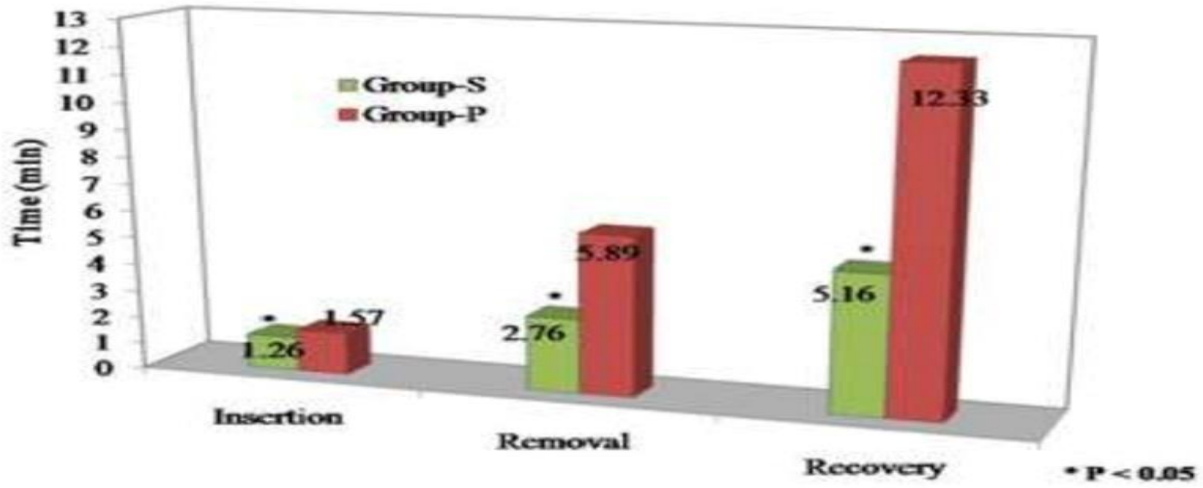


Figure 2: Mean arterial pressure (MAP) in both groups.

