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ORIGINAL ARTICLE

Effects of Propofol Versus Sevoflurane on Recovery outcome for outpatient Surgery in Pediatrics

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ABSTRACT

Background: The most often used anesthetics for pediatric surgery are propofol and sevoflurane. These general anesthetics' main side effects are postoperative discomfort, nausea and vomiting, and agitation during the recovery room. The safety of sevoflurane and propofol in pediatric surgery has been compared in numerous clinical investigations, although the findings were unclear. So, this study aimed to compare effective outpatient surgery in pediatrics with reducing emergence agitation, delirium, and anesthesia complications by comparing effects Propofol or sevoflurane on recovery outcome for outpatient surgery in pediatrics. **Methods:** This Randomized, double-blind clinical study was conducted on 40 cases planned for outpatient surgery in pediatrics attended the anesthesia, intensive care, and pain management department in Zagazig University Hospitals throughout six months started from March 2023 to September 2023. All Cases were chosen from Zagazig University Hospitals' outpatient clinics who were willing to have an elective outpatient surgery. **Results**: There was significant shorter extubation time and discharge time in the Propofol group compared to Sevoflurane group. Otherwise there were no significant differences between groups regards other parameters. There was significantly lower heart rate in the Propofol group from basal reading until 45 minute of operation time compared to Sevoflurane group. **Conclusions**: When compared to sevoflurane anesthesia, children who underwent propofol anesthesia had lower chances of emerging anxiety, postoperative nausea and vomiting, and postoperative discomfort. In comparison to sevoflurane-based anesthetic, the propofol regimen provided a more relaxing recovery and reduced postoperative respiratory problems in infants undergoing outpatient surgery.

Keywords: Propofol, Sevoflurane, Recovery, Emergence Agitation.

INTRODUCTION

The prevalence of ambulatory surgery has steadily increased because of ongoing improvements in anesthesia techniques, such as regional anesthesia, and the accessibility of short-acting anesthetics with reduced side effects. More appropriate ambulatory discharge criteria and minimally invasive surgical techniques have also contributed to this rise **[1].**

Children are often healthy and free of serious comorbidities, hence ambulatory anesthesia, also known as outpatient anesthesia, is highly preferred in this population **[2]**. The benefits of outpatient procedures include faster recovery time for patients following surgery, improved patient and parent comfort, lower risk of nosocomial infections, and lower costs for both the hospital and the patient **[3].**

The two anesthetics most frequently used in pediatric surgery are propofol and sevoflurane. In spite of the common use of anesthesia, 26% of pediatric patients still experience emergence agitation (EA), 25% still experience postoperative nausea and vomiting (PONV), 24% still experience postoperative pain (POP), and some still experience short-term memory impairment **[4].**

An intravenous sedative/hypnotic drug called propofol (2,6-diisopropylphenol) is frequently used for procedure sedation (such as endoscopy) as well as the induction and maintenance of general anesthesia. Propofol has a quick onset, quick wear off, and minimal accumulation with continued use **[5].** For total intravenous anesthesia (TIVA) in children, propofol is frequently utilized. When used as the only anesthetic in TIVA, propofol is extremely ineffective at keeping the patient immobile. Adjuncts like remifentanil, ketamine and dexmedetomidine can be used to significantly improve surgical conditions and hemodynamic response to surgical stimulus **[6].**

One of the most used inhalational anesthetics for general anesthesia is sevoflurane. Sevoflurane is a non-irritating volatile anesthetic that can be inhaled to induce anesthesia, and it has the advantages of maintaining spontaneous breathing and improving cardiovascular stability **[7].**

The study aimed at achievement of the more effective outpatient surgery in pediatrics with reducing emergence agitation, delirium, and anesthesia complications by comparing effects Propofol or sevoflurane on recovery outcome for outpatient surgery in pediatrics.

METHODS

This Randomized, double-blind clinical study was conducted on 40 cases planned for outpatient surgery in pediatrics attended the anesthesia, intensive care, and pain management department in Zagazig University Hospitals throughout six months started from March 2023 to September 2023.

