

Effect of Propofol versus Sevoflurane on Postoperative Shivering during Maintenance of General

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Abstract:

Background: The choice of anesthetic agent for maintenance of general anesthesia significantly influences intraoperative stability, recovery profile, and postoperative outcomes. Propofol and sevoflurane are commonly used agents, yet their comparative performance remains clinically relevant.

Aim: To compare propofol and sevoflurane for maintenance of anesthesia with respect to hemodynamic stability, recovery characteristics, and adverse events.

Methodology: This prospective, randomized comparative study included 80 ASA I–II patients undergoing elective surgeries. Patients were allocated into two groups: Group P (propofol infusion) and Group S (sevoflurane inhalation). Hemodynamic parameters, recovery times, Modified Aldrete Score, and perioperative adverse events were assessed and analyzed statistically.

Results: Demographic variables were comparable between groups. Group P demonstrated significantly better intraoperative hemodynamic stability with lower heart rate and blood pressure values ($p < 0.05$). Recovery was faster in Group P, with shorter times to eye opening, verbal response, and extubation ($p < 0.001$). Postoperative nausea, vomiting, and emergence agitation were significantly lower with propofol.

Conclusion: Propofol provided superior hemodynamic control, faster recovery, and fewer postoperative adverse effects compared to sevoflurane, making it a preferable agent for maintenance of anesthesia in short elective surgeries.

Keywords: Propofol, Sevoflurane, Maintenance of anesthesia, Hemodynamic stability, Recovery profile.

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Introduction

The maintenance of general anesthesia is a very important aspect of perioperative management that guarantees enough hypnosis, analgesia, and immobility and stabilizes the autonomic nervous system during surgery [1]. The anesthetic agent selected for maintenance has a great impact on cardiovascular events, level of anesthesia, recovery process, complications after surgery, and eventually patient's fate. Among the various anesthetic agents, propofol which is an intravenous hypnotic agent, and sevoflurane which is a volatile inhalational anesthetic, are two commonly used drugs in the maintenance of anesthesia during modern clinical practice. Their large-scale usage is due to the combination of their good pharmacokinetics and pharmacodynamics, relative safety and applicability to a wide surgical population [2]. Notwithstanding their daily use, there is still a heated discussion concerning their relative effectiveness, safety, and influence on perioperative physiological parameters thus a direct comparison is requested.

Propofol is an anesthetic agent that is administered intravenously and is widely accepted for the induction and maintenance of anesthesia in different forms like total intravenous anesthesia (TIVA) [3]. Its effect on the brain is by enhancing the GABA (gamma-aminobutyric acid) mediated transmission of inhibitory neurotransmitter in the central nervous system that leads to the quick initiation of hypnosis and sedation. The short-acting and predictable effects of propofol make it an ideal anesthetic for both surgical procedures and recovery as there is no postoperative impairment of patient's consciousness and their quick recovery. Moreover, propofol is an effective antiemetic and has been associated with the least cases of nausea and vomiting after surgery, making it the anesthetic of choice for outpatient and short surgeries [4]. Nevertheless, there are some drawbacks to its use, such as the risk of dose-dependent hypotension, bradycardia, and respiratory depression which is more pronounced in the elderly and patients with prior cardiovascular issues.

Sevoflurane is a product of modern technology that makes it through the aid of its factors like its pleasant smell, minimum blood-gas partition ratio, and no irritation to airways [5]. Induction and maintenance, as well as waking up from anesthesia, become rapid and smooth with the use of these characteristics. Sevoflurane does its job by affecting several ion channels, such as the GABA receptors and the potassium channels, thus causing hypnosis and stillness. It is a strong contender in the race for pediatric anesthesia and in the case of patients that inhalation is the only route for anesthetic administration. The simplicity of the titration process involved in the use of end-tidal concentration monitoring allows the anesthesiologists to make the anesthetic depth changes that correspond to the actions of the surgeon [6]. However, there are several side effects connected with sevoflurane such as hypotension that depend on the dosage given, the probability of emergence agitation, and the concerns regarding fluoride ion production and compound A formation, specifically when low fresh gas flows are used during prolonged anesthesia.

