Section: Anaesthesiology

Original Research Article

COMPARISON OF TOTAL INTRAVENOUS ANAESTHESIA (TIVA) AND INHALATIONAL ANAESTHESIA ON RECOVERY PROFILE AND POSTOPERATIVE NAUSEA AND VOMITING: A PROSPECTIVE RANDOMIZED STUDY

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ABSTRACT

Background: Postoperative nausea and vomiting (PONV) and delayed recovery remain significant concerns following general anaesthesia, affecting patient satisfaction, post-anaesthesia care unit (PACU) stay, and overall hospital efficiency. Total Intravenous Anaesthesia (TIVA) using propofol is associated with rapid recovery and intrinsic antiemetic properties. This study aimed to compare TIVA with sevoflurane-based inhalational anaesthesia in terms of recovery profile and incidence of PONV. **Materials and Methods:** This prospective, randomized, single-center controlled trial was conducted from December 2024 to November 2025 in a tertiary care teaching hospital. A total of 120 ASA physical status I–II patients aged 18–60 years undergoing elective surgery under general anaesthesia were enrolled. Patients were randomly allocated into two groups: Group T (n = 60) received TIVA with propofol infusion, and Group I (n = 60) received sevoflurane-based inhalational anaesthesia. Primary outcomes included time to eye opening, time to extubation, time to response to verbal commands, and incidence of PONV within 24 hours. Requirement of rescue antiemetics was also recorded. Statistical analysis was performed using Student's t-test and Chi-square test, with $p < 0.05$ considered significant. **Result:** Baseline demographic characteristics were comparable between groups ($p > 0.05$). Recovery was significantly faster in Group T: eye opening (6.8 ± 1.2 vs 9.4 ± 1.5 min), extubation (8.1 ± 1.4 vs 11.2 ± 1.8 min), and verbal response (9.2 ± 1.6 vs 12.5 ± 2.0 min) ($p < 0.001$). Total PONV incidence was significantly lower in Group T (13.3%) compared to Group I (36.7%) ($p = 0.003$). Rescue antiemetic requirement was also reduced (10% vs 30%, $p = 0.005$). **Conclusion:** TIVA with propofol provides faster recovery and significantly reduces postoperative nausea and vomiting compared to sevoflurane-based inhalational anaesthesia. TIVA may be preferred in elective surgeries where rapid recovery and minimal PONV are priorities.

INTRODUCTION

General anaesthesia is an essential component of modern surgical practice, ensuring patient comfort, amnesia, analgesia, and immobility during operative procedures. Over the past few decades, advancements in anaesthetic pharmacology and perioperative monitoring have significantly improved patient safety and recovery outcomes.[1] Among contemporary anaesthetic techniques, Total Intravenous Anaesthesia (TIVA) using propofol and inhalational anaesthesia with volatile agents such as sevoflurane are widely practiced.[2]

Sevoflurane is commonly used due to its rapid onset, smooth induction, minimal airway irritation, and reliable maintenance of anaesthesia.[3] However, inhalational agents are associated with certain limitations, including postoperative nausea and vomiting (PONV), delayed recovery, and prolonged post-anaesthesia care unit (PACU) stay.[4] PONV remains one of the most distressing postoperative complications, with an incidence ranging from 20–30% in general surgical populations and up to 70–80% in high-risk patients.[5] It may result in dehydration, electrolyte imbalance, aspiration,

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wound complications, delayed oral intake, prolonged hospitalization, and decreased patient satisfaction.[6]

Total Intravenous Anaesthesia, particularly with propofol infusion, has gained increasing popularity due to its favorable pharmacokinetic profile, rapid redistribution, predictable clearance, and intrinsic antiemetic properties.[7] Propofol is believed to exert antiemetic effects through modulation of serotonin activity in the chemoreceptor trigger zone.[8] Additionally, TIVA facilitates smoother and faster recovery, which aligns with Enhanced Recovery After Surgery (ERAS) protocols emphasizing early awakening, rapid extubation, and early mobilization.[9]

Although several studies have compared TIVA and inhalational anaesthesia, variations in patient populations, surgical duration, and clinical settings warrant further evaluation.[10] Therefore, this prospective randomized study was undertaken to compare the recovery profile and incidence of postoperative nausea and vomiting between TIVA and sevoflurane-based inhalational anaesthesia in patients undergoing elective surgical procedures.

