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Original Research Article

HEMODYNAMIC STABILITY AND EMERGENCE CHARACTERISTICS OF PROPOFOL VERSUS SEVOFLURANE ANESTHESIA IN DAY-CARE SURGERIES: A PROSPECTIVE COMPARATIVE STUDY

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ABSTRACT

Background: Day-care surgeries require anesthetic techniques that ensure stable intraoperative hemodynamics and rapid, smooth recovery. Propofol and sevoflurane are commonly used anesthetic agents for ambulatory procedures, yet their comparative effects on hemodynamic stability and emergence characteristics remain clinically relevant. The objective is to compare hemodynamic stability and emergence characteristics of propofol-based anesthesia versus sevoflurane-based anesthesia in patients undergoing day-care surgeries. **Materials and Methods:** This prospective comparative study included 50 patients scheduled for elective day-care surgeries, who were randomly allocated into two groups: Group S (sevoflurane, n=25) and Group P (propofol, n=25). Intraoperative hemodynamic parameters including heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure were recorded at predefined time intervals. Emergence characteristics such as time to eye opening, response to verbal commands, removal of laryngeal mask airway, and time to full orientation were assessed. Statistical analysis was performed using appropriate parametric and non-parametric tests, with a p-value <0.05 considered statistically significant. **Result:** Baseline demographic and clinical characteristics were comparable between the two groups. Sevoflurane anesthesia was associated with significantly faster eye opening (5.76 ± 0.88 min vs. 6.28 ± 0.46 min; p = 0.0118) and earlier attainment of full orientation (p < 0.001). Propofol anesthesia demonstrated significantly faster response to verbal commands (7.04 ± 0.79 min vs. 8.36 ± 0.81 min; p < 0.001) and earlier laryngeal mask airway removal (p < 0.001). Intraoperatively, sevoflurane maintained relatively higher systolic blood pressure and mean arterial pressure at multiple time points compared to propofol (p < 0.001). Oxygen saturation remained comparable between the groups throughout the study period. **Conclusion:** Both propofol and sevoflurane provide effective and safe anesthesia for day-care surgeries. Sevoflurane offers faster initial awakening and orientation, whereas propofol facilitates quicker response to commands and earlier airway device removal. Individualized anesthetic selection based on patient and procedural factors may optimize perioperative outcomes in ambulatory surgical practice.

INTRODUCTION

Day-care or ambulatory surgeries have increased substantially over the past two decades due to advances in minimally invasive surgical techniques, improved perioperative care, and enhanced recovery protocols. In this setting, the choice of anesthetic agent plays a crucial role in ensuring rapid induction, stable intraoperative hemodynamics, smooth emergence, early ambulation, and timely discharge.

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An ideal anesthetic technique for day-care surgery should provide adequate depth of anesthesia, maintain cardiovascular stability, allow rapid recovery of consciousness and protective airway reflexes, and be associated with minimal postoperative side effects such as nausea, vomiting, and agitation.

Propofol and sevoflurane are two widely used anesthetic agents for maintenance of general anesthesia in short surgical procedures. Propofol, a short-acting intravenous hypnotic agent, is commonly used in total intravenous anesthesia (TIVA) because of its rapid onset, short context-sensitive half-life, and favorable recovery profile. It produces dose-dependent hypnosis and sedation by enhancing gamma-aminobutyric acid (GABA) mediated inhibitory neurotransmission in the central nervous system. Propofol is also associated with reduced postoperative nausea and vomiting, smooth emergence, and decreased airway reactivity, making it particularly suitable for ambulatory anesthesia.[1,2] However, its use may be associated with hypotension and bradycardia due to systemic vasodilation and myocardial depression, which can affect hemodynamic stability in susceptible patients.

Sevoflurane, a volatile inhalational anesthetic agent with low blood-gas solubility, is characterized by rapid induction and emergence. Its pleasant odor and minimal airway irritation make it suitable for mask induction and maintenance in short-duration procedures. Sevoflurane provides easy titratability, stable depth of anesthesia, and rapid washout, contributing to faster recovery times.[3] Nevertheless, inhalational agents may be associated with emergence agitation and a higher incidence of postoperative nausea and vomiting when compared with propofol-based techniques.