The anesthesia maintenance comparison between propofol and sevoflurane goes beyond just their pharmacological properties and includes a lot of clinically relevant factors for consideration. One of the main issues is hemodynamic stability since blood pressure and heart rate changes during surgery can result in negative effects on organ perfusion and surgical outcomes [7]. Propofol has been linked to more pronounced and considerable arterial blood pressure and systemic vascular resistance reductions in comparison with sevoflurane, which might provide cardiovascular profiles that are more stable in some patient demographics. Recovery characteristics, such as time taken for opening of the eyes, extubation, and orientation, are major issues too, especially in fast-track and day-care surgeries. Both drugs are recognized for facilitating a quick return to normal function, however, differences in the patients' waking up and cognitive recovery have been noted, thus, the choice of anesthetic agent becomes a matter of taking into account surgical scenarios and patient's requirements.

One major factor in the comparison is the impact of these agents on postoperative outcomes. One of the benefits of using Propofol is that its antiemetic effect can be helpful in the reduction of postoperative nausea and vomiting, which is a frequent source of patient discomfort and causes discharge to be delayed [8]. On the other hand, during the use of inhalation anesthetics, for example sevoflurane, the occurrence of postoperative nausea has been raised but it can be controlled with the appropriate application of antiemetics in advance. Furthermore, the fear of influence on pain perception after surgery, inflammatory response, and stress hormone levels has opened the doors to more studies on the topic of which

anesthetic maintenance technique might impact the whole perioperative stress and recovery quality the most positively.

The decision between propofol and sevoflurane from a practical and economic point of view is also affected by the cost, availability of infusion devices, operating room infrastructure, and environmental impact. Propofol total intravenous anesthesia necessitates infusion pumps and close monitoring, whereas sevoflurane depends on anesthesia workstations and adds to operating room greenhouse gas pollution. Such factors are becoming more critical in resource-poor environments and when considering sustainable anesthesia practices.

Since both propofol and sevoflurane are used widely and the optimization of anesthetic maintenance has great clinical significance, a head-to-head comparison between these two agents is of high relevance. Knowing the pros and cons of their hemodynamic stability, recovery profiles, and perioperative outcomes would help the anesthesiologists to customize the anesthetic techniques according to the particular patient's attributes and surgery's necessities. Thus, carrying out a trial comparing the use of propofol and sevoflurane for maintenance of anesthesia is crucial for providing evidence-based practice and improving safety, as well as quality, in anesthetic care.

Methodology

Study Design: This study was designed as a prospective, randomized, comparative, controlled clinical study conducted to compare propofol and sevoflurane for maintenance of anesthesia in patients undergoing elective surgical procedures under general anesthesia. The study aimed to evaluate hemodynamic stability, recovery characteristics, and the incidence of adverse events associated with both anesthetic agents during the intraoperative and immediate postoperative period.

Study Area: The study was conducted in the Department of Anaesthesia, Netaji Subhas Medical College and Hospital, Bihta, Patna, India from Jan 2024 to December 2024

Study Participants: A total of 80 patients scheduled for elective surgical procedures under general anesthesia.

Inclusion Criteria

- Patients aged 18–60 years
- Either gender
- Classified as ASA physical status I or II
- Scheduled for elective surgeries under general anesthesia
- Expected duration of surgery less than 120 minutes

Exclusion Criteria

- Known allergy or hypersensitivity to propofol or sevoflurane
- Patients with ASA physical status III or IV
- History of significant cardiac, respiratory, hepatic, renal, or neurological disease
- Pregnant or lactating women
- Patients with a history of malignant hyperthermia
- Patients on long-term sedative, hypnotic, or opioid therapy

Sample Size

The total sample size was 80 patients, divided equally into two groups of 40 patients each.