MATERIALS AND METHODS

Study Design and Setting: This prospective, randomized, parallel-group, single-center controlled study was conducted in the Department of Anaesthesiology at a tertiary care teaching hospital over a period of 12 months, from December 2024 to November 2025.

Study Population: A total of 120 adult patients scheduled for elective surgical procedures under general anaesthesia were enrolled in the study.

Inclusion Criteria

- Age between 18 and 60 years
- Either gender
- American Society of Anesthesiologists (ASA) Physical Status I or II
- Scheduled for elective surgical procedures under general anaesthesia
- Expected duration of surgery between 1 and 3 hours
- Hemodynamically stable at the time of preoperative evaluation
- Completed standard preoperative clinical assessment
- Provided written informed consent and agreed to postoperative follow-up for 24 hours

Exclusion Criteria

- American Society of Anesthesiologists (ASA) Physical Status III or IV.
- Pregnancy or lactation.
- History of motion sickness or previous severe postoperative nausea and vomiting.
- Known hypersensitivity to propofol, sevoflurane, or related study medications.
- Body mass index (BMI) greater than 35 kg/m².
- Emergency surgery, chronic opioid use, significant gastrointestinal, neurological, or psychiatric disorders, or requirement for planned postoperative mechanical ventilation.

Randomization and Allocation

After confirming eligibility and obtaining informed consent, patients were randomly assigned in a 1:1 ratio into two groups using a computer-generated randomization sequence. A total of 120 patients were allocated as follows:

- Group T (n = 60): Total Intravenous Anaesthesia (TIVA) with propofol infusion
- Group I (n = 60): Inhalational anaesthesia with sevoflurane

Allocation concealment was ensured using sealed, opaque, sequentially numbered envelopes. The envelopes were opened immediately prior to induction of anaesthesia to maintain concealment and minimize selection bias.

Blinding: Due to the nature of the anaesthetic techniques, the attending anaesthesiologist administering the intervention could not be blinded to group allocation. However, postoperative recovery assessment and evaluation of postoperative nausea and vomiting were performed by independent observers who were blinded to group assignment. Data analysis was conducted without disclosure of group identity to minimize assessment and analytical bias.

Anaesthetic Technique: All patients were evaluated preoperatively and standard fasting guidelines were followed. Standard monitoring, including electrocardiography (ECG), non-invasive blood pressure (NIBP), pulse oximetry (SpO_2), and end-tidal carbon dioxide ($EtCO_2$), was instituted in the operating room prior to induction of anaesthesia.

Preoperative Medication

All patients received:

- Midazolam 0.02 mg/kg intravenously
- Glycopyrrolate 0.2 mg intramuscularly

Induction of Anaesthesia (Both Groups)

Anaesthesia was induced with:

- Propofol 2 mg/kg IV
- Fentanyl 2 µg/kg IV
- Vecuronium 0.1 mg/kg IV to facilitate endotracheal intubation

After adequate muscle relaxation, endotracheal intubation was performed and mechanical ventilation was initiated with oxygen–air mixture to maintain normocapnia.

Maintenance of Anaesthesia

- Group T (TIVA Group): Anaesthesia was maintained with continuous propofol infusion at a rate of 100–150 µg/kg/min.
- Group I (Inhalational Group): Anaesthesia was maintained with sevoflurane at 1–2% concentration in an oxygen–air mixture.

Additional doses of vecuronium were administered as required to maintain adequate muscle relaxation.

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Reversal and Extubation

At the completion of surgery, residual neuromuscular blockade was reversed with:

- Neostigmine 0.05 mg/kg IV
- Glycopyrrolate 0.01 mg/kg IV

Patients were extubated after meeting standard extubation criteria, including adequate spontaneous ventilation and responsiveness.

Outcome Measures: The study outcomes were categorized as primary and secondary outcomes.

Primary Outcomes

1. Time to Eye Opening:

Defined as the time interval (in minutes) from discontinuation of anaesthetic agents to spontaneous eye opening by the patient.

2. Time to Extubation:

Defined as the time interval (in minutes) from cessation of anaesthesia to removal of the endotracheal tube after fulfillment of standard extubation criteria.

3. Time to Response to Verbal Commands:

Defined as the time interval (in minutes) from discontinuation of anaesthetic agents to the patient's appropriate response to simple verbal commands.

4. Incidence of Postoperative Nausea and Vomiting (PONV):

Presence of nausea and/or vomiting occurring within the first 24 hours postoperatively.