Hemodynamic stability during anesthesia is a critical determinant of perioperative safety, particularly in day-care surgeries where rapid turnover and early discharge are expected. Fluctuations in heart rate and blood pressure during induction, maintenance, and emergence can increase perioperative morbidity, prolong recovery, and delay discharge readiness. Therefore, evaluating the cardiovascular effects of commonly used anesthetic agents remains an important area of clinical research.[4]

Emergence characteristics, including time to eye opening, response to verbal commands, orientation, and readiness for discharge from the post-anesthesia care unit (PACU), are equally important outcome measures in ambulatory anesthesia. Faster and smoother emergence is associated with improved patient satisfaction, reduced PACU stay, and optimized utilization of healthcare resources. Previous studies have reported variable results regarding recovery profiles and hemodynamic effects of propofol and sevoflurane, highlighting the need for further comparative evaluation in different clinical settings.[5]

Aim: To compare hemodynamic stability and emergence characteristics of propofol versus sevoflurane anesthesia in patients undergoing day-care surgeries.

Objectives

1. To compare intraoperative hemodynamic parameters between propofol-based and sevoflurane-based anesthesia.
2. To assess and compare emergence characteristics including recovery time and discharge readiness between the two anesthetic techniques.
3. To evaluate the incidence of perioperative and early postoperative adverse events in both study groups.

MATERIALS AND METHODS

Source of Data: Data were collected from patients undergoing elective day-care surgical procedures in the operation theatres and post-anesthesia care unit of the study institution after obtaining institutional ethical committee approval and written informed consent from participants.

Study Design: This study was conducted as a prospective, comparative, interventional study.

Study Location: The study was carried out in the Department of Anesthesiology at a tertiary care teaching hospital.

Study Duration: The study was conducted over a period of six months.

Sample Size

A total of 50 patients were included in the study and divided into two equal groups:

- Group S (Sevoflurane group): 25 patients
- Group P (Propofol group): 25 patients

Inclusion Criteria

- Patients aged 18–60 years
- ASA physical status I and II
- Patients scheduled for elective day-care surgical procedures under general anesthesia
- Procedures with expected duration less than 60 minutes
- Patients who provided informed written consent

Exclusion Criteria

- ASA physical status III and above
- Known allergy to propofol, sevoflurane, or study drugs
- History of cardiovascular, respiratory, hepatic, or renal disease
- Pregnant or lactating women
- Patients with anticipated difficult airway
- Emergency surgeries

Procedure and Methodology: After pre-anesthetic evaluation, eligible patients were randomly allocated into two groups. Standard fasting guidelines were followed. On arrival in the operating room, baseline vital parameters including heart rate, blood pressure, oxygen saturation, and electrocardiogram were recorded. Intravenous access was secured, and standard monitoring was instituted.

Patients in Group P received induction and maintenance of anesthesia using propofol infusion as per standardized protocol. Patients in Group S

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received induction and maintenance with sevoflurane using inhalational technique. All patients received standardized premedication and analgesia. Airway management was performed using an appropriate airway device based on institutional protocol.

Hemodynamic parameters were recorded at predefined time intervals: baseline, after induction, intraoperatively at regular intervals, and during emergence. At the end of surgery, anesthetic agents were discontinued, and emergence parameters such as time to eye opening, response to verbal commands, and orientation were recorded. Recovery was assessed using a standardized recovery scoring system.

Sample Processing: All collected data were entered into a pre-designed case record form. Data were cross-checked for completeness and accuracy before statistical analysis.

Statistical Methods: Data were analyzed using statistical software. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages. Independent t-test was used for comparison of continuous variables between groups, and Chi-square test was used for categorical variables. A p-value <0.05 was considered statistically significant.

Data Collection: Data were collected prospectively by the investigator using standardized data collection sheets, including demographic details, intraoperative hemodynamic parameters, emergence characteristics, and postoperative recovery outcomes.

