



Original Research Article

A COMPARATIVE STUDY OF DESFLURANE VERSUS SEVOFLURANE IN OBESE PATIENTS UNDERGOING LAPAROSCOPY SURGERY: EFFECT ON RECOVERY PROFILE

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ABSTRACT

Background: Obesity presents significant anesthetic challenges due to altered respiratory mechanics, pharmacokinetics, and increased perioperative risks. Volatile anesthetics such as desflurane and sevoflurane are commonly used due to their low blood-gas solubility, but their comparative effects on recovery profiles in obese patients remain an area of clinical interest. **Aim:** To compare desflurane and sevoflurane with respect to recovery characteristics, cognitive function, hemodynamic stability, and postoperative adverse effects in obese patients undergoing laparoscopic surgery.

Materials and Methods: This prospective, randomized, double-blind study included 80 obese patients (BMI ≥ 30 kg/m²), aged 18–60 years, undergoing elective laparoscopic surgery. Patients were allocated into two groups: desflurane (Group D) and sevoflurane (Group S). Standardized anesthesia protocols were followed. Primary outcomes included recovery parameters (eye opening, extubation, orientation), Modified Aldrete Score, and Mini-Mental State Examination (MMSE). Secondary outcomes included intraoperative hemodynamics, adverse events, and post-anesthesia care unit (PACU) stay duration.

Results: Baseline characteristics were comparable between groups. Desflurane demonstrated significantly faster recovery, with shorter times to eye opening (4.6 ± 1.4 vs 7.5 ± 1.5 min), verbal response (5.2 ± 1.3 vs 8.1 ± 1.4 min), and extubation (6.3 ± 1.1 vs 9.2 ± 1.6 min) ($p < 0.001$). Cognitive recovery was also faster, with earlier return to baseline MMSE (39.6 ± 12.8 vs 51.1 ± 13.5 min; $p = 0.001$). Modified Aldrete Scores were significantly higher in the desflurane group at all intervals, indicating quicker recovery. Hemodynamic parameters and respiratory variables remained stable and comparable in both groups. The incidence of adverse effects was low and statistically insignificant. PACU discharge readiness was achieved earlier with desflurane (45.8 ± 7.5 vs 58.2 ± 8.4 min; $p < 0.001$).

Conclusion: Desflurane provides significantly faster emergence, improved early cognitive recovery, and reduced PACU stay compared to sevoflurane in obese patients undergoing laparoscopic surgery, without compromising hemodynamic stability or safety.

Keywords: Desflurane, Sevoflurane, Obesity, Laparoscopic surgery, Recovery profile, MMSE, PACU.

INTRODUCTION

Obesity is a complex medical condition characterized by an abnormal or excessive accumulation of body

fat, generally defined by a Body Mass Index (BMI) greater than or equal to 30 kg/m². The global prevalence of obesity has tripled since 1975, with approximately 650 million adults classified as obese

by recent WHO estimates. Specifically, in India, the burden of obesity has escalated significantly, attributed largely to urbanization, sedentary lifestyles, and dietary transitions towards high-calorie diets.

Laparoscopic surgery, frequently employed in obese patients, presents clear benefits such as reduced postoperative pain, shorter hospital stays, quicker recovery, and lower incidence of wound complications compared to open surgery. Despite these advantages, the perioperative management of obese patients undergoing laparoscopy is inherently challenging. Airway management, intraoperative hemodynamic stability, and optimal postoperative recovery remain critical concerns due to pathophysiological alterations in obesity, such as reduced pulmonary compliance, increased oxygen consumption, and altered pharmacokinetics of anesthetic drugs. Importantly, obese patients exhibit increased risks for postoperative respiratory complications, including hypoxia, atelectasis, and obstructive sleep apnea exacerbation, necessitating rapid emergence and effective airway control postoperatively to optimize patient safety.^[1] Anesthetic agent selection significantly influences postoperative recovery and patient satisfaction, particularly in obese patients undergoing laparoscopic procedures. Ideal anesthetic agents for this patient population must demonstrate rapid titration capabilities, predictable pharmacokinetics, hemodynamic stability, and rapid emergence characteristics. Among commonly used inhalational anesthetic agents, desflurane and sevoflurane are preferred due to their favorable pharmacological profiles, characterized by low blood-gas partition coefficients (0.45 for desflurane and 0.65 for sevoflurane), enabling rapid induction, precise titration, and swift emergence.^[2] Sevoflurane, a fluorinated methyl isopropyl ether derivative, is widely favored due to its pleasant odor, minimal airway irritation, and stable hemodynamic properties, making it particularly suitable for obese patients prone to airway sensitivity. Sevoflurane's clinical effectiveness has been documented extensively, demonstrating smooth maintenance of anesthesia, minimal respiratory depression, and stable intraoperative and postoperative hemodynamics. However, its lipid solubility can cause anesthetic accumulation in adipose tissue, potentially prolonging emergence times in obese individuals.^[3] Desflurane, a fluorinated ether anesthetic, has become increasingly popular for use in obese patients undergoing laparoscopic procedures due to its rapid pharmacokinetics and minimal tissue solubility. Its extremely low blood-gas partition coefficient facilitates swift elimination and rapid emergence from anesthesia, thereby reducing recovery time, which is particularly advantageous in obese patients with significant adipose tissue reservoirs.

