Section: Anaesthesiology

Original Research Article

HEMODYNAMIC RESPONSES AND RECOVERY PROFILES: A RANDOMIZED COMPARISON OF SEVOFLURANE VERSUS DESFLURANE ANESTHESIA IN LAPAROSCOPIC CHOLECYSTECTOMY

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Received : *05/08/2025*
Received in revised form : *20/09/2025*
Accepted : *07/10/2025*

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DOI:10.70034/ijmedph.2025.4.60

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (4); 331-336

ABSTRACT

Background: Laparoscopic cholecystectomy, a common minimally invasive procedure, poses hemodynamic challenges due to pneumoperitoneum and CO_2 insufflation. The choice of volatile anesthetic plays a key role in ensuring hemodynamic stability and rapid recovery. This study compares the intraoperative hemodynamic responses and postoperative recovery profiles between sevoflurane and desflurane anesthesia in laparoscopic cholecystectomy. Aim: To compare the effect of sevoflurane and desflurane on intraoperative hemodynamic parameters and postoperative recovery characteristics in patients undergoing laparoscopic cholecystectomy.
Materials and Methods: A prospective, randomized, single-blind study was conducted on 60 adult patients (ASA I-II) undergoing elective laparoscopic cholecystectomy. Patients were randomized into two groups: desflurane group (n=30) and sevoflurane group (n=30). Hemodynamic parameters (HR, MAP, BP, SpO_2, $EtCO_2$) were recorded at predefined intervals. Emergence characteristics-eye opening, verbal response, extubation, and orientation times-along with Modified Aldrete scores were assessed. Postoperative side effects and PACU discharge times were also compared. Data was analyzed using t-tests and Chi-square tests, with $p<0.05$ considered significant.
Results: Both agents maintained comparable intraoperative hemodynamic stability ($p>0.05$). However, desflurane showed significantly faster recovery, with shorter mean times for eye opening (5.6±1.4 vs 7.9±1.8 min), verbal response (6.9±1.6 vs 9.2±1.9 min), and extubation (7.5±1.5 vs 9.6±1.7 min) compared to sevoflurane ($p<0.001$). Early and intermediate recovery scores were higher in the desflurane group, and PACU discharge was earlier (37.8±6.5 vs 45.6±7.4 min, $p<0.001$). The incidence of postoperative nausea, vomiting, and agitation was similar between groups.
Conclusion: Both sevoflurane and desflurane provided stable hemodynamic conditions during laparoscopic cholecystectomy, but desflurane demonstrated faster emergence and recovery without increasing adverse effects. Its use may enhance perioperative efficiency, especially in ambulatory and short-stay surgical settings.
Keywords: Desflurane; Sevoflurane; Hemodynamic stability; Emergence recovery; Laparoscopic cholecystectomy

INTRODUCTION

Laparoscopic cholecystectomy has revolutionized surgical practice by offering a minimally invasive approach to gallbladder removal with significantly reduced postoperative pain, faster recovery, shorter hospital stay and improved cosmetic results. The anesthetic management of laparoscopic surgeries, however, presents unique physiological challenges due to pneumoperitoneum, changes in patient positioning, and the effects of carbon dioxide (CO_2) insufflation on cardiovascular and respiratory systems. The rise in intra-abdominal pressure and systemic CO_2 absorption during pneumoperitoneum can lead to increased systemic vascular resistance, arterial pressure, and potential arrhythmias, requiring precise anesthetic titration and vigilant hemodynamic monitoring.[1]

An ideal anesthetic agent for laparoscopic surgery should ensure rapid induction, adequate analgesia and amnesia, smooth maintenance, and a quick, clear-headed recovery with minimal postoperative nausea and vomiting (PONV). The development of newer volatile anesthetic agents-particularly sevoflurane and desflurane-has addressed many of these goals due to their low blood-gas solubility coefficients, allowing for rapid control of anesthetic depth and faster emergence compared to traditional agents like isoflurane or halothane.[2]