Secondary Outcome

1. Requirement of Rescue Antiemetics:

Administration of antiemetic medication within the first 24 postoperative hours in patients who developed nausea or vomiting. Injection Ondansetron 0.15 mg/kg body weight intravenously was administered as the rescue antiemetic.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) software, version 25.0 (IBM Corp., Armonk, NY, USA).

Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages.

The normality of data distribution was assessed prior to analysis. Continuous variables between the two groups were compared using the independent Student's t-test. Categorical variables were analyzed using the Chi-square test or Fisher's exact test where appropriate.

A p-value of less than 0.05 was considered statistically significant. All statistical tests were two-tailed.

RESULTS

A total of 120 patients were enrolled and randomized equally into two groups (n = 60 each). All patients completed the study and were included in the final analysis.

1. Demographic Characteristics

The demographic variables and duration of surgery were comparable between the two groups. There was no statistically significant difference in baseline characteristics ($p > 0.05$).

Table 1: Demographic Data

Parameter	Group T (TIVA) (n=60)	Group I (Sevoflurane) (n=60)	p-value
Age (years)	38.5 ± 9.2	37.8 ± 8.7	0.72
Gender (M/F)	32 / 28	30 / 30	0.68
Duration of Surgery (min)	105 ± 22	108 ± 25	0.54

Table Notes Data are expressed as mean ± standard deviation for continuous variables and number (percentage) for categorical variables. Comparisons between groups were performed using the independent Student's t-test and Chi-square test. A p-value < 0.05 was considered statistically significant.

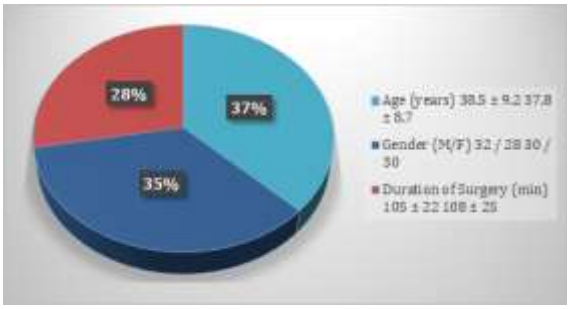

Figure 1: Comparison of Demographic Characteristics Between Group T and Group I

Figure Notes The figure illustrates the comparison of age, gender distribution, and duration of surgery between the TIVA (Group T) and Sevoflurane (Group I) groups. Data are presented as mean ± standard deviation for continuous variables and number (percentage) for categorical variables. No statistically significant differences were observed between the groups ($p > 0.05$).

2. Recovery Profile

Recovery parameters were significantly faster in Group T compared to Group I.

Table 2: Comparison of Recovery Parameters

Parameter	Group T (Mean ± SD)	Group I (Mean ± SD)	p-value
Time to Eye Opening (min)	6.8 ± 1.2	9.4 ± 1.5	<0.001
Time to Extubation (min)	8.1 ± 1.4	11.2 ± 1.8	<0.001
Time to Verbal Response (min)	9.2 ± 1.6	12.5 ± 2.0	<0.001

Table Notes Data are expressed as mean ± standard deviation. Comparisons between the two groups were performed using the independent Student's t-test. A p-value < 0.05 was considered statistically significant.

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All recovery parameters showed statistically significant improvement in the TIVA group.

3. Incidence of Postoperative Nausea and Vomiting (PONV)

The incidence of PONV within 24 hours was significantly lower in the TIVA group.

Table 3: Incidence of Postoperative Nausea and Vomiting

Outcome	Group T (n=60)	Group I (n=60)	p-value
Nausea	8 (13.3%)	18 (30%)	0.02
Vomiting	4 (6.7%)	14 (23.3%)	0.01
Total PONV	8 (13.3%)	22 (36.7%)	0.003

Table Notes Data are presented as number (percentage). Comparisons between groups were performed using the Chi-square test. A p-value < 0.05 was considered statistically significant.