The Mini Mental State Examination (MMSE), a widely employed cognitive assessment tool, is particularly useful in evaluating postoperative

cognitive recovery. Prior comparative studies using MMSE to assess cognitive recovery in obese laparoscopic patients found that desflurane consistently facilitated earlier achievement of baseline cognitive function compared to sevoflurane, potentially reducing complications related to prolonged postoperative cognitive impairment.^[4]

This prospective, randomized, double-blind study is thus designed to address existing knowledge gaps by rigorously comparing desflurane and sevoflurane for their effects on postoperative cognitive recovery (via MMSE scores), emergence characteristics, intraoperative hemodynamic stability, and postoperative adverse events in obese patients undergoing laparoscopic surgery. The outcomes from this study will provide evidence-based guidance for anesthetic agent selection, optimize perioperative management strategies, and potentially reduce postoperative complications in the rapidly growing population of obese surgical patients, thereby enhancing overall patient safety and satisfaction.^[5]

MATERIALS AND METHODS

This prospective, randomized, double-blind clinical trial was conducted in the Department of Anesthesiology, Bombay Hospital, Indore, the study was conducted over 15 months (December 2023–March 2025).

Inclusion Criteria

- Patients aged 18 to 60 years of either sex.
- Body mass index (BMI) ≥ 30 kg/m² (as calculated using height and weight measured preoperatively).
- American Society of Anesthesiologists (ASA) physical status classification II
- Scheduled for elective laparoscopic abdominal surgery (e.g., cholecystectomy, appendectomy, or sleeve gastrectomy) under general anesthesia.
- Provision of written informed consent after thorough explanation of study procedures.

Exclusion Criteria

- History of severe chronic obstructive pulmonary disease (COPD) or restrictive lung disease (documented by preoperative pulmonary function tests showing FEV₁ < 50 % predicted or FVC < 50 % predicted).
- Hepatic impairment, defined as Child-Pugh class B or C cirrhosis, or serum bilirubin > 2 mg/dL without alternate explanation.
- End-stage renal disease, defined as estimated glomerular filtration rate (eGFR) < 30 mL/min/1.73 m² or requirement for dialysis.
- Documented cardiovascular disease including recent (within past 6 months) myocardial infarction, unstable angina, history of coronary artery bypass grafting or percutaneous coronary intervention, congestive heart failure (New York Heart Association class III or IV), or uncontrolled hypertension (resting systolic

blood pressure > 160 mm Hg or diastolic > 100 mm Hg despite medications).

- History of cerebrovascular accident or transient ischemic attack within the previous year.
- Known or suspected susceptibility to malignant hyperthermia, based on personal or family medical history.
- Any neuromuscular disorder (e.g., myasthenia gravis, muscular dystrophy) that could alter neuromuscular blockade or recovery.
- Use of investigational drugs or participation in another clinical trial within 30 days preceding enrollment.
- Chronic exposure to psychoactive medications (e.g., antipsychotics, antidepressants, or benzodiazepines) within 30 days prior to surgery.
- Pregnancy or current breastfeeding.
- Refusal to participate or inability to comprehend instructions for cognitive testing.

Study Sampling

Eligible patients were screened consecutively during preoperative anesthesia evaluation clinics. After providing written informed consent, participants were assigned a unique study identification number. Randomization was performed using a computer-generated random number sequence in blocks of eight to ensure balance between the two arms. The allocation sequence was kept in sequentially numbered, opaque, sealed envelopes prepared by an independent statistician.

Study Sample Size

The sample size calculation was based on detecting a 10-minute difference in time to recover baseline MMSE score between the two groups, with a standard deviation of 12 minutes, an alpha error of 0.05, and power of 80 %. Using the formula for comparing two means, the required sample size per group was computed as follows:

$$n = \left(\frac{Z_{1-\alpha/2} + Z_{1-\beta}}{\Delta/\sigma} \right)^2 = \left(\frac{1.96 + 0.84}{10/12} \right)^2 \approx 32$$
$$32n = (\Delta/\sigma)^2 (Z_{1-\alpha/2} + Z_{1-\beta})^2 = (10/12)^2 (1.96 + 0.84)^2 \approx 32$$

Ultimately, 40 patients per group (total N = 80) were recruited to ensure adequate data completeness and statistical validity.

2. Study Groups

Participants were allocated into two parallel arms:

- Group D (Desflurane Group): Patients received desflurane for maintenance of anesthesia. The desflurane vaporizer was set to deliver an end-tidal concentration equivalent to 1.0–1.3 age-adjusted minimum alveolar concentration (MAC) in 50 % oxygen and 50 % air at a fresh gas flow of 2 L/min.
- Group S (Sevoflurane Group): Patients received sevoflurane for maintenance of anesthesia. The sevoflurane vaporizer was adjusted to deliver an end-tidal concentration equivalent to 1.0–1.3

age-adjusted MAC in 50 % oxygen and 50 % air at a fresh gas flow of 2 L/min.