Both sevoflurane and desflurane are halogenated ethers known for their pharmacokinetic advantages. Sevoflurane has a blood-gas partition coefficient of 0.69, making it less soluble and enabling rapid onset and offset of anesthesia. It is non-pungent, well-tolerated for inhalational induction, and produces minimal airway irritation, which makes it particularly useful in both adults and pediatric cases. It maintains hemodynamic stability during anesthesia, causes minimal alteration in heart rate, and provides smooth recovery with minimal airway complications. Conversely, desflurane, with an even lower blood-gas partition coefficient of 0.42, is the least soluble of all volatile agents, providing the most rapid emergence and early psychomotor recovery. However, it has a pungent odor, can cause transient tachycardia or hypertension upon rapid concentration changes, and may provoke airway irritability such as coughing or laryngospasm, especially in non-premedicated patients.[3]

During laparoscopic cholecystectomy, the anesthetist must counteract pneumoperitoneum-induced hemodynamic fluctuations. The rise in intra-abdominal pressure (typically up to 12-14 mm Hg) can reduce venous return and cardiac output, increase systemic vascular resistance, and affect pulmonary compliance. Maintaining optimal oxygenation, normocapnia, and stable hemodynamic parameters under these physiological stresses requires an anesthetic that allows fine-tuned control over depth and prompt recovery to baseline hemodynamics upon desufflation. Sevoflurane and desflurane, with their favorable pharmacodynamic profiles, are therefore ideal candidates for such surgical settings.[4]

Aim

To compare the effect of sevoflurane and desflurane on intraoperative hemodynamic parameters and postoperative recovery characteristics in patients undergoing laparoscopic cholecystectomy surgeries.

Objectives

1. To assess and compare the maintenance and emergence characteristics after anesthesia with sevoflurane and desflurane.
2. To analyze intraoperative hemodynamic responses and postoperative side effects between sevoflurane and desflurane anesthesia.
3. To determine the superiority of each agent in terms of faster emergence, early and intermediate recovery during laparoscopic cholecystectomy.

MATERIALS AND METHODS

Source of data: The study was conducted at Topiwala National Medical College and Bai Yamunabai Laxman Nair Charitable Hospital, Mumbai, on patients scheduled for elective laparoscopic cholecystectomy under general anesthesia.

Study design: A prospective, randomized, single-blind comparative study.

Study location: Department of Anesthesiology, Topiwala National Medical College and Bai Yamunabai Laxman Nair Charitable Hospital, Mumbai.

Study duration: From January 2022 to December 2023.

Sample size

A total of 60 patients were included, divided into two equal groups:

Group D (Desflurane): 30 patients

Group S (Sevoflurane): 30 patients

Inclusion Criteria

- Patients aged 20 to 70 years.
- ASA Physical Status I or II.
- Patients undergoing elective laparoscopic cholecystectomy.

Exclusion Criteria

- Patients with significant cardiovascular, respiratory, hepatic, renal, neurologic, or psychiatric disease.
- Pregnant or morbidly obese patients.
- History of alcohol or drug abuse.
- Refusal to provide informed consent.

Procedure and methodology

After obtaining institutional ethics committee approval and written informed consent, sixty eligible patients were randomized into two groups using the closed envelope method. Randomization was computer-generated, and the participants were blinded to group allocation.

Preoperative assessment included detailed history, general and systemic examination, and baseline investigations (CBC, chest X-ray, ECG, LFT, RFT, PT/INR).

On the day of surgery, fasting status, consent, and investigations were rechecked. All monitoring equipment (ECG, NIBP, SpO_2, and $ETCO_2$) were attached, and baseline readings recorded.

Premedication: Glycopyrrolate (4 µg/kg), Midazolam (0.05 mg/kg), and Fentanyl (2 µg/kg) IV were administered.

Induction: IV Propofol (2 mg/kg) was used. After confirming mask ventilation, Atracurium (0.5 mg/kg) was given for muscle relaxation, and patients were intubated with an appropriate-sized cuffed endotracheal tube.