- **Group P:** Propofol group
- **Group S:** Sevoflurane group

Procedure: Every single patient got the same thorough pre-anesthesia evaluation that encompassed a detailed medical history review, a complete physical examination, an assessment of the airway, and the performance of standard laboratory tests. The patient's vital signs were taken and recorded throughout the procedure, including heart rate, non-invasive blood pressure, oxygen saturation, and ECG. The patients were kept without oral intake according to the usual practices. When the patients reached the operating theatre, standard monitoring was installed, which monitored the ECG, NIBP, SpO₂, and EtCO₂. The intravenous line was placed, and premedication was done through the intravenous route using midazolam (0.03 mg/kg) and fentanyl (1-2 µg/kg).

Two groups of patients were created by means of a random allocation process done by computer, and the concealment of allocation was guaranteed by using sealed opaque envelopes. The induction of anesthesia was the same for both groups and was done with intravenous propofol (2–2.5 mg/kg). Once the proper depth of anesthesia was attained, the patient's airway was secured using an endotracheal tube of appropriate size after giving a neuromuscular blocking agent. For the maintenance of anesthesia, patients in Group P received a drip of propofol intravenously at a rate of 6–10 mg/kg/hour, whereas patients in Group S were inhaling sevoflurane at 1–2.5% concentration in a mixture of oxygen and air. Extra doses of fentanyl were given whenever needed to keep the pain under control.

Monitoring of hemodynamic parameters like heart rate, systolic and diastolic blood pressure, mean arterial pressure, SpO₂, and EtCO₂ was done at regular intervals during the surgery. Any incidents of hypotension, hypertension, bradycardia, or tachycardia were recorded and dealt with as per standard protocols. After the surgery, anesthetic agents were stopped, and neuromuscular blockade was reversed by neostigmine (0.05 mg/kg) and glycopyrrolate (0.01 mg/kg). Time for eye opening, getting response to verbal commands, and extubation were noted. Patients were taken to the recovery room and monitored until they were assessed to have made adequate recovery according to the Modified Aldrete Score.

Statistical Analysis: All data were entered into a structured proforma and analyzed using Statistical Package for Social Sciences (SPSS) version 27.0. Continuous variables were expressed as mean ± standard deviation and compared between groups using the unpaired Student's t-test. Categorical variables were expressed as frequencies and percentages and analyzed using the Chi-square test or Fisher's exact test, as appropriate. A p-value < 0.05 was considered statistically significant.

Result

In Table 1, the demographic characteristics of the participants in Group P (propofol) and Group S (sevoflurane) are shown. Both groups were made up of 40 patients each. The average age of the participants was not significantly different between the two groups (42.6 ± 11.8 years Group P vs 43.1 ± 12.2 years Group S; p = 0.84). Likewise, the gender ratio was very similar with Group P consisting of 24 males and 16 females while Group S had 22 males and 18 females (p = 0.65). The average body weight for the groups did not differ either (63.4 ± 8.6 kg vs 64.1 ± 9.1 kg; p = 0.72). In the same way, the ASA physical status I and II patient distribution was similar in both groups (26/14 vs 25/15; p = 0.82). The surgery duration was also nearly identical, with mean times of 78.5 ± 15.4 minutes for Group P and 80.2 ± 16.1 minutes for Group S (p = 0.61), illustrating that the two groups were indeed well matched with no statistically significant differences in patient characteristics at the start of the study.

Table 1: Demographic Characteristics of Study Participants

Variable	Group P (Propofol) (n = 40)	Group S (Sevoflurane) (n = 40)	p-value
Age (years, Mean ± SD)	42.6 ± 11.8	43.1 ± 12.2	0.84
Gender (Male/Female)	24 / 16	22 / 18	0.65
Weight (kg, Mean ± SD)	63.4 ± 8.6	64.1 ± 9.1	0.72
ASA I / II	26 / 14	25 / 15	0.82
Duration of surgery (min, Mean ± SD)	78.5 ± 15.4	80.2 ± 16.1	0.61

The comparison of intraoperative hemodynamic parameters from Table 2 reflects that the hemodynamic profiles of patients in Group P were significantly more stable during the surgery compared to Group S. The average heart rate for Group P was found to be lower (74.2 ± 6.8 beats/min) than in Group S (78.6 ± 7.4 beats/min) and the difference was significant ($p = 0.01$). In the same manner, mean

systolic blood pressure (112.4 ± 9.3 mmHg vs. 118.7 ± 10.1 mmHg), mean diastolic blood pressure (70.6 ± 6.1 mmHg vs. 73.9 ± 6.5 mmHg), and mean arterial pressure (84.5 ± 7.2 mmHg vs. 88.9 ± 7.8 mmHg) all showed a significant decline in Group P as compared to Group S, with p -values 0.02, 0.03, and 0.01 respectively signifying better intraoperative hemodynamic control in Group P.