The induction agents, analgesic regimen, neuromuscular blockade, and adjunct medications were identical between groups to isolate the effects of the volatile agent on recovery and cognitive outcomes. An independent anesthesiologist prepared the vaporizer and concealed it from the observer responsible for recording postoperative endpoints.

3. Study Procedure

Upon arrival in the preoperative holding area, each enrolled patient underwent measurement of height and weight. Ideal Body Weight (IBW) and Lean Body Weight (LBW) were calculated using the Devine and Janmahasatian formulas, respectively. A baseline Mini-Mental State Examination (MMSE) was administered by a trained research nurse fluent in both English and Hindi to ensure accurate comprehension. Standard fasting guidelines were confirmed (nil per os for 6 hours for solids and 2 hours for clear fluids). Intravenous access was established using an 18-gauge cannula, and standard monitoring was initiated, including electrocardiography (ECG), non-invasive blood pressure (NIBP), pulse oximetry, and end-tidal carbon dioxide (EtCO₂) monitoring. Patients were positioned in the ramped “sniffing” position to optimise airway alignment.

Premedication consisted of intravenous midazolam 0.05 mg/kg (LBW) administered 10 minutes prior to induction for anxiolysis, followed by glycopyrrolate 10 µg/kg (LBW) as an antisialagogue. Intravenous fentanyl 2 µg/kg (LBW) was administered 3 minutes before induction.

Mechanical ventilation was initiated in volume-controlled mode with a tidal volume of 6 mL/kg (IBW), respiratory rate adjusted to maintain EtCO₂ between 35–40 mmHg, and positive end-expiratory pressure (PEEP) of 5 cm H₂O. An oxygen–air mixture (50:50) was delivered at a flow rate of 2 L/min. Anaesthesia was maintained using the assigned volatile agent. In Group D, desflurane was administered to achieve an age-adjusted end-tidal concentration equivalent to 1.0 MAC, while in Group S, sevoflurane was used similarly. Depth of anaesthesia was monitored using clinical parameters (heart rate, blood pressure, lacrimation) and, where available, processed EEG monitoring (BIS), targeting values between 40 and 60.

Intraoperative analgesia was supplemented with fentanyl boluses of 0.5 µg/kg (LBW) if heart rate or blood pressure increased by more than 20% from baseline. Neuromuscular blockade was maintained with intermittent boluses of rocuronium 0.15 mg/kg (IBW), guided by TOF monitoring to maintain one to two twitches. Approximately 15 minutes before the anticipated end of surgery, the volatile anaesthetic concentration was reduced to 0.8 MAC, and intravenous ondansetron 8 mg was administered for prophylaxis against postoperative nausea and vomiting.

At the completion of surgery, the volatile agent was discontinued, and fresh gas flow was increased to 8 L/min to facilitate rapid elimination. Neuromuscular blockade was reversed using sugammadex 2 mg/kg (IBW) once adequate spontaneous recovery was observed. Extubation was performed after confirming standard criteria, including patient responsiveness, adequate spontaneous ventilation, and sustained head lift. Following extubation, patients were transferred to the post-anaesthesia care unit (PACU) and positioned supine with a 30-degree head elevation. Postoperative recovery parameters recorded included time to eye opening on verbal command, time to follow commands, time to extubation, and time to orientation. Modified Aldrete scores were assessed at 0, 5, and 10 minutes after arrival in PACU. Cognitive function was assessed using MMSE at 15, 30, 45, and 60 minutes post-extubation until the baseline score was achieved or the patient was discharged from PACU.

Study Data Collection

A standardized case report form (CRF) was utilized for each participant. Preoperative data, including demographics, comorbidities, and baseline MMSE, were recorded in the holding area. Intraoperative data were collected in real time by a blinded observer—an anesthesia nurse not involved in patient management—documenting time stamps for induction, intubation, incision, pneumoperitoneum creation, vaporizer adjustments, and emergence events. Hemodynamic and respiratory parameters were recorded at predefined intervals using electronic anesthesia record logs supplemented by manual charting when necessary. The amount of volatile agent consumed was calculated from vaporizer readouts. In PACU, a dedicated research assistant recorded Modified Aldrete Scores, MMSE results, and adverse events at specified time points. Pain scores (verbal numeric rating scale 0–10) were acquired at arrival and every 15 minutes thereafter.

Data Analysis

Statistical analysis was performed using MedCalc software (version 22.009). Continuous variables were tested for normality using the Shapiro–Wilk test. Normally distributed data were summarized as mean \pm standard deviation, whereas non-normal data were expressed as median with interquartile range. Categorical variables were presented as frequencies and percentages. Baseline demographic and clinical characteristics were compared between groups using Student’s t-test for continuous normally distributed variables, the Mann–Whitney U test for continuous non-parametric variables, and the Chi-square test or Fisher’s exact test for categorical variables. The incidence of adverse events (PONV, bronchospasm, emergence agitation) was compared using Chi-square or Fisher’s exact test. A p-value $<$ 0.05 was considered statistically significant.