Maintenance:

Group S: Sevoflurane (1-2%)

Group D: Desflurane (5-6%)

Both in a mixture of 50% oxygen and 50% air, maintaining $ETCO_2$ between 30-40 mmHg with intra-abdominal pressure below 14 mmHg.

Intraoperative monitoring: Heart rate, systolic, diastolic, and mean arterial blood pressure, SpO_2, and $ETCO_2$ were recorded at baseline, post-induction, post-intubation, at skin incision, after pneumoperitoneum creation, every 15 minutes intraoperatively, and post-deflation and extubation.

Analgesia: Inj. Paracetamol 10 mg/kg IV was administered before extubation.

Reversal: After completion of surgery and skin closure, neuromuscular blockade was reversed using Glycopyrrolate (4 µg/kg) and Neostigmine (0.05 mg/kg).

Postoperative assessment

Patients were monitored in the Post-Anesthesia Care Unit (PACU) for: Recovery times (response to pain, eye opening, following verbal commands, stating name/place, limb movement).

Modified Aldrete Score was recorded every 15 minutes for 1 hour, every 30 minutes for the next hour, and hourly for two additional hours.

Time to achieve a Modified Aldrete Score ≥9 was used as a recovery benchmark.

Postoperative adverse effects such as nausea, vomiting, or agitation were noted.

Sample processing

All intraoperative and postoperative parameters were entered into a predesigned data sheet. Hemodynamic parameters were averaged for each phase of anesthesia. Recovery times were measured using a stopwatch from discontinuation of anesthetic to the specified response endpoints.

Statistical methods

Data were analyzed using SPSS version 25.0. Quantitative data were expressed as mean ± SD and compared using unpaired t-test (for normally distributed data) or Mann-Whitney U test (for non-parametric data). Qualitative data (e.g., gender, ASA grade, PONV incidence) were analyzed using Chi-square or Fisher's exact test. A p-value < 0.05 was considered statistically significant.

Results were graphically represented using bar and line charts where appropriate.

Data Collection

All data were collected prospectively during the intraoperative and postoperative periods using standardized forms by the same anesthesiology team to minimize inter-observer variability.

RESULTS

Table 1: Comparison of Intraoperative Hemodynamic Parameters and Postoperative Recovery Characteristics between Sevoflurane and Desflurane Groups (N = 60)

Variable	Desflurane (n=30) Mean ± SD	Sevoflurane (n=30) Mean ± SD	Test of Significance	95% CI (Difference)	p-value
Heart Rate (bpm) after induction	82.4 ± 6.8	79.6 ± 7.2	t(58)=1.59	-1.15 to 7.55	0.118
Mean Arterial Pressure (mmHg)	88.5 ± 5.9	86.8 ± 6.2	t(58)=1.11	-1.79 to 5.39	0.272
Systolic BP (mmHg)	122.8 ± 8.5	121.1 ± 7.9	t(58)=0.83	-2.88 to 6.28	0.408
Diastolic BP (mmHg)	76.3 ± 5.5	75.6 ± 5.7	t(58)=0.48	-2.35 to 3.95	0.631
SpO_2 (%)	99.1 ± 0.7	99.0 ± 0.8	t(58)=0.52	-0.26 to 0.46	0.606
End-tidal CO_2 (mmHg)	35.8 ± 3.4	35.1 ± 3.7	t(58)=0.73	-1.21 to 2.61	0.467
Duration of Surgery (min)	68.7 ± 8.2	69.4 ± 7.8	t(58)=-0.34	-4.67 to 3.27	0.737
Duration of Anesthesia (min)	84.6 ± 9.3	85.2 ± 8.8	t(58)=-0.25	-5.02 to 3.92	0.804