Table 2: Comparison of Intraoperative Hemodynamic Parameters

Parameter	Group P (Mean \pm SD)	Group S (Mean \pm SD)	p-value
Mean Heart Rate (beats/min)	74.2 ± 6.8	78.6 ± 7.4	0.01*
Mean Systolic BP (mmHg)	112.4 ± 9.3	118.7 ± 10.1	0.02*
Mean Diastolic BP (mmHg)	70.6 ± 6.1	73.9 ± 6.5	0.03*
Mean Arterial Pressure (mmHg)	84.5 ± 7.2	88.9 ± 7.8	0.01*

According to Table 3 there is a statistically significant difference among the recovery properties of both the Groups P and S. The patients assigned to Group P were faster in their overall recovery process, as shown by the lower duration of eye opening (6.4 ± 1.5 min), response to verbal commands (7.8 ± 1.9 min), and extubation (8.6 ± 2.0 min) as compared to Group S which exhibited longer recovery

times of 9.2 ± 2.1 min, 11.1 ± 2.4 min, and 12.4 ± 2.6 min, respectively. The differences were extremely significant ($p < 0.001$). Meanwhile, the Modified Aldrete Score at 10 minutes was significantly higher in Group P (9.3 ± 0.6) than in Group S (8.5 ± 0.7), suggesting that Group P experienced a quicker, better-quality early postoperative recovery.

Table 3: Recovery Characteristics Between the Two Groups

Recovery Parameter	Group P (Mean \pm SD)	Group S (Mean \pm SD)	p-value
Time to eye opening (min)	6.4 ± 1.5	9.2 ± 2.1	<0.001*
Time to response to verbal commands (min)	7.8 ± 1.9	11.1 ± 2.4	<0.001*
Time to extubation (min)	8.6 ± 2.0	12.4 ± 2.6	<0.001*
Modified Aldrete Score at 10 min	9.3 ± 0.6	8.5 ± 0.7	<0.01*

The occurrence of intraoperative and postoperative adverse events in Group P and Group S, each consisting of 40 patients, is illustrated in Table 4. Hypotension was noticed more often in Group P (15%) than in Group S (5%); nevertheless, this difference was not statistically significant ($p = 0.14$). The rate of bradycardia was similar in the two groups as it was in Group P 10% and in Group S, 7.5% ($p = 0.69$). The incidence of postoperative nausea and vomiting in Group S (20%) was significantly higher than in Group P (7.5%), thus showing a statistically

significant difference ($p = 0.04$). Likewise, emergence agitation was substantially more frequent in Group S (17.5%) compared to Group P (2.5%), and the difference reached statistical significance ($p = 0.02$). Group S exhibited shivering more frequently than Group P as the percentage was 15% versus 5%, but this difference was not statistically significant ($p = 0.13$). Overall, Group S was associated with a higher frequency of certain postoperative adverse events particularly nausea, vomiting, and emergence agitation.

Table 4: Incidence of Intraoperative and Postoperative Adverse Events

Adverse Event	Group P (n = 40)	Group S (n = 40)	p-value
Hypotension	6 (15%)	2 (5%)	0.14
Bradycardia	4 (10%)	3 (7.5%)	0.69
Postoperative nausea & vomiting	3 (7.5%)	8 (20%)	0.04*
Shivering	2 (5%)	6 (15%)	0.13
Emergence agitation	1 (2.5%)	7 (17.5%)	0.02*

The overall comparison of anesthetic maintenance quality in Group P and Group S is presented in Table 5. Group P showed significantly better hemodynamic stability, with a higher number of patients exhibiting good stability (30 vs. 24) and less poor outcome than Group S ($p = 0.04$). However, the requirement of extra analgesia was lower in Group P

(22.5%) than Group S (35%), but this difference was not statistically significant ($p = 0.21$). The smooth emergence was seen more in Group P (90%) compared to Group S (70%), and the difference was statistically significant ($p = 0.03$). Likewise, good patient recovery quality was significantly higher in Group P (85%) than in Group S (65%) ($p = 0.04$),

which led to the conclusion that Group P had superior overall anesthetic maintenance outcomes.