RESULTS

Most patients in both groups were middle-aged. The mean age in the Desflurane group was 46.5 ± 9.2 years, and in the Sevoflurane group 47.3 ± 8.7 years, with no statistically significant difference ($p = 0.58$).

Both groups had an almost equal gender ratio. Group D comprised 36 males (50 %) and 36 females (50 %), while Group S included 34 males (47.2 %) and 38 females (52.8 %). The difference was statistically insignificant ($p = 0.74$).

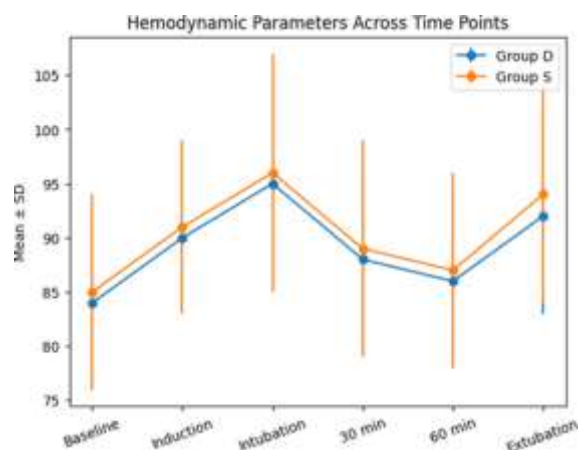
The mean BMI among participants was 33.8 ± 2.9 kg/m² in Group D and 34.1 ± 3.2 kg/m² in Group S ($p = 0.62$). Both groups satisfied the criteria for obesity (BMI \geq 30 kg/m²).

Comorbid diseases such as hypertension and diabetes were similarly distributed. Hypertension was present in 27.8 % of Group D and 30.6 % of Group S; diabetes in 25 % and 27.8 % respectively. OSA and hypothyroidism were also comparable ($p >$ 0.05). Therefore, co-existing disorders were unlikely to bias hemodynamic or recovery findings.

Average operative duration was 118 ± 22 min for Group D and 121 ± 25 min for Group S ($p = 0.45$). Equivalent surgical exposure ensured that differences in recovery could be attributed mainly to the anesthetic used rather than operative time variation.

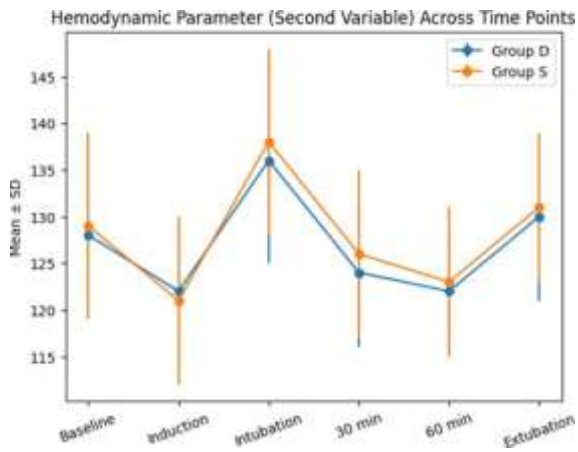
Pulse rate peaked during intubation in both groups due to sympathetic stimulation and returned to near baseline within 30 min. Mean pulse at intubation was 95 ± 10 bpm in Group D and 96

± 11 bpm in Group S. Throughout anesthesia, values were stable and differences were insignificant ($p >$ 0.05), reflecting adequate depth and cardiovascular stability.



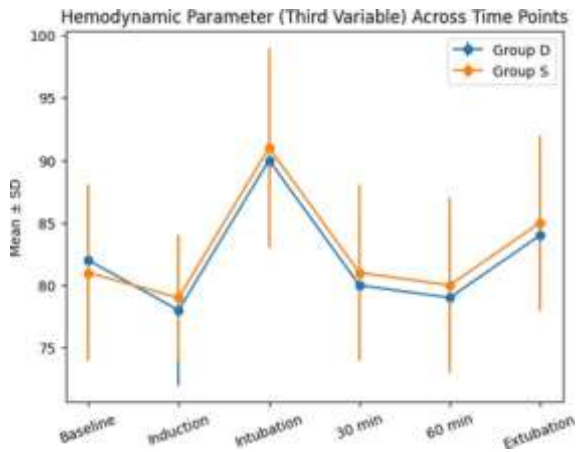
Graph 1: Pulse Rate at Various Time Intervals

A transient SBP rise was observed at intubation (136–138 mmHg), followed by stabilization. Mean SBP differences at any interval were statistically insignificant ($p >$ 0.05). Both anesthetics effectively maintained hemodynamic control throughout pneumoperitoneum and emergence.