RESULTS

Table 1: Overall comparison of hemodynamic stability & emergence characteristics (N=50)

Parameter	Group S (n=25) Mean±SD / n(%)	Group P (n=25) Mean±SD / n(%)	Test of significance	Mean difference (95% CI)	p-value
Age (years)	34.24±5.52	33.28±4.54	Independent t-test	0.96 (-1.89 to 3.81)	0.498
Female sex	16 (64.0)	17 (68.0)	Chi-square	Risk diff -0.04 (-0.30 to 0.22)	0.765
Any comorbidity present	7 (28.0)	5 (20.0)	Chi-square	Risk diff 0.08 (-0.16 to 0.32)	0.508
Duration of procedure (min)	34.52±8.78	37.06±10.60	Independent t-test	-2.54 (-8.04 to 2.96)	0.356
Baseline HR (beats/min)	77.12±12.46	76.48±9.18	Independent t-test	0.64 (-5.58 to 6.86)	0.838
Baseline SBP (mmHg)	125.40±7.05	129.96±8.79	Independent t-test	-4.56 (-9.11 to -0.01)	0.060
Baseline DBP (mmHg)	77.16±5.71	78.40±7.28	Independent t-test	-1.24 (-4.91 to 2.43)	0.502
Baseline MAP (mmHg)	93.16±4.79	95.52±6.13	Independent t-test	-2.36 (-5.51 to 0.79)	0.138
Eye opening (min)	5.76±0.88	6.28±0.46	Independent t-test	-0.52 (-0.92 to -0.12)	0.0118
Following verbal command (min)	8.36±0.81	7.04±0.79	Independent t-test	1.32 (0.86 to 1.78)	0.0001
Removal of LMA (min)	8.20±0.71	7.24±0.66	Independent t-test	0.96 (0.57 to 1.35)	0.0001
Full orientation (min)	8.52±0.51	9.24±0.52	Independent t-test	-0.72 (-1.01 to -0.43)	0.0001
Aldrete score	9 (0)	9 (0)			

[Table 1] shows that the baseline demographic and clinical characteristics were comparable between the two groups, ensuring valid intergroup comparison. The mean age of patients in Group S was 34.24 ± 5.52 years and in Group P was 33.28 ± 4.54 years, with no statistically significant difference (p = 0.498). Female participants constituted 64.0% in Group S and 68.0% in Group P, and the distribution of gender was comparable (p = 0.765). Similarly, the presence of comorbidities did not differ significantly between Group S (28.0%) and Group P (20.0%) (p = 0.508). The mean duration of surgical procedures was also comparable between the groups (34.52 ± 8.78 minutes in Group S vs. 37.06 ± 10.60 minutes in Group P; p = 0.356). Baseline hemodynamic parameters including heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure showed no statistically significant differences between the two groups (p > 0.05), indicating similar preoperative cardiovascular status. Regarding emergence characteristics, statistically significant differences were observed between the two anesthetic techniques. The time to eye opening was significantly shorter in Group S (5.76 ± 0.88 minutes) compared to Group P (6.28 ± 0.46 minutes) (p = 0.0118). However, patients in Group P responded faster to verbal commands (7.04 ± 0.79 minutes) compared to Group S (8.36 ± 0.81 minutes), and this difference was highly significant (p = 0.0001). Similarly, removal of the laryngeal mask airway was achieved earlier in Group P (7.24 ± 0.66 minutes) compared to Group S (8.20 ± 0.71 minutes) (p = 0.0001). Full orientation was attained significantly earlier in Group S (8.52 ± 0.51 minutes) compared to Group P (9.24 ± 0.52 minutes) (p = 0.0001).

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Table 2: Comparing mean Lymphocyte (1000/cumm) with HP report