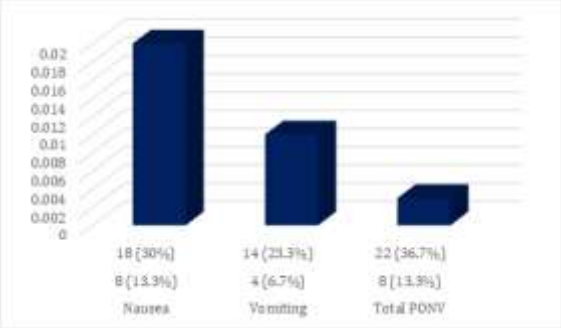

Figure 2: Comparison of Incidence of Postoperative Nausea and Vomiting Between Group T and Group I

Figure Notes The figure depicts the incidence of nausea, vomiting, and total postoperative nausea and vomiting (PONV) within 24 hours in the TIVA (Group T) and Sevoflurane (Group I) groups. Data are presented as number (percentage). A statistically significant reduction in PONV was observed in Group T compared to Group I ($p < 0.05$).

4. Rescue Antiemetic Requirement

Rescue antiemetics were required in 6 patients (10%) in Group T compared to 18 patients (30%) in Group I, which was statistically significant ($p = 0.005$).

Limitations

This study has certain limitations. It was conducted as a single-center study with a relatively limited sample size, which may affect the generalizability of the findings. The study population was restricted to ASA I–II patients undergoing elective surgeries of 1–3 hours duration, and therefore results may not be applicable to high-risk patients or prolonged procedures. Additionally, formal risk stratification for PONV (such as Apfel scoring) and cost-effectiveness analysis were not performed.

DISCUSSION

The present prospective randomized single-center study compared Total Intravenous Anaesthesia (TIVA) using propofol with sevoflurane-based inhalational anaesthesia in terms of recovery profile and postoperative nausea and vomiting (PONV) in elective surgical patients. The findings demonstrate that TIVA provides significantly faster recovery and a markedly lower incidence of PONV.[11-13]

Recovery Profile

Early emergence from anaesthesia is an essential goal in contemporary perioperative practice, particularly within Enhanced Recovery After Surgery (ERAS) pathways. In this study, patients in the TIVA group showed significantly shorter times to eye opening, extubation, and response to verbal commands compared to the inhalational group. These results can be explained by the pharmacokinetic properties of propofol, which include rapid redistribution, short context-sensitive half-time, and predictable clearance.[14]

In contrast, volatile anaesthetic agents such as sevoflurane depend on pulmonary elimination and may exhibit delayed washout in certain patients, potentially prolonging emergence. Faster recovery not only improves patient comfort but also facilitates early neurological assessment, shorter PACU stay, and improved operating room efficiency. The magnitude of improvement observed in the present study is clinically significant and consistent with previously published trials demonstrating faster recovery with propofol-based anaesthesia.[15]

Postoperative Nausea and Vomiting

PONV remains a common and distressing complication following general anaesthesia. The present study showed a significantly lower incidence of nausea, vomiting, and overall PONV in the TIVA group compared to the sevoflurane group. Additionally, the need for rescue antiemetics was substantially reduced in patients receiving TIVA.

The antiemetic effect of propofol is thought to be mediated through inhibition of serotonin activity in the chemoreceptor trigger zone and suppression of subcortical pathways involved in emesis. Furthermore, avoidance of volatile agents, which are well-recognized triggers for PONV, likely contributes to the observed reduction. The reduction in PONV seen in this study has important implications for patient satisfaction, early oral intake, and reduction in postoperative complications.

Clinical Implications

The results suggest that TIVA may be particularly beneficial in elective surgeries where rapid recovery and minimal postoperative discomfort are prioritized. TIVA may be especially advantageous in day-care procedures, ERAS protocols, and in patients with moderate risk of PONV. Reduced antiemetic requirement and improved recovery profile may also contribute to enhanced perioperative efficiency.

Overall, the findings of this study support the preferential use of TIVA with propofol in appropriately selected elective surgical patients.

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CONCLUSION

This prospective randomized single-center study demonstrates that Total Intravenous Anaesthesia (TIVA) with propofol provides significantly faster recovery and a lower incidence of postoperative nausea and vomiting compared to sevoflurane-based inhalational anaesthesia in elective surgical patients. Patients receiving TIVA exhibited earlier eye opening, faster extubation, quicker response to verbal commands, and reduced requirement for rescue antiemetics.

These findings suggest that TIVA may be a preferable anaesthetic technique in elective surgeries where rapid recovery, improved patient comfort, and minimal PONV are prioritized, particularly within Enhanced Recovery After Surgery (ERAS) protocols. However, the choice of anaesthetic technique should be individualized based on patient characteristics, surgical factors, and institutional resources.

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