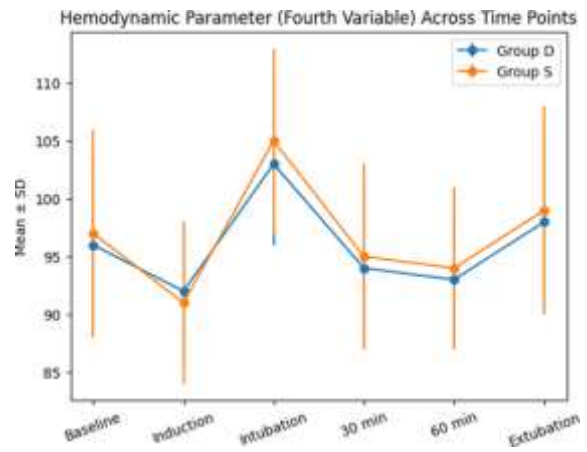
Graph 2: Systolic Blood Pressure (SBP) at Different Intervals

DBP variations mirrored systolic trends, showing minimal fluctuation. The peak value occurred at intubation (90–91 mmHg), normalizing within 30 minutes. No inter-group difference reached significance ($p > 0.05$), confirming comparable anesthetic depth and autonomic responses.



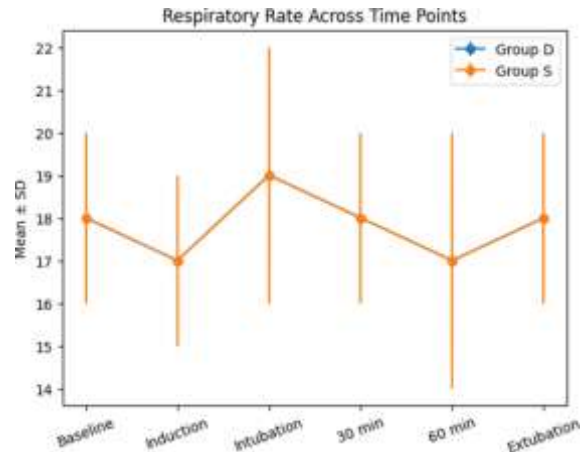
Graph 3: Diastolic Blood Pressure (DBP) at Different Intervals

MAP was stable throughout anesthesia, ranging between 91–105 mmHg. Both Desflurane and Sevoflurane maintained consistent perfusion pressures during pneumoperitoneum. Differences were not statistically significant ($p > 0.05$), underscoring hemodynamic equivalence of the agents.



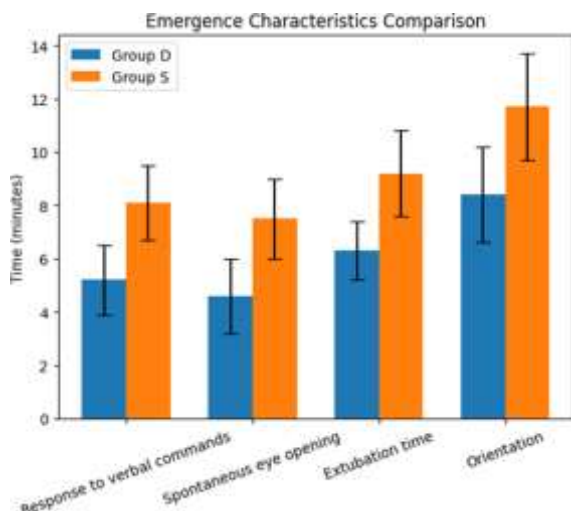
Graph 4: Mean Arterial Pressure (MAP) at Different Intervals

Respiratory rate remained within normal controlled limits (17–19 breaths/min) across both groups, indicating effective ventilation and stable anesthetic delivery. There was no significant difference ($p > 0.05$) at any stage, reflecting consistent respiratory management.



Graph 5: Respiratory Rate at Various Time Points

Desflurane demonstrated significantly shorter recovery milestones: verbal response (5.2 ± 1.3 min) vs Sevoflurane (8.1 ± 1.4 min), eye opening (4.6 ± 1.4 min vs 7.5 ± 1.5 min), and extubation (6.3 ± 1.1 min vs 9.2 ± 1.6 min). All differences were highly significant ($p < 0.001$), confirming faster emergence with Desflurane.



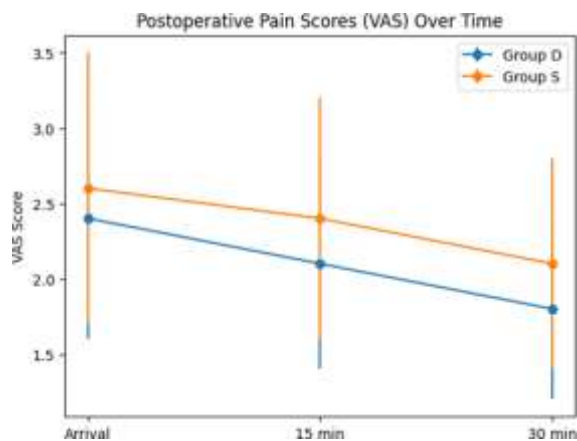
Graph 6: Recovery Time Parameters

The Modified Aldrete Score assesses readiness for discharge from the recovery area. Mean scores at arrival were 8.5 ± 0.7 for Group D and 7.9 ± 0.8 for Group S. At 5 minutes, the scores improved to 9.3 ± 0.6 and 8.7 ± 0.7 , respectively. By 10 minutes, nearly all patients in Group D achieved scores ≥ 9 , indicating faster recovery of consciousness and motor activity. The difference between groups was statistically significant at all intervals ($p < 0.01$), demonstrating that Desflurane facilitates quicker early postoperative recovery and discharge readiness compared with Sevoflurane.