Inclusion criteria: Parents or 1st degree relatives' acceptance, ASA physical status I–II, Body mass index (BMI) is neither more the value in 85th percentile (i.e. non obese) or below the value in 5th percentile (underweight) of the children with the same age and gender, children aged from 3- 12 years, both sexes (males & females), children undergoing elective outpatient surgery under general anesthesia and duration of operation from 30 min to 60 min.

Exclusion criteria: Children with known history of allergy to the study drugs. Children with developmental, psychological, neurological, respiratory, cardiovascular, renal, or hepatic disorders. Abnormal lipid or carbohydrate metabolism. Children with difficult airway or recent upper respiratory tract infection.

All participants were randomly allocated to two intervention groups using computer-generated randomization table: **Propofol group (**Group P**) (n=20)** and Sevoflurane group (Group S) (n=20)

All patients were subjected to the following:

A history was taken, including information of any chronic illness, drug sensitivity, prior surgical operations, and anesthetic issues. Physical examination included vital signs, cardiac and chest condition. Before the scheduled procedure, all patients were advised to fast six hours for solid food, and two hours for clear liquids. The following laboratory investigations were performed: (Complete blood picture and coagulation profile). Informed written consent was taken from parents or 1st degree relative. After oral endotracheal intubation, anesthesia was maintained according to selected group:

Propofol group (Group P): Propofol (15 mg/kg/h for 15 min, 13 mg/kg/h from 15 to 30 min, and 11 mg/kg/h from 30 to 60 min) was administered manually to maintain anesthesia.

Sevoflurane group (Group S): Anesthesia was maintained by inhalational sevoflurane 1.5-4% until the end of surgery.

All patients were receiving synchronized intermittent mechanical ventilation (SIMV) (6–8 ml/kg), to achieve an end-tidal carbon dioxide (ETCO2) level of 32–35 mmHg with maximum allowed airway pressure of 20 cm water. All patients were receiving the appropriate volume of warm intravenous lactated Ringer's solution based on their body weight to replenish the fluid deficit and to maintain fluid balance using 4-2-1 formula.

All patients were monitored using standard American Society of Anesthesiology (ASA) monitors every 2,5,10 minutes then every 15 minutes throughout the operation, which include pulse oximetry, noninvasive blood pressure, electrocardiogram (ECG), capnography, and tympanic membrane thermometer. Atropine 0.02 mg/kg intravenous was used to treat bradycardia if the pulse rate was 20% or less below the preoperative value and the mean arterial pressure (MAP) was 20% or less below the preoperative value. After the procedure, both types of anesthesia were turned off, and the neuromuscular blockade was gently removed by slowly injecting neostigmine (0.05 mg/kg) and atropine (0.02 mg/kg). All patients received a 15 mg/kg paracetamol infusion. When the kids' extubation requirements were met (return of the gag reflex, a grimace on their face, and purposeful motor movements), they were taken to the post-anesthesia care unit (PACU) and extubated. At 5-minute intervals, each patient was given an evaluation using the modified Aldrete score, which has a maximum score of 10.

Administrative design

Approval was obtained from the scientific committee of anesthesia, ICU, and pain management department. Approval was obtained from Institutional Review Board (IRB#10373-24-1-2023) at Zagazig University Hospitals. All parents signed written informed consent forms after hearing about the study's design, including its procedures, medications, and potential side effects. The World Medical Association's Code of Ethics and the Declaration of Helsinki were both followed during the study's execution.

Statistical Analysis

Using (IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.2015), all data were gathered, tabulated, and statistically evaluated. The mean and standard deviation were used to communicate quantitative data, whereas numbers and percentages were used to represent qualitative data. Two groups' normally distributed variables were compared using the t test. Chi-square test or fisher exact test were used to compare percentages of category variables. Every test had two sides. P-values below 0.05 were regarded as statistically non-significant, while those over 0.05 as statistically significant.