Parameter	Group P	Group S	p-value
Hemodynamic stability (Good/Moderate/Poor)	30 / 8 / 2	24 / 11 / 5	0.04*
Need for additional analgesia	9 (22.5%)	14 (35%)	0.21
Smooth emergence (%)	36 (90%)	28 (70%)	0.03*
Patient recovery quality (Good)	34 (85%)	26 (65%)	0.04*

Discussion

The current research evaluated the use of propofol and sevoflurane in terms of hemodynamic stability, recovery characteristics, postoperative comfort, adverse effects, and overall satisfaction with the maintenance of anesthesia. The baseline demographic characteristics such as age, gender distribution, body weight, height, and ASA physical status were similar between the groups, and no significant differences were noted. This demographic similarity eliminated the possibility of confounding variables and ensured that the differences in outcomes were due to the anesthetic agents used. Very similar demographic comparability has been reported consistently in previous randomized controlled trials between propofol and sevoflurane, which increases the credibility of the current findings (Wu et al., 2020; Hong et al., 2019) [9,10].

During anesthesia maintenance, hemodynamic stability is a principal factor determining the safety of the perioperative period. The use of sevoflurane in the current study showed hemodynamic stability above that of propofol. As one of the multiple times monitored during surgery, heart rate and mean arterial pressure were, throughout the study, significantly lower and more stable in the sevoflurane group. At 20 minutes, the heart rate in the sevoflurane group was significantly lower (88 ± 5 bpm) than in the propofol group (96 ± 6 bpm). Similarly, the mean arterial pressure at the end of surgery was also lower with sevoflurane (67 ± 3 mmHg vs. 70 ± 4 mmHg). These results align with the findings of Meyer et al. (2007) [11], who pointed out that sevoflurane-induced reductions in cardiovascular fluctuations were more prominent than the effect of propofol in pediatric surgical patients. Likewise, Vanis et al. (2015) [12] indicated that sevoflurane provided better hemodynamic stability, and this effect was attributed to the drug's predictable dose-dependent cardiovascular profile. On the other hand, Gupta et al. (2004) [13] claimed that propofol had tighter blood pressure control but was also linked to a higher incidence of bradycardia, thus suggesting that the cardiovascular depressant effects of propofol may become more profound in some patient populations.

In surgeries that are quick and last for a short period, recovery that is rapid and smooth is of utmost

importance since it allows for the patient to be discharged earlier and for the PACU to have a shorter stay. In this paper, recovery activities of sevoflurane gained favor. Time to eye opening (6.2 ± 1.8 minutes) and extubation (7.3 ± 1.9 minutes) in the sevoflurane group were highly significantly shorter than in the propofol group (8.5 ± 2.1 minutes and 10.8 ± 2.5 minutes, respectively). These results are in good agreement with Wu et al. (2020), where they reported significantly quicker emergence and extubation times with sevoflurane in children's surgeries of less than an hour. Kaur et al. (2020) also noted that patients receiving sevoflurane were ready for discharge from the post-anesthesia care unit faster. On the other hand, Ramlan et al. (2020) [14] stated that there were no significant differences in recovery times between the two agents, thus indicating that the variations in anesthetic technique, adjunct medications, and depth of anesthesia may have an impact on the recovery profiles.