Cognitive function was evaluated pre-operatively and during recovery. Both groups had similar baseline MMSE scores (≈ 29). Immediately post-operatively, scores dropped due to residual anesthetic effect but improved steadily. At 30 minutes, Group D scored 28.4 ± 0.8 compared with 27.3 ± 1.0 in Group S ($p = 0.001$). At 60 minutes, both nearly returned to baseline, confirming full cognitive restoration. The faster recovery of cognition in the Desflurane group underscores its rapid wash-out characteristics, making it more suitable for ambulatory and short-stay surgeries in obese patients.

Adverse events were minimal and comparable between groups. Incidence of nausea was 6.9 % in Group D and 11.1 % in Group S; vomiting occurred in 5.6 % and 8.3 %, respectively. Cough and bronchospasm were infrequent (< 7 %). None required significant medical intervention. The differences were statistically insignificant ($p > 0.05$), demonstrating that both agents have similar safety profiles with low postoperative complications when used in obese patients under standardized conditions. Pain intensity was rated using a Visual Analogue Scale (VAS). On arrival in PACU, mean VAS was 2.4 ± 0.8 in Group D and 2.6 ± 0.9 in Group S. Scores declined gradually, reaching 1.8 ± 0.6 vs 2.1 ± 0.7 at 30 minutes. Although the Desflurane group reported slightly lower pain scores, differences were statistically insignificant ($p > 0.05$). Adequate analgesia and comparable surgical stimulus

ensured uniform peri-operative pain control across both anesthetic techniques.



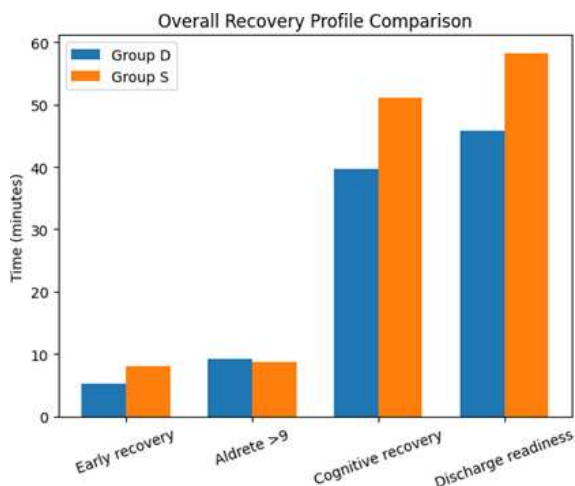
Graph 7: Post-Operative Pain Scores (VAS) in PACU

Time taken to regain pre-operative MMSE was notably shorter with Desflurane (39.6 ± 12.8 min) compared with Sevoflurane (51.1 ± 13.5 min, $p = 0.001$). This suggests more rapid cognitive recovery and readiness for ambulation in the Desflurane group. The difference of approximately 11 minutes, although modest, has significant clinical relevance in day-care and bariatric settings, where early orientation reduces PACU stay and resource utilization.

Patients were considered fit for discharge once Aldrete ≥ 9 and MMSE \approx baseline. The mean discharge readiness time was 45.8 ± 7.5 min for Group D and 58.2 ± 8.4 min for Group S ($p < 0.001$). Desflurane enabled a 20 % faster turnover in the recovery room. This finding has practical implications for reducing operating room occupancy, improving workflow efficiency, and minimizing postoperative resource demand in obese surgical populations.

Surgeons rated intra-operative conditions (visibility, muscle relaxation, hemodynamic stability) on a 1–5 Likert scale. Mean satisfaction scores were 4.7 ± 0.5 in Group D and 4.5 ± 0.6 in Group S. The difference was not statistically significant ($p = 0.12$). Both anesthetic agents provided adequate surgical field clarity and operating conditions, confirming that rapid emergence with Desflurane does not compromise intra-operative quality.

Comprehensive analysis combining early, intermediate, and cognitive recovery indices revealed significantly better outcomes in the Desflurane group across all dimensions. Early recovery averaged 5.2 ± 1.3 min vs 8.1 ± 1.4 min, Aldrete > 9 achieved in 9.3 ± 0.6 min vs 8.7 ± 0.7 min, and cognitive recovery in 39.6 ± 12.8 min vs 51.1 ± 13.5 min. The data establish Desflurane as the superior agent for faster emergence, improved psychomotor recovery, and shorter PACU stay, without an increase in adverse events.