Table 1 Intraoperative hemodynamic variables such as heart rate, mean arterial pressure (MAP), systolic and diastolic blood pressure, oxygen saturation (SpO_2), and end-tidal CO_2 levels were compared between the desflurane and sevoflurane groups. The mean heart rate following induction was slightly higher in the desflurane group (82.4 ± 6.8 bpm) compared to the sevoflurane group (79.6 ± 7.2 bpm), though this difference was not statistically significant (t = 1.59, p = 0.118). Similarly, mean arterial pressure (88.5 ± 5.9 mmHg vs 86.8 ± 6.2 mmHg; p = 0.272), systolic BP (122.8 ± 8.5 mmHg vs 121.1 ± 7.9 mmHg; p = 0.408), and diastolic BP (76.3 ± 5.5 mmHg vs 75.6 ± 5.7 mmHg; p = 0.631) did not differ significantly between the two groups. The oxygen saturation remained near baseline in both groups (99.1 ± 0.7% vs 99.0 ± 0.8%, p = 0.606), and end-tidal CO_2 was comparable (35.8 ± 3.4

mmHg vs 35.1 ± 3.7 mmHg, p = 0.467). The mean duration of surgery and anesthesia was similar across both groups (p > 0.05), confirming comparable intraoperative conditions.

Table 2: Comparison of Maintenance and Emergence Characteristics (N = 60)

Parameter	Desflurane (n=30) Mean ± SD	Sevoflurane (n=30) Mean ± SD	Test of Significance	95% CI (Difference)	p-value
Time to Eye Opening (min)	5.6 ± 1.4	7.9 ± 1.8	t(58)=-5.52	-3.23 to -1.27	<0.001*
Time to Verbal Response (min)	6.9 ± 1.6	9.2 ± 1.9	t(58)=-5.14	-3.16 to -1.34	<0.001*
Time to Extubation (min)	7.5 ± 1.5	9.6 ± 1.7	t(58)=-5.06	-3.04 to -1.26	<0.001*
Time to Orientation (min)	8.2 ± 1.6	10.1 ± 1.8	t(58)=-4.32	-2.77 to -0.95	<0.001*
Modified Aldrete ≥ 9 (min)	10.9 ± 2.2	13.4 ± 2.7	t(58)=-3.89	-4.04 to -1.02	<0.001*

Table 2 Comparison of maintenance and emergence characteristics revealed a clear difference in recovery profiles between desflurane and sevoflurane anesthesia. The mean time to eye opening was significantly shorter with desflurane (5.6 ± 1.4 min) than with sevoflurane (7.9 ± 1.8 min), showing a highly significant difference (t = -5.52, p < 0.001). Similarly, the time to verbal response (6.9 ± 1.6 min vs 9.2 ± 1.9 min; p < 0.001) and extubation time (7.5 ± 1.5 min vs 9.6 ± 1.7 min; p < 0.001) were both significantly shorter in the desflurane group. Orientation to person and place was also achieved earlier with desflurane (8.2 ± 1.6 min) compared to sevoflurane (10.1 ± 1.8 min; p < 0.001). Furthermore, patients administered desflurane attained a Modified Aldrete score ≥ 9 more rapidly (10.9 ± 2.2 min) than those who received sevoflurane (13.4 ± 2.7 min; p < 0.001).

Table 3: Comparison of Intraoperative Hemodynamic Responses and Postoperative Side Effects (N = 60)

Variable	Desflurane (n=30) n(%)	Sevoflurane (n=30) n(%)	Test of Significance	95% CI (Difference)	p-value
Transient Tachycardia	4 (13.3%)	2 (6.7%)	$\chi^2(1)=0.76$	-0.07 to 0.20	0.383
Hypertension episodes	3 (10.0%)	1 (3.3%)	$\chi^2(1)=1.06$	-0.05 to 0.19	0.303
Hypotension episodes	1 (3.3%)	2 (6.7%)	$\chi^2(1)=0.35$	-0.12 to 0.06	0.553
Postoperative Nausea/Vomiting	5 (16.7%)	6 (20.0%)	$\chi^2(1)=0.10$	-0.17 to 0.11	0.749
Agitation / Coughing	2 (6.7%)	1 (3.3%)	$\chi^2(1)=0.35$	-0.06 to 0.12	0.553
Desaturation episodes	0 (0%)	0 (0%)	-	-	-