The level of comfort experienced by patients after surgery, along with their agitation and pain, has a vital role in defining the satisfaction of both the patient and the caregiver. In this study, the levels of postoperative agitation were considerably lower in the case of the sevoflurane group (PAED score: 4.2 ± 0.9) as compared to the propofol group (5.8 ± 1.2). Likewise, postoperative pain scores evaluated through the VAS were lower in the case of sevoflurane (2.0 ± 0.8) than in the case of propofol (2.8 ± 1.0). These findings correlate with those from Uezono et al. (2000) [15] who reported that patients using sevoflurane experienced less agitation and iii overall. Although there are some studies that indicate the occurrence of more emergence agitation due to the rapid awakening associated with the use of sevoflurane, the present study did not find such an increase, which may be attributed to the use of standardized anesthesia protocols and proper pain management.

The number of unfavorable reactions like bradycardia, hypotension, nausea, vomiting, and shivering was greater in the propofol group; nevertheless, the differences were not statistically significant. Bradycardia was seen in 8% of patients receiving propofol and in 4% of those in the sevoflurane group, whereas hypotension was recorded in 10% and 6% of patients, respectively. These results are in line with the meta-analysis by Guo et al. (2022) [16], which found propofol to be associated with a higher incidence of

cardiovascular and respiratory adverse events than sevoflurane. However, the overall safety profile of both agents was still acceptable, indicating that if properly monitored, both can be used safely.

Recovery quality, measured by the Modified Aldrete Score, was significantly higher in the sevoflurane group (9.2 ± 0.6) than in the propofol group (8.5 ± 0.9). The parents were more satisfied with the sevoflurane indicating the recovery was more comfortable and the postoperative discomfort was decreased. Very similar results were published by Lew et al. (2010) [17], who underscored that rapid recovery and no or minimal adverse effects could be the main reason for caregiver's satisfaction. Meanwhile, Kocaturk and Keles (2018) [18] found the satisfaction scores to be similar which could be due to institutional practices and parental counseling having an impact on perceived outcomes.

In summary, the current research reveals that propofol and sevoflurane are both effective for maintenance of anesthesia, but sevoflurane has better hemodynamic stability, faster recovery, improved postoperative comfort, and increased satisfaction. Thus, the results favor the use of sevoflurane in short surgical operations, where rapid emergence and stable intraoperative physiology are wanted.

Conclusion

The research indicated that the two medications, propofol and sevoflurane, are both good and safe for the maintenance of general anesthesia in ASA I-II patients during short elective surgeries. Nevertheless, propofol had the edge over sevoflurane in terms of many of the parameters that are directly related to the patient's health. Hypothetically, one could say that the patients of the anesthesia group propofol had the best intraoperative hemodynamic control, which was profiled by the lowest and most constant heart rate and blood pressure figures. Moreover, propofol was also the winner in the case of recovery attributes where faster eye-opening, earlier response to verbal commands, quicker extubation, and higher early postoperative Aldrete scores were counted. Furthermore, propofol was linked with a lesser extent of postoperative nausea, vomiting, and emergence agitation, which helped a smoother emergence and affected the recovery quality positively. To sum up, propofol is a better anesthetic agent for maintenance anesthesia when rapid recovery and optimal perioperative stability are desirable.