Graph 8: Overall Recovery Summary

DISCUSSION

The present study demonstrated a comparable age profile between the two groups. In a similar adult laparoscopic population, Korat et al. included patients aged 18–70 years and reported the fastest recovery with desflurane, while Lokhande and Koshire studied patients aged 20–60 years and also found faster emergence with desflurane.^[6,7]

Sex distribution in the present study was nearly equal between groups. The present data clearly show that both anesthetic arms were well matched before induction. Patil et al also studied mixed adult laparoscopic populations and found that desflurane provided faster emergence despite comparable baseline group characteristics.^[8]

The present study specifically focused on obese patients and demonstrated a highly comparable BMI distribution between groups. In a similar obesity-based setting, Wu et al. studied 80 obese patients with BMI ≥ 30 kg/m² and found that desflurane significantly reduced time to eye opening, extubation, and operating-room exit compared with sevoflurane.^[9]

The present study showed a comparable burden of associated comorbidities in both groups. Similarly evaluated higher-risk obese cohorts and still found that desflurane produced faster emergence without compromising stability.^[9]

The mean duration of surgery was similar in the two groups, measuring 118 \pm 22 minutes in Group D and 121 \pm 25 minutes in Group S ($p = 0.45$). Likewise, obese-patient studies by Wu et al., assessed bariatric or gastrointestinal laparoscopic procedures of sufficient anesthetic duration and still documented quicker emergence with desflurane.^[9]

Pulse rate remained stable and comparable across both groups throughout the perioperative period. Baseline pulse was 84 \pm 8 bpm in Group D and 85 \pm 9 bpm in Group S ($p = 0.61$), rising at induction to 90 \pm 7 and 91 \pm 8 bpm, and peaking at intubation at 95 \pm 10 and 96 \pm 11 bpm respectively, with all differences statistically insignificant. By 30 and 60 minutes, values returned close to baseline, and

extubation pulse was 92 \pm 9 bpm in Group D versus 94 \pm 10 bpm in Group S. These findings indicate that both anesthetics provided satisfactory autonomic stability during laryngoscopy, pneumoperitoneum, and emergence. In a similar pattern, Patil et al. documented that heart rate and MAP remained within 20% of baseline in both groups, despite faster recovery with desflurane.^[8]

The systolic blood pressure pattern in the present study was comparable in both groups. Baseline SBP was 128 \pm 9 mmHg in Group D and 129 \pm 10 mmHg in Group S ($p = 0.59$). In comparison, Korat et al. noted that both desflurane and sevoflurane caused less blood pressure reduction than propofol, supporting the stability of volatile agents in laparoscopic settings.^[6]

Diastolic blood pressure in the present study mirrored the systolic trend and remained stable across both groups. Baseline DBP was 82 \pm 6 mmHg in Group D and 81 \pm 7 mmHg in Group S ($p = 0.53$), decreasing slightly after induction to 78 \pm 6 and 79 \pm 5 mmHg, and increasing transiently during intubation to 90 \pm 7 and 91 \pm 8 mmHg respectively. By 30 minutes, values were 80 \pm 6 vs 81 \pm 7 mmHg, at 60 minutes 79 \pm 6 vs 80 \pm 7 mmHg, and at extubation 84 \pm 6 vs 85 \pm 7 mmHg, with all p -values > 0.05 . This confirms comparable suppression of autonomic responses and equivalent anesthetic depth with both agents. In line with this, Patil et al. showed that desflurane and sevoflurane maintained cardiovascular parameters within 20% of baseline.^[8]

Mean arterial pressure remained within a narrow and clinically acceptable range throughout the procedure in both groups. This is consistent with Patil et al., who specifically stated that MAP, along with heart rate and oxygen saturation, remained within 20% of baseline in both anesthetic groups.^[8]

Respiratory rate remained stable in both groups, with baseline values of 18 \pm 2 breaths/min in each group ($p = 0.89$), decreasing slightly during induction and remaining within the controlled range throughout anesthesia. At intubation, values were 19 \pm 2 in Group D and 19 \pm 3 in Group S, while at 30 and 60 minutes and extubation, rates remained comparable, with no statistically significant difference. Patil et al. included oxygen saturation among monitored parameters and found both agents physiologically stable.^[8]

The time to response to verbal commands was significantly shorter in the desflurane group, measuring 5.2 \pm 1.3 minutes compared with 8.1 \pm 1.4 minutes in the sevoflurane group ($p < 0.001$). This indicates a substantially faster return of consciousness with desflurane. In a similar recovery-focused design, Patil et al. included verbal response among the main emergence endpoints and concluded that desflurane produced significantly faster recovery.^[8]

Spontaneous eye opening occurred significantly earlier in Group D (4.6 \pm 1.4 min) than in Group S (7.5 \pm 1.5 min, $p < 0.001$), confirming a more rapid emergence profile with desflurane. This finding is

strongly supported by prior studies. Kumar and Priyadarshini reported exact comparative values for eye opening, documenting 4.6 min with desflurane versus 5.3 min with sevoflurane,^[10] closely mirroring the direction of the present results.