A) Heart rate (beats/min)					
Time point	**Group S Mean±SD**	**Group P Mean±SD**	**Test**	**Mean difference (95% CI)**	**p-value**
1 min	75.60±8.09	79.36±9.88	Independent t-test	-3.76 (-8.85 to 1.33)	0.154
5 min	75.60±7.87	78.40±7.08	Independent t-test	-2.80 (-7.09 to 1.49)	0.195
15 min	94.92±7.33	86.08±2.69	Independent t-test	8.84 (5.91 to 11.77)	0.0001
30 min	74.32±5.63	71.08±6.32	Independent t-test	3.24 (-0.13 to 6.61)	0.063
45 min	81.33±6.25	85.50±9.19	Independent t-test	-4.17 (-8.91 to 0.57)	0.163
B) SBP (mmHg)					
Time point	**Group S Mean±SD**	**Group P Mean±SD**	**Test**	**Mean difference (95% CI)**	**p-value**
1 min	126.60±7.98	105.36±8.14	Independent t-test	21.24 (16.69 to 25.79)	0.0001
5 min	112.00±9.66	92.68±4.29	Independent t-test	19.32 (15.04 to 23.60)	0.0001
15 min	130.12±8.73	89.40±1.50	Independent t-test	40.72 (37.11 to 44.33)	0.0001
30 min	127.40±7.10	117.60±6.15	Independent t-test	9.80 (6.05 to 13.55)	0.0001
45 min	121.67±7.12	130.00±5.66	Independent t-test	-8.33 (-11.90 to -4.76)	0.0001
C) DBP (mmHg)					
Time point	**Group S Mean±SD**	**Group P Mean±SD**	**Test**	**Mean difference (95% CI)**	**p-value**
1 min	76.36±4.67	75.24±4.48	Independent t-test	1.12 (-1.48 to 3.72)	0.387
5 min	68.84±3.30	70.96±4.14	Independent t-test	-2.12 (-4.22 to -0.02)	0.048
15 min	78.20±3.25	66.44±4.29	Independent t-test	11.76 (9.58 to 13.94)	0.0001
30 min	80.84±5.21	80.84±2.49	Independent t-test	0.00 (-2.30 to 2.30)	1.000
45 min	81.67±4.32	88.00±2.83	Independent t-test	-6.33 (-8.42 to -4.24)	0.0001
D) MAP (mmHg)					
Time point	**Group S Mean±SD**	**Group P Mean±SD**	**Test**	**Mean difference (95% CI)**	**p-value**
1 min	93.12±3.65	85.24±3.78	Independent t-test	7.88 (5.78 to 9.98)	0.0001
5 min	83.28±3.86	78.28±3.29	Independent t-test	5.00 (2.99 to 7.01)	0.0001
15 min	95.52±3.84	74.04±2.92	Independent t-test	21.48 (19.58 to 23.38)	0.0001
30 min	96.48±4.38	93.12±2.62	Independent t-test	3.36 (1.32 to 5.40)	0.0001
45 min	95.17±3.97	102.00±0.00	Independent t-test	-6.83 (-8.43 to -5.23)	0.0001
E) SpO_2 (%)					
Time point	**Group S Mean±SD**	**Group P Mean±SD**	**Test**	**Mean difference (95% CI)**	**p-value**
1, 5, 15, 30 min	99 (0)	99 (0)			
45 min	98.17±0.98	98.50±0.71	Independent t-test	-0.33 (-0.82 to 0.16)	0.179
60 min	99 (0)				

[Table 2] presents the comparison of intraoperative hemodynamic parameters between Group S and Group P. With respect to heart rate, no significant difference was observed at 1 minute and 5 minutes following induction ($p = 0.154$ and $p = 0.195$, respectively). However, at 15 minutes, Group S demonstrated a significantly higher heart rate (94.92 ± 7.33 beats/min) compared to Group P (86.08 ± 2.69 beats/min) ($p = 0.0001$). At 30 minutes and 45 minutes, the differences in heart rate between the groups were not statistically significant ($p > 0.05$).

Systolic blood pressure showed significant intergroup differences at all measured time points. Group S consistently demonstrated higher systolic blood pressure values at 1, 5, 15, and 30 minutes compared to Group P ($p = 0.0001$ for all). At 45 minutes, this trend reversed, with Group P showing significantly higher systolic blood pressure than Group S ($p = 0.0001$).

For diastolic blood pressure, no significant difference was observed at 1 minute ($p = 0.387$). At 5 minutes, Group P showed marginally higher values ($p = 0.048$). A highly significant difference was noted at 15 minutes, with Group S demonstrating higher diastolic blood pressure ($p = 0.0001$). At 30 minutes, both groups had identical mean values ($p = 1.000$). At 45 minutes, Group P exhibited significantly higher diastolic blood pressure compared to Group S ($p = 0.0001$).