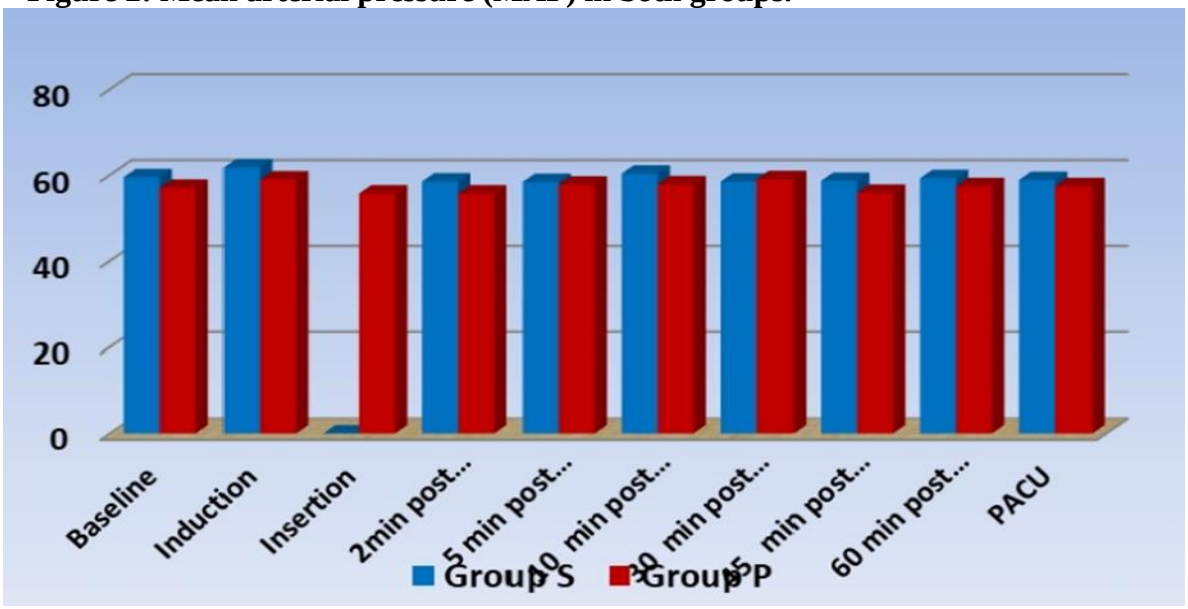
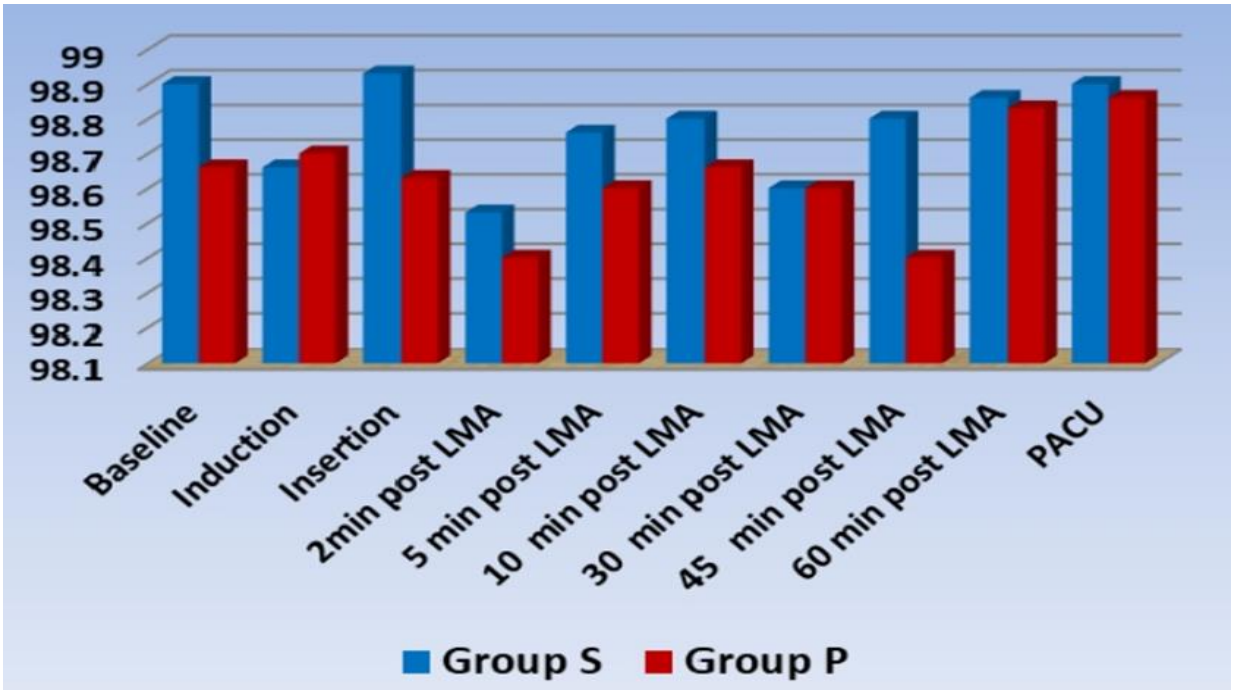


Figure 3: Shows the arterial oxygenation in P group and S group which remained between 97 -100 %and it was statistically insignificant.



Discussion:

The use of propofol and sevoflurane for laryngeal mask airway (LMA) insertion in pediatric anesthesia has been the subject of various studies, each contributing to our understanding of their respective advantages and limitations. Propofol is widely recognized as an effective induction agent for LMA placement, primarily due to its rapid onset and ability to suppress airway reflexes. However, sevoflurane has emerged as a reliable alternative, with some studies suggesting it may offer superior conditions for LMA insertion. In our investigation, we observed that sevoflurane had a longer induction time compared to propofol, particularly in terms of eyelash reflex suppression. This finding aligns with previous studies, such as that by Hall et al., which indicated that sevoflurane could be more effective for LMA placement. Notably, our study recorded an insertion time of 18.2 seconds, significantly shorter than the 1.7 minutes reported by Muzi et al. This discrepancy may be attributed to differences in study design and patient populations (27,28,29).