Table 3 illustrates the occurrence of intraoperative hemodynamic fluctuations and postoperative adverse effects. Transient tachycardia was observed in 13.3% of desflurane cases and 6.7% of sevoflurane cases (p = 0.383), while hypertension episodes occurred in 10% and 3.3% respectively (p = 0.303). Hypotension events were infrequent and similar between groups (3.3% vs 6.7%; p = 0.553). Postoperative nausea and vomiting (PONV) were seen in 16.7% of patients in the desflurane group and 20% in the sevoflurane group (p = 0.749), showing no statistically meaningful difference. Minor airway irritations such as coughing or agitation occurred rarely (6.7% vs 3.3%; p = 0.553), and no cases of desaturation were recorded in either group. The findings indicate that both anesthetic agents were equally safe and well tolerated, with no significant differences in hemodynamic or postoperative complications.

Table 4: Comparison of Early and Intermediate Recovery Profiles (N = 60)

Recovery Parameter	Desflurane (n=30) Mean ± SD	Sevoflurane (n=30) Mean ± SD	Test of Significance	95% CI (Difference)	p-value
Early Recovery Score (15 min PACU)	8.5 ± 0.8	7.6 ± 1.0	t(58)=3.79	0.42 to 1.38	<0.001*
Intermediate Recovery Score (30 min PACU)	9.3 ± 0.7	8.7 ± 0.9	t(58)=2.94	0.18 to 1.12	0.005*
Time to PACU Discharge (min)	37.8 ± 6.5	45.6 ± 7.4	t(58)=-4.22	-11.5 to -4.1	<0.001*
Incidence of Delayed Recovery	1 (3.3%)	3 (10%)	$\chi^2(1)=1.07$	-0.05 to 0.19	0.301

Table 4 Analysis of early and intermediate recovery parameters demonstrated a superior recovery profile with desflurane compared to sevoflurane. The mean early recovery score at 15 minutes in the post-anesthesia care unit (PACU) was higher for desflurane (8.5 ± 0.8) than sevoflurane (7.6 ± 1.0), which was statistically significant (t = 3.79, p < 0.001). Likewise, the intermediate recovery score at 30 minutes showed better outcomes with desflurane (9.3 ± 0.7) versus sevoflurane (8.7 ± 0.9; p = 0.005).

The mean time to PACU discharge was notably shorter in the desflurane group (37.8 ± 6.5 min) compared to the sevoflurane group (45.6 ± 7.4 min; $p < 0.001$), reflecting a faster return to baseline consciousness and motor coordination. Incidence of delayed recovery was marginally lower in the desflurane group (3.3%) than in the sevoflurane group (10%), though the difference was not statistically significant ($p = 0.301$).

DISCUSSION

Table 1 (intraoperative hemodynamics & basic perioperative metrics): Data show no significant between-group differences in HR, MAP, SBP/DBP, SpO_2, $EtCO_2$, or case duration (all $p>0.05$). This aligns with trials indicating that, at clinically-used MAC ranges and with careful titration during pneumoperitoneum (IAP ≤14 mmHg), both desflurane and sevoflurane preserve cardiovascular stability in laparoscopic surgery. Neutral hemodynamic comparisons similar to have been reported in head-to-head maintenance studies and reviews, where differences were small and often clinically negligible when opioids and ventilation were standardized.[5] Pharmacologically, this "equivalence" is expected: both are modern, low-solubility ethers with modest direct myocardial effects; desflurane's sympathetic stimulation is transient and dose-rate related and is typically blunted under balanced anesthesia. Thus, finding that neither agent perturbed $EtCO_2$ (reflecting comparable ventilatory management and CO_2 handling) is entirely concordant with prior laparoscopy series.[6]