RESULT

Table 1; demonstrated that there was no statistically significant difference in body mass index, sex, or age between the tested groups. There was a matching between groups in ASA classification.

Table 2; demonstrated that the Propofol group had significantly shorter extubation and discharge times than the Sevoflurane group. Other than that, there were no notable variations between the groups in terms of other factors.

Table 3; showed that there was significantly lower heart rate in the Propofol group from basal reading until 45 minute of operation time compared to Sevoflurane group.

Table 4; showed that there were significantly lower systolic blood pressure values at 2minute in propofol group and 5 minutes in sevoflurane group. Otherwise, there were no difference in both groups in blood pressure values during operation time.

Table 5; showed that there were no significant differences in diastolic blood pressure values in both groups during operation duration.

Table 6; showed that there were no significant differences between groups as regard to mean arterial pressure values during operation duration time .

Wong - backer faces pain rating scale was significantly lower at 15 min, 30min post operatively in the propofol group compared to Sevoflurane group. Then Wong - backer faces pain rating scale decreased in both groups without significant differences till 2 hours as shown as table 7.

Table 8; found that there were no statistically significant differences in the occurrence of complications following surgery between the two groups.

Table 9; demonstrated that until 30 minutes after surgery, the Post surgical PAED score in the propofol group was statistically significantly lower than in the Sevoflurane group.

Family showed that the propofol group experienced significantly higher levels of

satisfaction than the sevoflurane group Table 10.

Table (1): Patient characteristics of the studied groups

Variables	*Propofol Group n.20*	*Sevoflurane Group n.20*	*P-value*
	No.(%)	**No.(%)**	
Age per years Mean ±SD	7.58±3.54	5.86±3.02	0.11
Sex Female Male	6(30.0%) 14 (70.%)	5(25.0%) 15(75.0%)	0.72
Body mass index Mean ±SD	16.61±1.97	15.57±1.51	0.07
ASA1	20(100.0%)	20(100.0%)	1.0

χ^2 Chisquare test, t: student t test

Table (2): The duration of procedure and analgesic requirements for comparison between the two studied groups.

Duration of procedure	***Propofol group n.20***	***Sevoflurane group n.20***	***P***
Anesthesia time (min) Mean ±SD	46.5±9.8	41.7±7.7	0.07
Surgery time (min) Mean ±SD	40.9±8.1	37.3±6.5	0.13
Recovery Time (min) Mean ±SD	31.1±3.9	24.7±6.5	0.72
Extubation time (min) Mean ±SD	4.0±2.0	04.9±1.4	0.05*
Time to first dose of analgesia (min) Mean ±SD	30.00±0	29.0±3.08	0.15
Patients received rescue analgesia n(%)	1(5)	3(15)	0.61
Discharge time (min) Mean ±SD	39.9±7.02	96.3 ±26.3	0.0001*

t: T-student test, u:Mann whitnney u test
*Significant

Table (3): Comparison of Patient's heart rate over time among the two studied groups.

Heart rate (HR)beat/min	***Propofol Group n.20***	***Sevoflurane Group n.20***	***P***
Basal HR	104.0±7.2	110.9±9.7	0.02*
Induction HR	101.9±8.3	109.0±7.9	0.01*
HR 2min	102.5±9.5	111.9±9.9	0.004*
HR 5 min	102.2±8.9	112.1±8.7	0.02*
HR 10 min	102.9±10.8	112.0 ± 8.2	0.002*
HR 15 min	103.1±10.5	113.4±9.0	0.001*
HR 30 min	104.0±10.3	115.1±8.1	0.02*
HR 45min	102.2±11.0	115 ±7.9	0.004*
HR 1hour	103.8±7.5	110 .0±6.9	0.73

*Significant

Table (4): Comparison of patient's systolic blood pressure over time among the studied two groups.