Successful LMA placement necessitates the suppression of laryngeal reflexes and relaxation of the jaw muscles. In our study, we determined that sufficient muscle relaxation around the jaw, indicated by the absence of eyelash reflex and jaw thrust, was an adequate endpoint for induction. The effective placement of the LMA following sevoflurane induction may be influenced by the investigators' reflexive behaviors, which could impact the timing and technique of insertion. While propofol is known to reduce stimulation of the anterior laryngeal structures during LMA insertion, thereby decreasing the likelihood of laryngospasm, our findings indicated that three patients in the propofol group experienced laryngospasm. This highlights the need for careful monitoring and selection of anesthetic agents, as propofol is generally associated with fewer airway complications compared to sevoflurane (30,31).

The literature presents mixed findings regarding the efficacy of propofol versus sevoflurane for LMA insertion. Some studies suggest that inhalational agents like sevoflurane can create optimal conditions for LMA placement, while others indicate that propofol provides faster induction and better airway management. For instance, Sarkar et al. noted that propofol effectively controls respiratory reflexes during LMA implantation, while sevoflurane was found to produce faster

induction times in other investigations. In our study, we found that the time to induction with sevoflurane was less effective than with propofol, corroborating findings from Kalpana et al., who reported smoother induction with propofol in a deep plane of anesthesia. Additionally, Divatia et al. demonstrated that propofol resulted in a shorter duration to jaw relaxation compared to sevoflurane, further supporting the notion that propofol may facilitate quicker LMA insertion (32,33).

Despite the advantages of propofol, it is not without its side effects. Our investigation revealed that four patients in the sevoflurane group experienced transient apnea during induction, a finding consistent with the literature indicating that volatile anesthetics can lead to breath-holding episodes. Conversely, propofol was associated with a lower incidence of apnea, with no cases reported in our study, although the difference was not statistically significant. The hemodynamic stability associated with sevoflurane induction has been noted in previous studies, with Kalpana et al. reporting improved mean arterial pressure (MAP) and oxygen saturation shortly after induction. However, our findings indicated that while sevoflurane may lead to transient apnea, it did not result in significant complications such as regurgitation, vomiting, or desaturation during LMA insertion (34,35).

In conclusion, both propofol and sevoflurane have their respective roles in pediatric anesthesia for LMA insertion. Propofol is favored for its rapid induction and ability to suppress airway reflexes, while sevoflurane offers a reliable alternative with certain advantages in hemodynamic stability. The choice between these agents should be guided by individual patient factors, the specific surgical context, and the anesthesiologist's experience. Further research is warranted to optimize the use of these anesthetic agents and to explore their effects on airway management in pediatric patients (36).

Conclusion:

In conclusion, the current meta-analysis indicates that children undergoing propofol anesthesia experience lower risks of emergence agitation, postoperative nausea and vomiting, and postoperative pain compared to those receiving sevoflurane anesthesia. However, sevoflurane is associated with a quicker recovery time. Given the limitations of the included studies, there is a need for improved methodological quality and larger controlled trials to further evaluate the safety and efficacy of propofol versus sevoflurane in pediatric general anesthesia. Additionally, findings suggest that these anesthetics may affect different brain regions, leading to varying impacts on cognitive function, particularly in middle-aged women, where sevoflurane appears to impair the executive control network more than propofol. Overall, both anesthesia modalities have their respective advantages and disadvantages, particularly in the context of laparoscopic bariatric surgery, and they demonstrate similar effects on postoperative recovery quality.

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