Extubation time in the present study was significantly shorter with desflurane (6.3 ± 1.1 min) compared with sevoflurane (9.2 ± 1.6 min, $p < 0.001$). Earlier extubation is particularly important in obese patients because delayed return of airway reflexes can increase the risk of hypoventilation, obstruction, and PACU monitoring burden. In support of this, Patil et al., reported earlier extubation with desflurane in laparoscopic surgery.^[8]

Orientation was regained significantly earlier with desflurane, at 8.4 ± 1.8 minutes, compared with 11.7 ± 2.0 minutes with sevoflurane ($p < 0.001$). In a comparable trend, Kumar and Priyadarshini reported recall of name at 7 minutes with desflurane versus 8.7 minutes with sevoflurane.^[10]

The Modified Aldrete Score was significantly higher in the desflurane group at all early recovery intervals: 8.5 ± 0.7 vs 7.9 ± 0.8 on PACU arrival ($p = 0.001$), 9.3 ± 0.6 vs 8.7 ± 0.7

after 5 minutes ($p = 0.001$), and 9.8 ± 0.5 vs 9.3 ± 0.6 after 10 minutes ($p = 0.002$). These findings indicate more rapid normalization of physiological and neurologic recovery parameters with desflurane. In direct comparison, Gangakhedkar and Monteiro documented earlier achievement of Aldrete ≥ 9 at 11.1 min with desflurane versus 17.8 min with sevoflurane.^[11]

Cognitive recovery assessed by MMSE favored desflurane in the present study. Preoperative scores were similar (29.3 ± 0.7 vs 29.1 ± 0.8 ; $p = 0.28$), but postoperative scores were higher in the desflurane group at PACU arrival (24.5 ± 1.2 vs 23.9 ± 1.3 ; $p = 0.04$), 15 minutes (26.8

± 1.1 vs 25.9 ± 1.2 ; $p = 0.01$), and 30 minutes (28.4 ± 0.8 vs 27.3 ± 1.0 ; $p = 0.001$). By 60

minutes, both groups had nearly returned to baseline and the difference was no longer significant (29.1 ± 0.6 vs 28.8 ± 0.7 ; $p = 0.07$). In contrast, Bansal et al. reported that the sevoflurane group returned to baseline MMSE significantly earlier, with 40.07 ± 13 min versus

51.2 ± 11.7 min in the desflurane group ($p = 0.001$).^[12]

Postoperative adverse effects were infrequent and statistically comparable in the present study. Nausea occurred in 6.9% of Group D and 11.1% of Group S, vomiting in 5.6% and 8.3%, cough in 4.2% and 6.9%, and bronchospasm in 1.4% and 2.8%, with all differences non-significant. Gahlot et al. reported that postoperative nausea and vomiting were slightly higher with desflurane but not statistically significant.^[13]

Postoperative pain scores were low and comparable in both groups. On PACU arrival, VAS was 2.4 ± 0.8 in Group D and 2.6 ± 0.9 in Group S ($p = 0.39$); at 15 minutes, 2.1 ± 0.7 vs 2.4 ± 0.8 ($p = 0.25$); and at 30 minutes, 1.8 ± 0.6 vs 2.1 ± 0.7 ($p = 0.19$). Although

the desflurane group showed numerically lower scores, the difference was not statistically significant. The time required to return to baseline MMSE was significantly shorter with desflurane in the present study, at 39.6 ± 12.8 minutes versus 51.1 ± 13.5 minutes with sevoflurane ($p = 0.001$).

In contrast, Bansal et al. reported the opposite trend, with the sevoflurane group achieving baseline MMSE earlier at 40.07 ± 13 minutes compared with 51.2 ± 11.7 minutes for desflurane ($p = 0.001$).^[80] PACU discharge readiness was achieved significantly earlier in the desflurane group, at 45.8 ± 7.5 minutes, compared with 58.2 ± 8.4 minutes in the sevoflurane group ($p < 0.001$). In a directly comparable finding, Ahmed et al. reported a shorter PACU stay with desflurane in obese patients undergoing laparoscopic sleeve gastrectomy.^[14]

Surgeon satisfaction was high in both groups, with mean scores of 4.7 ± 0.5 in Group D and 4.5 ± 0.6 in Group S ($p = 0.12$), showing no significant difference. This is consistent with prior studies such as Patil et al. where intraoperative hemodynamics remained stable in both groups and no compromise in surgical conditions was described.^[8]

Overall, the present study demonstrates a consistent and clinically relevant recovery advantage with desflurane. Aldrete recovery was also better at arrival, 5 minutes, and 10 minutes, while cognitive recovery to baseline MMSE was faster (39.6 ± 12.8 vs 51.1 ± 13.5 min) and PACU discharge readiness occurred earlier (45.8 ± 7.5 vs 58.2 ± 8.4 min). In contrast, intraoperative pulse, blood pressure, respiratory rate, postoperative pain, adverse events, and surgeon satisfaction were comparable.

CONCLUSION

The present study establishes that desflurane is a more effective inhalational anesthetic than sevoflurane for obese patients undergoing laparoscopic surgery when recovery profile is the main concern. Desflurane provides significantly faster awakening, earlier extubation, quicker restoration of orientation and cognition, higher early recovery scores, and shorter PACU discharge time, while maintaining equivalent hemodynamic stability, respiratory safety, pain control, and adverse-effect profile. Therefore, desflurane can be considered the preferred volatile anesthetic agent in obese laparoscopic patients when the goals are rapid, smooth, and clinically efficient postoperative recovery.

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