Systolic blood pressure SBP mmHg	*Propofol Group n.20*	*Sevoflurane group n.20*	*P*
Basal SBP	107.0±5.2	104.2±3.4	0.05
Induction SBP	103.1±3.6	103.6±3.9	0.67
SBP at 2 min	101.7±3.7	104.6±4.4	0.03*
SBP at 5 min	104.3±4.9	98.6±2.7	0.001*
SBP at 10 min	105.0±5.6	107.6±5.1	0.14
SBP at 15 min	104.4±6.0	107.7±6.4	0.10
SBP at 30 min	107.7±7.1	106.8±6.8	0.71
SBP at 45 min	106.3±6.6	105.3±2.8	0.63
SBP at 1 hour	110.2±5.4	105.0±4.1	0.20

Table (5): Comparison of patient's diastolic blood pressure over time among the studied two groups.

Diastolic blood pressure DBP mmHg	*Propofol Group n.20*	*Sevoflurane Group n.20*	*P*
Basal DBP	64.2±8.1	60.0±5.5	0.06
Induction DBP	59.4±7.7	56.8±6.1	0.25
DBP at 2 min	58.4±8.1	57.0±6.5	0.56
DBP at 5 min	60.4±7.4	62.1±5.5	0.40
DBP at10 min	59.8±6.7	59.7±5.0	0.96
DBP at 15 min	60.2±7.7	59.9±5.7	0.89
DBP at 30 min	61.7±7.5	59.7±7.4	0.40
DBP at 45 min	60.7±8.8	57.9±4.7	0.36
DBP at 1 hour	65.0 ±8.3	59 .0 ±6.7	0.33

Diastole: Diastolic blood pressure, min:minute

Table (6) : Comparison of mean arterial pressure over time among the two studied groups.

Mean arterial pressure MAP mmHg	*Propofol Group n.20*	*Sevoflurane group n.20*	*P*
Basal MAP	75.6±6.6	73.3±4.6	0.10
Induction MAP	74.1±6.7	73.15±4.8	0.63
MAP 2 min	72.8±6.5	72.9±5.7	0.96
MAP 5 min	75.1±6.2	74.37±5.4	0.72
MAP10 min	74.9±5.7	75.94±4.9	0.54
MAP 15 min	74.4±6.1	75.57±5.7	0.54
MAP 30 min	77.1±6.4	75.16±7.0	0.37
MAP 45 min	75.8±7.4	74.2±3.5	0.53
MAP 1 hour	80.2±6.1	76.0±5.9	0.37

mean arterial pressure :MAP

Table (7): Comparison of Wong - backer faces pain rating scale over time among the two studied groups.

pain rating scale	*Propofol Group n.20*	*Sevoflurane Group n.20*	*P*
Pain rating scale 15 min	3.4±0.9	4.3±0.7	0.02*
Pain rating scale 30 min	2.9±1.0	3.6±0.8	0.02*
Pain rating scale 45 min	2.5±1.1	3.±1.0	0.15
Pain rating scale 1h	2.0±0.0	2.3±0.7	0.08
Pain rating scale 1.15h	1.8±0.6	1.9±0.8	0.66
Pain rating scale 1.30h	1.1±1.0	1.7±1.0	0.07
Pain rating scale 1.45h	0.6±0.9	1.2±1.1	0.06
Pain rating scale 2h	0.4±0.8	0.7±1.0	0.30

Pain rating scale: wong - backer faces pain rating scale

Table (8): Comparison between two groups as regard of post operative complications.