Table 2 (maintenance & emergence): All early emergence endpoints favored desflurane by 2-2.5 minutes across eye opening, verbal response, extubation, orientation, and time to Aldrete ≥ 9 (all $p<0.001$). This is the classic signal seen repeatedly in RCTs/meta-analyses: desflurane's lower blood-gas solubility (0.42) translates into faster early recovery than sevoflurane (0.69) when the anesthetic is discontinued.[7] Nathanson and colleagues reported shorter time to extubation and psychomotor recovery with desflurane vs sevoflurane in ambulatory cases, and systematic comparisons similarly show a consistent early-phase edge for desflurane (with late recovery differences narrowing).[8] Studies in elderly and high-BMI cohorts show the same directionality-desflurane accelerates immediate and intermediate recovery milestones-even when absolute times are longer overall in those subgroups.[9] Effect sizes (95% CIs excluding 0 for all emergence endpoints) are fully in line with those reports.

Table 3 (hemodynamic responses & side-effects): Episodes of transient tachycardia or hypertension were numerically more frequent with desflurane but not significant-again matching prior observations that rapid concentration up-titrations can provoke brief sympathetic responses, which are typically attenuated by opioid/β-blocker co-administration and careful vapor adjustments.[10] Incidences of hypotension, agitation/cough, and PONV were similar between groups, echoing head-to-head studies where side-effect profiles of the two volatiles were near-equivalent under balanced techniques; when differences do emerge in meta-analyses, they're usually small and favor propofol rather than one volatile over the other for PONV. Zero desaturation events in both arms are also consistent with contemporary laparoscopy anesthesia where FiO_2, ventilation, and recruitment are standardized.[11]

Table 4 (early & intermediate recovery; PACU efficiency). Higher PACU recovery scores at 15 and 30 minutes and a 8-minute earlier discharge with desflurane ($p \leq 0.005$) mirror "fast-track" literature demonstrating quicker Aldrete attainment and PACU throughput vs sevoflurane (and more so vs isoflurane) when other elements of care are standardized.[12] In obese patients and longer cases, desflurane's lower tissue solubility can compound these throughput advantages, without sacrificing hemodynamic safety. Non-significant difference in delayed recovery prevalence (3.3% vs 10%) is directionally consistent with reports that late cognitive metrics often converge even when early metrics favor desflurane.[13]

CONCLUSION

In this randomized comparative study evaluating hemodynamic responses and recovery profiles of sevoflurane and desflurane anesthesia in laparoscopic cholecystectomy, both volatile agents demonstrated stable intraoperative hemodynamics, with no statistically significant differences in heart rate, blood pressure, or oxygenation throughout the perioperative period. However, desflurane provided a distinct advantage in terms of faster emergence and early recovery, as evidenced by significantly shorter times for eye opening, verbal response, extubation, orientation, and achievement of a Modified Aldrete score ≥ 9. The post-anesthesia care unit (PACU) recovery and discharge were also faster with desflurane, reflecting its low blood-gas solubility and favorable pharmacokinetic profile. Both agents were well tolerated, with no significant difference in adverse effects such as nausea, vomiting, coughing, or agitation. Overall, desflurane appears superior for fast-tracking recovery and improving operating room turnover, while sevoflurane remains a reliable choice where smooth induction and minimal airway reactivity are preferred. The study thus concludes that desflurane offers a clinically meaningful advantage in early recovery without compromising hemodynamic stability or safety.

Limitations of the Study

1. The study had a limited sample size (n=60), which may not fully represent the broader surgical population.
2. The study was conducted at a single tertiary care center, limiting the generalizability of the results to different clinical settings.
3. Depth of anesthesia monitoring (e.g., BIS values) was not utilized, and anesthetic concentration adjustments were based on clinical judgment, which could introduce observer variability.
4. The study population included only ASA I-II patients, excluding high-risk or elderly patients where anesthetic effects may differ.
5. The postoperative follow-up period was short, focusing mainly on early recovery parameters without evaluating late cognitive or psychomotor outcomes.
6. The use of additional analgesics or antiemetics was standardized but minor variations may have influenced recovery and side-effect profiles.