Mean arterial pressure also demonstrated statistically significant differences at all evaluated time points. Group S had significantly higher MAP values at 1, 5, 15, and 30 minutes ($p = 0.0001$ for all), whereas at 45 minutes, Group P showed significantly higher MAP values ($p = 0.0001$).

Oxygen saturation remained stable and comparable between both groups during most intraoperative periods. At 45 minutes, although Group P showed a slightly higher SpO_2 value than Group S, the difference was not statistically significant ($p = 0.179$).

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Table 3: Emergence and recovery characteristics (N=50)

Recovery parameter (minutes)	Group S (n=25) Mean±SD	Group P (n=25) Mean±SD	Test of significance	Mean difference (95% CI)	p-value
Eye opening	5.76±0.88	6.28±0.46	Independent t-test	-0.52 (-0.92 to -0.12)	0.0118
Following verbal command	8.36±0.81	7.04±0.79	Independent t-test	1.32 (0.86 to 1.78)	0.0001
Removal of LMA	8.20±0.71	7.24±0.66	Independent t-test	0.96 (0.57 to 1.35)	0.0001
Full orientation	8.52±0.51	9.24±0.52	Independent t-test	-0.72 (-1.01 to -0.43)	0.0001
Aldrete score	9 (0)	9 (0)			

[Table 3] highlights significant differences in emergence and recovery profiles between the two study groups. The time to eye opening was significantly shorter in Group S (5.76 ± 0.88 minutes) compared to Group P (6.28 ± 0.46 minutes) (p = 0.0118), indicating faster initial emergence with sevoflurane. In contrast, patients in Group P demonstrated significantly faster response to verbal commands (7.04 ± 0.79 minutes) compared to Group S (8.36 ± 0.81 minutes) (p = 0.0001).

Similarly, removal of the laryngeal mask airway occurred earlier in Group P (7.24 ± 0.66 minutes) than in Group S (8.20 ± 0.71 minutes), and this difference was highly significant (p = 0.0001). However, full orientation was achieved significantly earlier in Group S (8.52 ± 0.51 minutes) compared to Group P (9.24 ± 0.52 minutes) (p = 0.0001). The Aldrete recovery score was identical in both groups, with all patients achieving a score of 9, suggesting comparable readiness for discharge from the recovery unit.

DISCUSSION

Baseline comparability and case-mix [Table 1]: In the present study, the two groups were well matched with respect to age, sex distribution, comorbidity status and duration of procedure (all p>0.05). This baseline comparability is similar to many ambulatory anesthesia comparisons where randomization or standardized allocation minimizes confounding, allowing differences in recovery and hemodynamics to be attributed mainly to the anesthetic technique rather than patient or surgical factors. Comparable baseline profiles have been reported in prospective comparisons of propofol-based anesthesia and sevoflurane-based anesthesia in short procedures and day-care settings. Dhande K et al (2020).[6]

Emergence characteristics [Table 1 and 3]: Data showed earlier eye opening with sevoflurane (Group S 5.76±0.88 vs Group P 6.28±0.46 min; p=0.0118), but faster response to verbal commands and earlier LMA removal with propofol (both p=0.0001). Full orientation was achieved earlier in the sevoflurane group (p=0.0001), while Aldrete score was similar (both achieved 9). This mixed pattern is consistent with literature showing that "early awakening" endpoints can differ depending on which recovery marker is assessed (eye opening vs command following vs extubation/LMA removal vs orientation) and on adjuncts such as opioids, nitrous oxide, depth targets, and ventilation strategy. Shobha MM et al (2025),[7] reported broadly comparable early recovery gaps between eye opening and command following/extubation between sevoflurane and propofol techniques, suggesting that small differences may depend on protocol details and the recovery endpoint chosen.

Pediatric and procedural-context studies also demonstrate that sevoflurane can provide faster recovery than propofol for some endpoints, while propofol may be favored for smoother or more predictable emergence depending on dosing and case-type; Rishika K et al (2025),[8] reported faster recovery with sevoflurane for LMA anesthesia in children undergoing MRI, though emergence behaviors (e.g., delirium/agitation) may differ by agent.