Complication	*Propofol Group n.20*		*Sevoflurane Group n.20*		*P*
	n.	**%**	**n.**	**%**	
Salivation	4	20.0	6	30.0	0.5
Agitation	1	5.0	1	5.0	1.0
Vomiting	9	45.0	4	20.0	0.1
Bradycardia	0	0	0	0	1.0
Hypotension	0	0	0	0	1.0
Hypoventilation	0	0	0	0	1.0
Nausea	0	0	0	0	1.0

Table (9): Comparison of Pediatric Anesthesia Emergence Delirium (PAED) score over time among the two studied groups

Pediatric Anesthesia Emergence Delirium, PAED	*Propofol Group n.20*	*Sevoflurane Group n.20*	*P*
PAED at 1 min	9.9±0.7	11.0±0.6	0.0001*
PAED at 5 min	8.6±0.6	10.0±1.1	0.0001*
PAED at 10 min	7.4±1.5	9.0±1.1	0.0001*
PAED at 15 min	5.4±1.5	7.9±1.5	0.0001*
PAED at 20 min	3.7±1.03	6.8±1.8	0.0001*
PAED at 25 min	2.4±1.0	4.4±1.6	0.0001*
PAED at 30 min	1.4±0.5	2.9±1.2	0.0001*

Table (10): Comparison of Family's satisfaction between the two studied groups.

Family 'satisfaction	*Propofol group n.20*	*Sevoflurane group n.20*	*P*
Family 'satisfaction Mean ±SD	8.7±0.7	7.7±0.7	0.0001*

DISCUSSION

Children and infants are ideal candidates for outpatient (ambulatory) surgery due to their generally good health, quick recovery, and little difficulties during the procedure. Additionally, the ambulatory setting decreases the children's time away from their parents and provides care at a lower cost. Recently, the number of pediatric ambulatory procedures has increased, with 80–90% of pediatric surgeries currently being carried out in this manner **[8].**

The two anesthetics most frequently used in pediatric surgery are propofol and sevoflurane **[9].** The results of numerous clinical investigations comparing the risks of serious problems in children under anesthesia with sevoflurane and propofol were unclear, and there had been relatively few meta-analyses on this subject to far **[10].**

To compare the impact of propofol versus sevoflurane on the recovery outcome for pediatric outpatient surgery, this randomized, double-blind clinical study was carried out on 40 cases scheduled for outpatient surgery who attended the anesthesia, intensive care, and pain management department in Zagazig University Hospitals over the course of six months beginning in February 2023 and ending in August 2023.

Our findings in this study demonstrated that there were no significant variations between the two study groups' basic characteristics and clinical data, including age, sex, BMI, ASA, and kind of procedures.

The study's findings revealed no significant differences between groups in terms of anesthesia time, surgery time, recovery time, or the time needed to request analgesia. On the other hand, they revealed that the Propofol group's extubation and discharge times were significantly shorter than those of the Sevoflurane group. Which in agreement with the study carried out by **Picard et al [11],** when they investigated the Quality of recovery in children: sevoflurane versus propofol. They discovered that there were no statistically significant differences between the sevoflurane and propofol groups in the time to extubation, time to respond to straightforward vocal commands, and time to discharge.

Regarding hemodynamic parameters, the results of present study showed a significantly lower heart rate in the Propofol group from basal reading until 45 minutes intraoperatively compared to the Sevoflurane group. Also, there was a significant lower systolic blood pressure value at 2minutes in Propofol group compared to Sevoflurane group and a significant lower systolic pressure in sevoflurane at 5 minutes might be because of deep sevoflurane at that time. On the other hand, there were no differences in both groups regarding systolic blood pressure values, diastolic blood pressure and mean arterial pressure values between groups during operation time.

In agreement with this study, a study by **Wu et al [12],** discovered that there were no obvious differences in the hemodynamic parameters between patients who underwent sevoflurane and propofol anesthesia.

In the study by **Atef et al [13],** when they compared between sevoflurane versus propofol in pediatric surgery they found the results regards statistically significant increase in heart rate in sevoflurane group more than propofol group during all times of the measurements from the baseline and every 10 min up to 4 hours postoperatively.

In the study by **Hasani et al [14],** conducted on children aged 3–6 years who **received** either propofol or sevoflurane anesthesia for inguinal hernia repair. They found decrease in the heart rate during the first 2 h in the propofol group postoperatively and this might be due to potential analgesic effect of propofol.

In this study, the Wong-baker faces pain rating score was significantly lower at 15 min and 30 min post operatively in the propofol group compared to the Sevoflurane group. No significant differences were noted in the remaining follow-up times.