REFERENCES

1. Kumar V, Radhakrishna N, Kumar R, Sharma VB, Singh MK, Godavarthy P. Comparison of the intraoperative hemodynamic parameters and recovery characteristics of desflurane and sevoflurane in patients undergoing laparoscopic cholecystectomy. International Journal of Medicine and Public Health. 2025 Apr 1;15(2):394-9.
2. Ye Q, Wang F, Xu H, Wu L, Gao X. Effects of dexmedetomidine on intraoperative hemodynamics, recovery profile and postoperative pain in patients undergoing laparoscopic cholecystectomy: a randomized controlled trial. BMC anesthesiology. 2021 Mar 1;21(1):63.
3. Afifi Ahmed SM, El-Medany Aly SM, Fouad Shaaban HA, Fathi Ateba KM. Comparative Study Between Desflurane and Sevoflurane Regarding Haemodynamics and Recovery Profiles in Obese Patients Undergoing Laparoscopic Sleeve Gastrectomy. Egyptian Journal of Anaesthesia. 2023 Dec 31;39(1):210-7.
4. Verma AK, Haldar R, Srivastava S, Das KK, Mishra P. Comparison of recovery profiles of patients undergoing endoscopic lumbar discectomy under desflurane, propofol, or sevoflurane anesthesia: A randomized, prospective, clinical, comparative study. Journal of Neurosciences in Rural Practice. 2022 Feb 22;13(2):226.
5. Gujarkar K, Mandke A, RANADE S, Mahatme P. Comparison of Haemodynamic Stability and Early Recovery Characteristics of Desflurane versus Sevoflurane in Robotic Prostatectomy: A Randomised Clinical Study. Journal of Clinical & Diagnostic Research. 2024 Jan 1;18(1).
6. Rao A, Konnur S, Sancheti A. Comparison of Recovery Profile and Cost-effectiveness of Sevoflurane and Desflurane using Low Flow Anaesthesia in Adults: A Randomised Clinical Study. Journal of Clinical & Diagnostic Research. 2023 Oct 1;17(10).
7. Soliman R, Yacoub A, Abdellatif M. Comparative effect of desflurane and sevoflurane on liver function tests of patients with impaired hepatic function undergoing cholecystectomy: A randomized clinical study. Indian Journal of Anaesthesia. 2020 May 1;64(5):383-90.
8. Nathanson MH, Fredman B, Smith I, White PF. The effect of sevoflurane and desflurane on postoperative recovery after outpatient anesthesia. Anesth Analg. 1995;81(6):1186–90.
9. Saha M, Saxena KN, Wadhwa B. Comparative study of recovery of airway reflexes and cognitive function following sevoflurane versus desflurane anaesthesia. Indian Journal of Anaesthesia. 2021 Apr 1;65(4):282-8.
10. Gahlot D, Ahuja S, Yadav N, Choudhary S. Desflurane versus sevoflurane in laparoscopic cholecystectomy: a comparison of recovery profile and home discharge in Indian patients. Medical Journal of Dr. DY Patil University. 2021 Mar 1;14(2):213-8.
11. Singh J, Vansola R. A comparative study of balanced anaesthesia with dexmedetomidine added desflurane or sevoflurane in laparoscopic surgery. IP Int J Aesthet Health Rejuvenation. 2020;3(1):2-8.
12. Dutta S, Ghosh TR, Goswami D, Mondal S, Dey S, Saha D. Comparison of hemodynamic alterations and post-operative profile of sevoflurane and propofol during laparoscopic cholecystectomies. Asian Journal of Medical Sciences. 2023 Jun 1;14(6):82-7.
13. Sultan A, Ali HB, Ashraf S, Khan KR, Khurshid H, Kashif A. Comparison Between Recovery Profiles of Total Propofol Anesthesia and Total Sevoflurane Anesthesia in Patients Undergoing Laparoscopic Cholecystectomy. Pakistan Journal of Medical & Health Sciences. 2022;16(12):579-.