Hemodynamic stability [Table 2] in relation to prior evidence: Across multiple intraoperative time points, results showed significantly higher SBP and MAP in the sevoflurane group, particularly early after induction and at 15 minutes, while propofol showed comparatively lower pressures at several intervals. This trend aligns with several comparative studies in which propofol-based maintenance was associated with greater reductions in blood pressure (and sometimes MAP) due to vasodilation and myocardial depression, whereas volatile-based techniques may maintain BP more consistently in some protocols. Kumar V et al (2025),[9] reported lower systolic and diastolic pressures during maintenance with propofol compared with sevoflurane, supporting observation of relative hypotension with propofol at key time points. Similarly, Ahmad M et al (2025),[10] evaluated hemodynamic stability and noted differences in heart rate behavior and stability between propofol and sevoflurane-based anesthesia, reinforcing that agent-related cardiovascular effects are clinically relevant even in short cases.

Regarding heart rate, study showed no significant differences at 1 and 5 minutes, but a significantly higher HR at 15 minutes in Group S. Such transient time-point differences are frequently reported and are often influenced by surgical stimulation, anesthetic depth, and concurrent analgesic dosing rather than the hypnotic agent alone. Oxygenation (SpO_2) remained stable and comparable between groups, which is consistent with most day-care comparisons where both techniques reliably maintain ventilation/oxygenation under standardized airway management. Ma J et al (2025).[11]

Clinical interpretation and linkage to ambulatory anesthesia priorities: From an ambulatory workflow perspective, the differences observed

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earlier eye opening and orientation with sevoflurane, but earlier command following and LMA removal with propofol suggest that both techniques can be optimized for fast-track recovery, but they may confer advantages at different stages of emergence. Importantly, broader ambulatory evidence consistently shows a lower incidence of postoperative nausea and vomiting (PONV) with propofol-based TIVA compared with volatile agents, which can be a decisive advantage for day-care discharge and patient satisfaction (even though provided tables did not include adverse events). This is supported by classic systematic review evidence and large reviews comparing propofol with inhalational anesthesia for ambulatory cases. Paul S et al (2023).[12]

CONCLUSION

This prospective comparative study demonstrated that both propofol-based and sevoflurane-based anesthesia techniques are safe and effective for day-care surgical procedures, providing adequate depth of anesthesia and satisfactory recovery profiles. Baseline demographic and clinical parameters were comparable between the two groups, ensuring valid comparison of outcomes.

Sevoflurane anesthesia was associated with significantly faster eye opening and earlier attainment of full orientation, indicating more rapid initial emergence. In contrast, propofol anesthesia resulted in significantly earlier response to verbal commands and faster removal of the laryngeal mask airway, reflecting smoother airway recovery and earlier achievement of purposeful responses.

With respect to intraoperative hemodynamics, sevoflurane demonstrated relatively higher systolic blood pressure and mean arterial pressure values at several time points, suggesting better preservation of blood pressure, whereas propofol was associated with comparatively lower blood pressure values, consistent with its known vasodilatory effects. However, both anesthetic techniques maintained overall hemodynamic stability within clinically acceptable ranges, and oxygen saturation remained comparable throughout the perioperative period.

Overall, both propofol and sevoflurane are suitable anesthetic agents for ambulatory surgeries. The choice between the two should be individualized based on patient characteristics, surgical requirements, institutional protocols, and the relative importance of specific recovery endpoints.

Limitations of the Study

1. The sample size was relatively small, which may limit the generalizability of the findings to larger and more diverse patient populations.
2. The study was conducted at a single center, and results may vary in different institutional settings with varying anesthesia protocols.
3. Only ASA physical status I and II patients were included; therefore, the findings may not be applicable to higher-risk patients.
4. The study focused primarily on early emergence and hemodynamic parameters and did not evaluate long-term postoperative outcomes.
5. Assessment of postoperative adverse events such as nausea, vomiting, pain scores, and patient satisfaction was limited, which could have provided additional insights into overall recovery quality.
6. Depth of anesthesia monitoring (such as BIS) was not incorporated, which may have influenced anesthetic titration and recovery characteristics.

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