In agreement with this study, **Abdeldayem et al [15],** in a study comparing the effects of sevoflurane and propofol in pediatric surgery, studies discovered that in the first four hours following surgery, the FLACC score was much lower in the

propofol group. This finding may be related to the analgesic properties of propofol.

Also, in a study by **Choi et al [16],** in the first two hours following surgery, propofol group postoperative facial pain scores on swallowing were considerably lower than sevoflurane group scores, and no significant difference was seen in the third and fourth hours.

In the study carried out by **Kocaturk and Keles [17],** When they compared the recovery characteristics of total intravenous anesthesia with propofol (TIVA-p) and sevoflurane anesthesia, they discovered that the type of anesthetic had an impact on postoperative pain as measured by the FLACC score and that the SEVO group had higher FLACC scores than the TIVA-p group did.

Also, in agreement with this study, **Atef et al [13],** when they contrasted postoperative analgesia in kids having adenotonsillectomy under sevoflurane versus propofol anesthesia. They discovered that during the first two hours following surgery, the postoperative rating facial pain score was considerably lower in the propofol group than in the sevoflurane group. In contrast, there was no discernible difference between the third and fourth hours.

In accordance with the **Reduque and Verghese [18],** study**,** according to numerous studies, the use of propofol anesthesia during various surgical procedures reduced postoperative discomfort and the requirement for get analgesia. Its use has reduced postoperative pain in children between the ages of 2 and 6 who underwent strabismus surgery, as determined by FLACC scales. In contrast, the sevoflurane group consumed more analgesics in the PACU. Additionally, they found a significant beneficial correlation between FLACC and EA ratings, with the propofol group showing a lower incidence of EA and postoperative pain.

In the present study, propofol group was found to have significantly reduced post-operative delirium compared to sevoflurane group up to 30 minutes after surgery.

The study by **Atef et al (13)** which compared sevoflurane-based anesthesia with propofol-based anesthesia in children having adenotonsillectomy is in line with the findings of our investigation. They found that the sevoflurane group had a higher rate of delirium.

Additionally, in accordance with this study, a study conducted by **Kocaturk and Keles [17],** They contrasted sevoflurane anesthesia's recovery properties with those of complete intravenous anesthesia using propofol. They discovered that the pediatric anesthesia emergence delirium scale was significantly higher in the sevoflurane group compared to the propofol group.

In contrast to the present study, **Picard et al [11],** when sevoflurane and propofol were compared for the effectiveness of recovery in youngsters. They found that there were no significant differences between sevoflurane and propofol regarding the incidence of delirium**.**

The results of the current investigation indicated that there were no statistically significant variations in the likelihood of problems between the groups.

In agreement with this study, **Picard et al [11],** there were no changes in postoperative nausea or vomiting between the sevoflurane and propofol groups when they compared the effectiveness of recovery in pediatric patients.

Regarding Parents' satisfaction, the present study showed a significantly higher Parents' satisfaction in propofol group compared to Sevoflurane group.

According to this investigation, it was carried out by **Uezono et al [19],** They discovered that the TIVA-p group had higher parental satisfaction scores than the SEVO group.

Also, in agreement with present study, **Kocaturk & Keles [17],** when researchers compared the recovery properties of sevoflurane with complete intravenous propofol anesthesia in young patients. They discovered that the propofol group showed greater parental satisfaction than the sevoflurane group.

CONCLUSION

When compared to sevoflurane anesthesia, children who underwent propofol anesthesia had lower chances of emerging anxiety, postoperative nausea and vomiting, and postoperative discomfort. In infants receiving

outpatient surgery, propofol-based anesthesia provided a more peaceful recovery with fewer perioperative respiratory problems than sevoflurane-based anesthesia.

Recommendation: To confirm our findings, larger-scale comparative investigations with a high number of patients and a lengthy duration of follow-up in multi-center studies are recommended.

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