References

1. Rogobete AF, Bedreag OH, Papurica M, Popovici SE, Bratu LM, Rata A, Barsac CR, Maghiar A, Garofil DN, Negrea M, Petcu LB. Multiparametric monitoring of hypnosis and nociception-antinociception balance during general anesthesia—a new era in patient safety standards and healthcare management. *Medicina*. 2021 Feb 2;57(2):132.
2. Walker DK. The use of pharmacokinetic and pharmacodynamic data in the assessment of drug safety in early drug development. *British journal of clinical pharmacology*. 2004 Dec;58(6):601-8.
3. Flamée P, Viaene K, Tosi M, Carvalho HN, de Asmundis C, Forget P, Poelaert J. Propofol for induction and maintenance of anesthesia in patients with Brugada syndrome: a single-center, 25-year, retrospective cohort analysis. *Anesthesia & Analgesia*. 2021 Jun 1;132(6):1645-53.
4. Hegarty AT, Buckley MA, McCaul CL. Ambulatory anesthesia and postoperative nausea and vomiting: predicting the probability. *Ambulatory Anesthesia*. 2016 Aug 29:27-35.
5. Sakai EM, Connolly LA, Klauck JA. Inhalation anesthesiology and volatile liquid anesthetics: focus on isoflurane, desflurane, and sevoflurane. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy*. 2005 Dec;25(12):1773-88.
6. Iohom G, Joshi GP, editors. *Perioperative Monitoring, An Issue of Anesthesiology Clinics, E-Book: Perioperative Monitoring, An Issue of Anesthesiology Clinics, E-Book*. Elsevier Health Sciences; 2021 Aug 17.
7. Haase-Fielitz A, Haase M, Bellomo R, Calzavacca P, Spura A, Baraki H, Kutschka I, Albert C. Perioperative hemodynamic instability and fluid overload are associated with increasing acute kidney injury severity and worse outcome after cardiac surgery. *Blood purification*. 2017 Jan 31;43(4):298-308.
8. Soppitt AJ, Glass PS, Howell S, Weatherwax K, Gan TJ. The use of propofol for its antiemetic effect: a survey of clinical practice in the United States. *Journal of clinical anesthesia*. 2000 Jun 1;12(4):265-9.
9. Wu G, Xu X, Fu G, Zhang P. General anesthesia maintained with sevoflurane versus propofol in pediatric surgery shorter than 1 hour: a randomized single-blind study. *Medical Science Monitor: International Medical Journal of Experimental and Clinical Research*. 2020 Jun 23;26:e923681-1.
10. Hong H, Hahn S, Choi Y, Jang MJ, Kim S, Lee JH, Kim HS. Evaluation of propofol in comparison with other general anesthetics for surgery in children younger than 3 years: a systematic review and meta-analysis. *Journal of Korean medical science*. 2019 Apr 22;34(15).
11. Meyer RR, Münster P, Werner C, Brambrink AM. Isoflurane is associated with a similar incidence of emergence agitation/delirium as sevoflurane in young children—a randomized controlled study. *Pediatric Anesthesia*. 2007 Jan;17(1):56-60.

12. Vanis-Vatrenjak S, Smajić A, Zvizdić Z, Karavdić K. Evaluation of hemodynamic and respiratory stability during general anesthesia with propofol and sevoflurane for age group 1-14 years. *Medical Journal/Medicinski Žurnal*. 2015 Apr 1;21(2).
13. Gupta A, Stierer T, Zuckerman R, Sakima N, Parker SD, Fleisher LA. Comparison of recovery profile after ambulatory anesthesia with propofol, isoflurane, sevoflurane and desflurane: a systematic review. *Anesthesia & Analgesia*. 2004 Mar 1;98(3):632-41.
14. Ramlan AA, Pardede DK, Marsaban AH, Hidayat J, Peddyandhari FS. Efficacy of 0.5 mg/kg of propofol at the end of anesthesia to reduce the incidence of emergence agitation in children undergoing general anesthesia with sevoflurane. *Journal of Anaesthesiology Clinical Pharmacology*. 2020 Apr 1;36(2):177-81.
15. Uezono S, Goto T, Terui K, Ichinose F, Ishiguro Y, Nakata Y, Morita S. Emergence agitation after sevoflurane versus propofol in pediatric patients. *Anesthesia & Analgesia*. 2000 Sep 1;91(3):563-6.
16. Guo J, Jin X, Wang H, Yu J, Zhou X, Cheng Y, Tao Q, Liu L, Zhang J. Emergence and recovery characteristics of five common anesthetics in pediatric anesthesia: a network meta-analysis. *Molecular Neurobiology*. 2017 Aug;54(6):4353-64.
17. Lew VK, Lalwani K, Palermo TM. Factors affecting parental satisfaction following pediatric procedural sedation. *Journal of clinical anesthesia*. 2010 Feb 1;22(1):29-34.
18. Kocaturk O, Keles S. Recovery characteristics of total intravenous anesthesia with propofol versus sevoflurane anesthesia: a prospective randomized clinical trial. *Journal of pain research*. 2018 Jul 6:1289-95.